UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

September 2, 2014

MEMORANDUM

FROM: Dr. Amanda D. Rodewald, Chair /*Signed*/
Science Advisory Board (SAB) Panel for the Review of the EPA Water Body Connectivity Report

TO: Dr. David Allen, Chair
EPA Science Advisory Board

SUBJECT: Comments to the chartered SAB on the Adequacy of the Scientific and Technical Basis of the Proposed Rule Titled "Definition of 'Waters of the United States' Under the Clean Water Act."

In your memorandum of June 25, 2014 you requested that members of the SAB Panel for the Review of the EPA Water Body Connectivity Report provide comments to the chartered SAB on the adequacy of the scientific and technical basis of the proposed rule titled "Definition of 'Waters of the United States' Under the Clean Water Act." You indicated that comments from members of the Panel would inform a separate SAB letter to the Administrator, which the chartered SAB will prepare, regarding the adequacy of the scientific and technical basis of the proposed rule.

In response to your request, the SAB Panel held public teleconferences on August 20th and 21st, 2014 to develop comments on the adequacy of the science supporting the proposed rule. Panel members provided comments in response to five questions focused on the scientific and technical basis of the following aspects of the proposed rule: 1) the definition of tributaries as Waters of the United States; 2) the definition of adjacent waters and wetlands as Waters of the United States; 3) the definition of other waters on a case-by-case basis as Waters of the United States; 4) other definitions and the exclusion of specified waters, and 5) other aspects of the proposed rule. Responses to these questions and other matters of concern were discussed during the Panel's two public teleconferences. This memorandum summarizes the main points of discussion. The attached individual written comments from Panel members provide additional details.

Key Points Discussed in Response to the Questions Provided to the Panel

Summary: Most Panel members commented that the available science supported the key points of the EPA's proposed rule – namely that tributaries, adjacent waters, and adjacent wetlands should be considered Waters of the United States whereas "other waters" should not be categorically included. Rather, Panel members commented in general that "other waters" could be considered (a) on an individual case-by-case basis, (b) in aggregate for similarly-situated other waters, or (c) regionally jurisdictional for other groups of similarly situated waters (e.g., prairie potholes). The Panel members raised a number of concerns about the proposed definitions and offered suggestions to improve clarity and applicability. There also was concern that several broad exclusions (e.g., groundwater, ditches, gullies/rills/swales, and artificial lakes and ponds) were not supported by the available science.

Question 1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

Nearly all Panel members agreed that even though connectivity occurs along a gradient, there is nonetheless strong scientific evidence that tributaries, as a group, have strong influence on the physical, chemical, and biological integrity of downstream waters, and therefore the available science supports making all tributaries jurisdictional under the Clean Water Act. Two panelists objected to any inclusion of tributaries in the Waters of the U.S. by rule. They commented that connectivity occurs along a gradient and consequently necessitates case-by-case examination.

Several panelists raised concerns about the definition of tributaries in the proposed rule. One important criticism was that, while the proposed rule states that "tributary" means a water physically characterized by the presence of a bed and banks and ordinary high water mark, not all tributaries have ordinary high water marks (OHWM). The absence of OHWM is relatively common in ephemeral streams within arid and semi-arid environments or low gradient landscapes. In these contexts, the flow of water is unlikely to cause OHWM. In addition, some types of tributaries, such as spring-fed streams, lack an obvious OHWM because their groundwater sources dominate the water budget, are temporally stable, and do not produce sufficient fluctuations in the hydrograph to generate an OHWM. For this reason, the panelists recommended that the presence of OHWM not be a required attribute of a tributary and suggested that the wording in the definition could be changed to "bed, bank, and other evidence of flow."

Another concern expressed by panelists was that the definition of "tributary" in the proposed rule includes lentic systems (e.g., lakes, ponds, wetlands) as well as lotic (stream-type) systems. Because tributaries are not typically defined this way, there was concern that the definition in the proposed rule would generate confusion. Panel members discussed whether flow-through lentic systems should be defined as tributaries or as adjacent waters and wetlands. The latter option was favored by most panelists.

Another topic of discussion was that the concept of a connectivity gradient should be introduced early in the preamble of the proposed rule, not solely in the section dealing with "other waters." Panelists commented that the concept of a connectivity gradient applies to all waters, including tributaries and adjacent waters and wetlands, though most panelists agreed that certain types of water bodies typically fall at the higher end of the connectivity gradient.

Question 2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the

proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

There was widespread agreement among panelists that, although connectivity occurs along a gradient, adjacent waters and wetlands have a strong influence on the physical, chemical, and biological integrity of traditional navigable waters. Therefore, nearly all members of the Panel agreed that the available science supports the categorical determination in the proposed rule that adjacent waters and wetlands are jurisdictional under the Clean Water Act. Two members did not agree that the available science supports any categorical determination of jurisdiction by rule.

Concerns were raised by Panel members about the definition of adjacent waters and wetlands. The proposed rule defines the term "adjacent" to mean bordering, contiguous, or neighboring. Neighboring waters are defined to include those with a shallow subsurface hydrological connection or a confined surface hydrologic connection to a jurisdictional water. The main issues raised by panelists were that adjacent waters and wetlands should not be defined solely on the basis of: 1) geographical proximity / distance to jurisdictional waters, 2) surface or shallow subsurface water connections to jurisdictional waters, or 3) hydrologic connections to jurisdictional waters. First and foremost, the panel members agreed that any definition or determination of adjacency should be based on functional relationships, not distance. The relationship between distance and connectivity was seen as ambiguous, and panelists commented that it was not a good indicator of the degree of connectivity. Panelists also discussed the role of groundwater in connecting adjacent waters and wetlands to jurisdictional waters. Panel members commented that, while the proposed rule indicates that neighboring waters connected to jurisdictional waters through a shallow subsurface connection would be included in the Waters of the U.S., the science indicates that regional groundwater sources can strongly affect connectivity. In addition, Panel members commented that the importance of biological and chemical connectivity should be more thoroughly discussed in the preamble of the proposed rule because the scientific literature clearly shows that these kinds of connectivity are important.

The Panel also discussed the role that the temporal component of connectivity should play in defining adjacent waters and wetlands. The proposed rule indicates that "neighboring" waters include those located within the riparian area or floodplain of a jurisdictional water. Panel members discussed whether there is a particular flood interval (e.g., 10-20 year) that would be useful in defining the floodplain. There was general agreement among panelists that use of best professional judgment is probably the most realistic and practical option in this regard. Panelists also commented that consideration of the temporal dimension of connectivity is particularly important in arid systems with intermittent and ephemeral waters. Finally, members recognized that the definition of adjacent waters and wetlands is critical because it will delineate where "other waters" begin. The Panel's draft review of the EPA Draft Report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence,* provides extensive text on issues related to delineation of floodplain waters and wetlands.

Question 3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

There was general agreement among panelists that, based on the available science, it is appropriate to define "other waters" as Waters of the U.S. on a case-by-case basis, either alone or in combination with similarly-situated waters in the same region. That said, panel members recognized that the scientific literature has clearly established that "other waters" can have very strong effects on downstream waters, particularly when considered in aggregate.

Panel members discussed various aspects of case-by-case evaluation of the connectivity of "other waters." Panelists agreed that "other waters" should not be identified by means of a listing process such as that previously used to identify "Type 3" wetlands. Rather, members commented that use of a flowpath approach (broadly considering hydrological, chemical, and biological flowpaths) was the most scientifically rigorous way to identify "other waters" and the extent to which they are similarly situated. In this regard, Panel members commented that explicit reference to the type of flowpath, and information indicating whether it is surface only, shallow subsurface, or includes all hydrologic connections, would be particularly useful. The descriptions in the preamble of the proposed rule of evidence of physical, hydrological, and biological connectivity would be more scientifically rigorous if they focused on the magnitude or impact of the connection instead of a presence/absence (binary) perspective. Several Panel members commented that it would be useful for the agency to consider the conceptual flowpath model developed in the SAB Connectivity Panel's draft review of the EPA draft report, *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence*. Panel members noted that Panel's the review can provide useful guiding principles for decisions.

Many panelists commented that distance should not be the primary metric used to evaluate significance of connection of "other waters" to jurisdictional waters. Panelists commented that using distance in this way is inconsistent with the scientific understanding of how hydrological, geochemical, and biological processes affect connectivity. Members further commented that the determination of connection via shallow subsurface pathways must take into account topographic gradient and soil and aquifer hydraulic properties as well as distance separating water bodies. For example, some highly permeable soils/aquifers with high hydraulic conductivity and a strong topographic gradient can transport water and dissolved solutes over longer distances between upgradient and downgradient waters than lower permeability soils/aquifers. Panel members commented that, in order to evaluate the connectivity of "other waters," it is important to understand hydrogeologic conditions and groundwater flow. In addition, panelists noted that it is important to consider the movement of biota (which varies temporally and by species), and the variability in water flows through shallow subsurface connections (due, for example, to the availability of water or the nature of the substrate).

Some panelists expressed concern about the use of the term "in the region" in the definition of other waters on a case-by-case basis as Waters of the U.S. Panel members noted that it could be problematic if "in the region" were to mean "in the watershed" because surface and ground-watershed units may not align. Panel members commented that a more scientifically justified approach would include surface and subsurface waters in watershed delineation. Members also commented that it would not be appropriate to use ecoregions to identify "similarly situated" "other waters" because ecoregions were developed on the basis of terrestrial vegetation communities, in combination with soils and climate, and do not reflect hydrologic regions. Panel members commented that use of Hydrologic-Landscape Regions would be a good alternative approach for identifying similarly situated "other waters."

Panel members generally agreed that aggregating "similarly situated" waters is scientifically justified, given that the combined effects of these waters on downstream waters are often only measurable in aggregate. Panelists also were generally comfortable with the idea of using "similarly situated" waters to guide aggregation. However, there was much discussion about the most scientifically justified method for aggregating waters. Panel members agreed that the available science supported aggregating waters based on functional attributes and flowpaths.

In the preamble of the proposed rule, the EPA and the U.S. Army Corps of Engineers requested input on the following four options for determining which waters and wetlands are “similarly situated”: (1) “Other waters” are similarly situated only in certain areas of the country (e.g. in certain ecoregions); (2) Certain subcategories of “other waters” as a class have a significant nexus; (3) No “other waters” are similarly situated and all “other waters” must be evaluated individually; and (4) All “other waters” in the watershed are similarly situated. Panel members generally expressed a preference for combining options 1 and 2 so that both the geographic region and type of water would be considered. There was general agreement among Panel members that the rule should not prescribe methods for determining which waters are similarly situated given that these methods are constantly improving and changing. Rather, Panel members suggested developing a set of questions that must be addressed when determining whether “other waters” are similarly situated. Panel members commented that there are certain subcategories / types of other waters in certain regions/areas where there is sufficient scientific evidence to categorically determine that these types of waters are jurisdictional (e.g., prairie potholes, Carolina and Delmarva Bays, pocosins, Texas coastal prairie wetlands, western vernal pools). Members also commented that the science does not support a determination to exclude any groups of “other waters” (or subcategories thereof, e.g., Great Plains playa lakes) from jurisdictional status.

Panel members commented that as the science continues to develop, other sets of wetlands may be identified as “similarly situated.” Panel members further noted that before such determinations are made, additional research will be required to establish degree of connectivity and analyze spatial and temporal variability and threshold levels of connectivity. This research will be a requisite step in further development of rules relative to the jurisdictional status of “additional other waters of the U.S.” In particular, research will be needed to determine whether categories of “other waters” are similarly situated, have a significant nexus, and are jurisdictional by rule, or whether as a class they do not have such a significant nexus and might not be jurisdictional. Vernal pools in the eastern and Midwestern U.S. are especially in need of this attention.

Question 4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.

Panel members commented on the following proposed definitions and exclusions of specified waters and features from the Waters of the U.S.

Definitions.

Tributary. Several Panel members raised concerns about the definition of tributaries. As previously mentioned, one criticism discussed by Panel members was that not all tributaries will have ordinary high water marks (OHWM). The absence of OHWM is relatively common in ephemeral streams within arid and semi-arid environments or low gradient landscapes. Some types of tributaries, such as spring-fed streams, lack an obvious OHWM because their groundwater sources dominate the water budget, are temporally stable, and do not produce sufficient fluctuations in the hydrograph to generate an OHWM. For this reason, some panelists recommended that the presence of OHWM not be a required attribute of a tributary, and suggested that the wording in the definition could be changed to “bed, bank, and other evidence of flow.” Others spoke of the need to allow for variation among regions (e.g., the arid west).

Shallow subsurface connection. Panel members commented that the definition of shallow subsurface connection in the proposed rule is not clear. Members noted that the definition does not indicate how deep a "shallow" subsurface connection could be. The examples on p. 22208 in the preamble of the proposed rule imply that this definition includes only very shallow (in the soil) connections rather than deeper geologic (except in karst systems) connections. Some panel members noted that shallow unconfined aquifers provide hydrologic and chemical connections among many wetland types, often on reasonably short time scales (i.e., 1-20 years). Members commented that such connections are critical to the integrity of these wetlands and should be included in the definition of a shallow subsurface connection. Members commented that these types of shallow unconfined aquifers meet the criteria listed on p. 22208 in the preamble of the rule because they "exhibit a direct connection to the water found on the surface in wetlands and open waters." Panel members noted, for example, that a sand dune aquifer connects emergent marshes on the Oregon coast to the Coos Bay estuary and the nearshore coastal zone via shallow groundwater flowpaths.

Adjacent waters. As previously mentioned, Panel members commented that adjacent waters should not be defined solely on the basis of: 1) geographical proximity (as suggested on p. 22209), or 2) a hydrologic connection. Members also commented that it should be acknowledged that the movement of biota establishes connectivity.

Riparian area. Panel members commented that the definition of riparian area in the proposed rule is problematic because it is based on hydrologic flows and not the host of other functions that riparian areas provide. Likewise, Panel members commented that **upland** also needs to be defined, especially as related to ditches.

Significant and significant nexus. Panel members generally found that the term "significant nexus" was poorly defined in the proposed rule and that the use of the term "significant" was vague. Panel members commented that the little guidance was provided in the preamble of the rule to interpret these terms. There was agreement among Panel members that it was important to articulate in the proposed rule that (1) "significant nexus" is not a scientific term but rather legal term that requires a policy determination in light of the law and science and (2) the relative strength of downstream effects should inform the conclusions about the significance of those effects for purposes of interpreting the Clean Water Act.

<u>Exclusions.</u> The proposed rule excludes certain waters from jurisdiction under the Clean Water Act. Panel members noted that many of the exclusions in the proposed rule do not have strong scientific justification and, rather, reflect policy decisions that account for stakeholder concerns and / or historical practices.

Groundwater and shallow subsurface connections. The proposed rule excludes groundwater, (including groundwater drained through subsurface drainage systems) from jurisdiction under the Clean Water Act. Panelists commented that the available science clearly shows that groundwater connections, particularly via shallow flowpaths in unconfined aquifers, are critical in supporting the hydrology and biogeochemical processes of wetlands and other waters and serve to connect waters and wetlands that have no apparent surface connections. Panel members commented that there is a vast scientific literature on the hyporheic zone on this topic. Indeed, in the arid and semi-arid lands, groundwater is the dominant source of flow to both tributaries and the main stem river segments. Panel members noted that in some volcanic and karst regions, springs and gaining streams are the dominant source of flow for both tributary and main stem river segments. For example, the middle section of the Snake River, including the Twin Falls and Boise, Idaho region of the Snake River Plain Province, is mostly sustained by groundwater, and various sections of the Green River in Kentucky are sustained by groundwater in the Karst region near Mammoth Cave National Park. Vast sections of the Rio Grande River and its tributaries in southern Colorado through central New Mexico (Taos, Santa Fe, and Albuquerque) are sustained mostly by groundwater.

EPA Office of Water staff explained that groundwater quality is not regulated under the Clean Water Act, but shallow subsurface waters can serve to establish connectivity between a water body and a Water of the U.S. Although this clarification was very useful, panelists commented that the preamble of the proposed rule did not provide a clear understanding of what are considered to be "shallow" subsurface connections. Panelists were also concerned that role of regional groundwater systems in establishing connectivity was not addressed by the proposed rule. Panelists commented that this is a problem because regional ground water flows commonly interact with the surface environment at sinks and springs. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops. Panelists commented that an understanding of regional ground water flow systems is critical to the understanding of four-dimensional hydrologic connectivity on both the local and regional scales. Understanding ground water flow in unique hydrogeologic settings, including the Floridan aquifer system (karst systems), the High Plains aquifer system (semi-arid systems), and the Snake River Plain and Rio Grande Rift aquifer systems (volcanic bedrock systems), is especially important.

Ditches. The proposed rule excludes from Clean Water Act jurisdiction ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow. In addition, the proposed rule excludes ditches that are not tributaries. There was extensive discussion among panelists of the proposed exclusion of these ditches. Panelists generally agreed that many research needs must be addressed in order to discriminate between ditches that should be excluded and included. Panel members commented that using the criterion of "less-than-perennial" flow to exclude ditches may not be consistent with addressing nutrient and sediment loading that affects drinking water, beach use, fishing, and other uses. Panel members also commented that ditches are perennial, intermittent, or ephemeral water conveyors, and that constructed ditches can change the hydrologic flow paths of local and subregional hydrologic systems.

Panel members offered specific comments about the proposed exclusion of two types of ditches. Members commented that exclusion of "ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow" may be problematic because many such ditches now drain areas that previously would have been identified as wetlands under the Cowardin classification system (e.g., in the Midwestern U.S.). Such ditches now drain uplands and may not experience perennial flow, but rather, may pond water without flow except under heavy precipitation events or during snowmelt, or may contain water and flow only during wet conditions. Because such ditches exist in heavily agricultural areas which are subject to runoff containing high concentrations of sediments, nutrients, and pesticides, these ditches may be important for certain ecosystem services such as attenuation of nonpoint source pollution. Panel members also expressed concern about the exclusion of ditches that are embedded in landscapes that were previously wetlands but, due to drainage, are now upland. Panelists suggested that historical evidence of the "upland" status of these ditches include historic reconstructions from surveyor's notes. Panel members commented that this is critical in some areas because many headwaters have been either converted to or networked with ditches, as in the Midwest.

Panelists noted that the proposed rule would exclude from jurisdiction ditches that are excavated in uplands and drain uplands but presumably drain into jurisdictional waters. Members commented that it is therefore important to consider the ditch drainage flowpath. It was noted, for example, that the exclusion of “ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow” might apply to much of northwestern Ohio, which is so flat that it is difficult to move water off the land. When ditches in this region do flow, they move water and much agricultural run-off to Lake Erie. This can result in harmful algal blooms and the loss of drinking water (e.g., as has occurred in Toledo and surrounding areas). Panelists commented that these ditches clearly have an effect on downstream water quality in the broad sense.

Panel members also commented that, because of the relative ease with which tile drains can now be installed, ephemeral channels without a bed and bank could easily be eliminated from jurisdiction under the proposed rule. It was noted that when ephemeral channels within farm fields are tiled, these waters deliver nutrient and pesticide-laden waters directly to downstream waters and increase “flashy” flows by reducing infiltration potential. Increased flows increase erosion and, along with increased nutrients and pesticides, degrade water and habitat quality and biotic integrity of downstream waters.

Gullies, rills, and non-wetland swales. Panelists commented that although gullies, rills, and non-wetland swales are excluded from jurisdiction under the proposed rule, the preamble of the rule notes that these features are important conduits for moving water between jurisdictional waters, making them important forms of hydrological and other types of connectivity. The preamble indicates that gullies, rills, and non-wetland swales are important in “fill and spill” waters, where flows spill from other waters/wetlands through gullies to stream channels (for example). Panel members commented that it is not clear how or why gullies that link two jurisdictional waters can be excluded from jurisdiction. A Panel member suggested that gullies that have been allowed to become permanent and minimally ephemeral, such as those caused by over grazing of livestock, should be included in the Waters of the U.S. Such gullies are observed throughout the Western U.S. Some Panel members suggested that gullies, rills, and non-wetland swales be assessed along a gradient of connectivity on a case-specific basis to determine whether they should be jurisdictional until the science is available to make an appropriate determination for the respective class as a whole.

Artificial lakes and ponds. Panel members commented that, although excluded from jurisdiction under the proposed rule, artificial lakes or ponds, or reflection pools, created by excavation, diking, or construction may be directly connected to the Waters of the U.S. by shallow or deeper groundwater. Panel members commented that a “blanket” exemption should therefore not be provided for these features. It was suggested that each feature be evaluated for exclusion through a hydrologic system analysis. Members commented that exemptions for artificial lakes and ponds could invite multiple abuses to the rule, particularly when land ownership and land use are changed with time.

Panel members commented that the manner in which decisions would be made about excluding other manmade features was not clearly explained in the preamble of the proposed rule. Members noted, for example, that it was not clear whether the proposed rule would exclude: artificial lakes and ponds that have connections to downstream waters, underground stormwater drainage, natural versus artificial swales, roadside ditches, stormwater quality basins, bioswales, detention basins, industrial water processing and/or treatment facilities, desalination brine storage basins, cooling systems, oil and gas tank basins, fish farms, and rice paddies.

Question 5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

In their individual written comments Panel members provided statements about other aspects of the scientific and technical basis of the proposed rule. Please refer to these individual comments.

Because the Panel was asked to provide comments to the chartered SAB and not consensus advice, we will not be providing a formal report. I hope this summary of the major points discussed and the attached comments from individual Panel members will be helpful to the chartered SAB as it develops advice to the agency on the adequacy of the scientific and technical basis of the proposed rule.

Attachment

Attachment

Individual Comments from Members of the SAB Panel for the Review of the EPA Water Body Connectivity Report on the Scientific and Technical Basis of the Proposed Rule Titled "Definition of 'Waters of the United States' Under the Clean Water Act"

September 2, 2014

Dr. Allison Aldous

Responses to questions regarding the definition of "Waters of the United States" under the Clean Water Act.

Revised Aug 22, 2014

The definition of Waters of the United States by the EPA and ACOE bases a determination of a "significant nexus" on the physical, chemical, and biological processes that connect and link wetlands waters to each other. These key processes are integral to the functioning of aquatic ecosystems, and the Rule is, for the most part, grounded in ecological, hydrological, and other physical sciences.

The agencies appropriately recognize that "significant nexus" is not a scientific term and that "*there is a gradient in the relation of waters to each other*" (p. 22193). This gradient in connectivity runs from a continuous and significant physical and ecological connection, to an infrequent and insignificant connection. Specific scientifically-grounded, objective methods must be put in place to draw the line between those waters having or not having a significant nexus to other jurisdictional waters. In some cases methods and/or criteria are proposed, and often the agencies seek feedback on these approaches, implying that technical guidance will be issued after the Rule is complete. Nevertheless, evaluating the technical accuracy of the definition is difficult in the absence of clear criteria.

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between <u>tributaries</u> (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The agencies are correct that tributaries and their associated ecosystems significantly affect the chemical, physical, and biological integrity of downstream waters.

Under this proposed definition, tributaries include (i) stream-type (lotic) tributaries which are identified using the indicators of a bed and banks and ordinary high water mark (OHWM), and which also contributes flow, either directly or indirectly to a jurisdictional water; and (ii) stillwater-type (lentic) tributaries which may lack a bed and banks or OHWM, as long as they contribute flow to a jurisdictional water. Thus even though the criteria of bed, banks, and OHWM are useful for defining lotic tributaries, the only criteria that a tributary <u>must</u> have under this definition is that it contributes flow to a jurisdictional water.

The definition of the lentic-type tributary (contributing flow from wetlands, lakes, and ponds) is not the way in which tributaries are traditionally defined in the scientific literature. It also makes the definition of a tributary confusing because there might be stream-type tributaries <u>without</u> one or more of the indicators (bed, bank, OHWM) but which could still be considered a tributary within the lentic-type. The lentic-type of freshwater ecosystems that often are connected to jurisdictional waters might be better included within the group of "adjacent waters," as suggested on p. 22203.

The definition of the lotic-type tributary is appropriately comprehensive because it inherently includes ephemeral and intermittent streams (as well as perennial) streams. The former types are often overlooked but ecologically important, particularly in arid landscapes with seasonal patterns of precipitation. However, there may be some types of tributaries that lack an obvious OHWM, for example ephemeral streams in arid locations. Therefore the definition should be "*bed and bank, and sometimes an OHWM*".

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The agencies are correct that adjacent water bodies significantly affect the chemical, physical, and biological integrity of downstream waters.

One problem with the way that 'adjacents waters' are defined is that groundwater is not adequately recognized as providing a connection (nexus) among water bodies. Groundwater flowpaths can be in the shallow subsurface, where flow is limited to the soil, and where water flows from one water body to another in hours to weeks. At the other end of the scale, groundwater can flow through deep bedrock deposits with travel times in the order of decades to centuries. In the proposed rule, only the shortest shallow flowpaths are recognized as providing a significant nexus among water bodies. The definition of a "shallow subsurface connection" is not entirely clear, but through the examples listed on p. 22208, it appears to be very shallow (i.e., in the soils) rather than within the surficial geology (except in karst systems).

Drawing the line at only the shortest shallow subsurface flowpaths is not supported by the science. Aquifers (particularly surficial unconfined ones) may provide hydrologic and chemical connections among wetland types, often on reasonably short time scales (i.e., 1-20 years) and so can meet the criteria listed on p. 22208 in that they "exhibit a direct connection to the water found on the surface in wetlands and open waters". Examples include glacial till and sand deposits. For example, a sand dune aquifer connects emergent marshes on the Oregon coast to the Coos Bay estuary and the nearshore coastal zone via shallow groundwater flowpaths (Jones 1992).

The agencies suggest distance as a metric to determine if a shallow subsurface connection significantly connects a water body to a jurisdictional water (p. 22207). However, some highly permeable soils / aquifers with high hydraulic conductivity and a strong topographic gradient can transport water and dissolved solutes over longer distances between upgradient and downgradient waters. Effects on the downgradient (jurisdictional) waters include, for example, a more prolonged and muted hydrograph and transport of dissolved compounds. In contrast, lower permeability soils/aquifers with low k in flatter landscapes will have a lesser effect over shorter distances. Therefore the determination of connection via shallow subsuface pathways must take into account gradient and soil and aquifer hydraulic properties as well as distance separating water bodies.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The agencies are correct that many types of water bodies that are not included as tributaries or adjacent waters may significantly affect the chemical, physical, and biological integrity of downstream waters. It is scientifically justified to aggregate similar waters for this analysis, for two reasons. First, wetlands within a region may be functionally similar in terms of their effects on downstream waters. For example, small pumice fens in the Upper Klamath Basin were found to have similar functions and relationships to downgradient perennial streams to warrant developing one hydrogeologic model representative of the entire group (Aldous and Bach 2014). Second, for some smaller wetlands, their effects on downstream waters are often only measurable in aggregate.

The agencies ask a number of questions related to how a significant nexus analysis should be done. The method ultimately selected for aggregating waters geographically (i.e., "in the region") and functionally (i.e., "similarly situated"), and for making a significant nexus determination, must be based primarily on hydrologic principles, because hydrology is the key ecosystem driver for most other processes. This must include both surface hydrologic processes as well as subsurface (i.e., shallow groundwater) processes occurring with the soils and within any shallow unconfined aquifers that serve to connect surface water bodies to one another. The latter is often implied (e.g., p. 22214, bottom of 1st column) but not explicitly discussed.

Using the "single point of entry" watershed based on NHD watersheds appears to be an appropriate approach. However, the agencies suggest that for regions where there are few previously-defined jurisdictional waters that 10-digit HUCs be used (p. 22212). If this is the case, some of those HUCs may not contain a jurisdictional water, and so how would a determination be made?

In proposing ways that "other waters" might be found to be "similarly situated", the agencies suggest using the Omernik Level III ecoregions (p. 22215) or Hydrologic Landscape Regions (p. 22216) approaches for considering wetlands and waters to be similarly situated. Omernik ecoregions may not be appropriate because they are based largely on patterns of terrestrial vegetation. Other approaches to regional classification of freshwater ecosystems are also available, including TNC's Ecological Drainage Units (Higgins 2003; Higgins et al. 2005) and WWF's Freshwater Ecoregions (Abell et al. 2008).

The approach ultimately taken should rely on a conceptual framework for wetland connectivity, such as the one described in the SAB final report. This framework described the pathways in 3 dimensions + time by which waters and wetlands are connected to one another.

Given that the science is constantly evolving, it is preferable to have an adaptive process for making jurisdiction determinations, rather than a list of waters that are defined as jurisdictional (or not) from the outset.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.

As described above, groundwater connections, particularly via shallow flowpaths in unconfined aquifers, are critical in supporting the hydrology and biogeochemical processes of wetlands and other waters, and they serve to connect waters and wetlands when they have no apparent surface connections. This is recognized in part in the Rule, yet not to the extent that these flowpaths are integral to supporting Waters of the US. Furthermore, groundwater is on the list of excluded waters. More clarity is needed in how groundwater is considered in making a jurisdictional determination, and a more inclusive definition is required that incorporates more than just shallow subsurface flow in soils.

Even if groundwater is excluded as a Waters of the US, it is important to recognize that activities that occur on the surface above those subsurface flows, such as ground disturbance (e.g., logging, road construction), introduction of contaminants (e.g., oil spills, application of agricultural chemicals), or groundwater abstraction (e.g., pumping shallow wells) will significantly affect the integrity of the downstream receiving waters (Brown et al. 2011).

Prior converted cropland is excluded from the list of jurisdictional waters. Cropland that historically was wetland, and is being restored to wetland, should not be excluded from the list of jurisdictional waters. It is not clear if this is included or excluded.

References:

Aldous, A.R. and L.B. Bach. 2014. Hydro-ecology of groundwater-dependent ecosystems: applying basic science to groundwater management, Hydrological Sciences Journal 59: 530-544.

Brown, J. B., L. B. Bach, A. R. Aldous, A. Wyers and J. DeGagné. 2011. Groundwater-dependent ecosystems in Oregon: an assessment of their distribution and associated threats. Frontiers in Ecology and the Environment 9: 97-102.

Higgins, J.V. 2003. Maintaining the ebbs and flows of the landscape – conservation planning for freshwater ecosystems. Pages 291-318 in Groves, C.R. Ed. Drafting a conservation blueprint: a practitioner's guide to regional planning for biodiversity. Island Press, Washington, D.C.

Higgins, J. V., M. T. Bryer, M. L. Khoury and T. W. Fitzhugh. 2005. A Freshwater classification approach for biodiversity conservation planning. Conservation Biology 19: 432-445.

Jones, M.A. 1992. Groundwater availability from a dune-sand aquifer near Coos Bay and North Bend, Oregon. U.S. Geological Survey Open-File Report 90-563. Portland, Oregon.

Dr. Genevieve Ali

I would like to start by congratulating the EPA and the U.S. Army Corps of Engineers for putting the draft rule up for discussion to the public as well as the scientific community. It is true that many determinations of jurisdictional waters have been traditionally made on a case-specific basis rather than using a predetermined framework for categorical (or automatic) determinations; the agencies' efforts to make the determination process more straightforward, consistent and transparent are therefore highly commendable. My answers to the charge questions can be found below.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.

Here I chose to answer the fourth charge question first as it addresses the "definition of other terms"; including that of "significant nexus". The draft rule does include a definition for "significant nexus"; however, I find it rather vague and subject to interpretation. Indeed, the EPA science report made a very eloquent demonstration that connections exist between streams and wetlands, regardless of whether they are at the head of a hydrographic network or not, and located in riparian and floodplain settings or not. The science report also made a very strong case for the multiple nature of those connections with biological, chemical, and hydrological exchanges, and with surface and subsurface components in some cases. The SAB panel tasked with reviewing the science report went on to discuss that connectivity expresses itself over a continuum or gradient and as such, it is reasonable to assume that "all is connected" to a certain extent, although the magnitude, frequency and duration of the connections are highly variable. The EPA science report did not, however, explicitly discuss the notion of significance, and I find that the definition provided in the draft rule does not resolve the issue as it equates "***significant***" with "***significantly affects*** the chemical, physical, or biological integrity" of a jurisdictional water, therefore never explaining what the root term "significant" means. The proposed rule goes on to say that "*for an effect to be significant, it must be more than speculative or insubstantial*", but it does not put forward any threshold for deciding what is *not* speculative or insubstantial. This definition of "significant nexus" is especially problematic when it comes to the "other waters" and the case-specific analyses needed to determine jurisdiction. The proposed rule would be more robust if the definition of "significant nexus" itself hinted at a tangible tool or methodology to make the job of the Corps Districts more straightforward and transparent when it comes to deciding what is *not* speculative or insubstantial.

I understand that the phrase "significant nexus" is a legal term and I appreciate the clarifications provided by Dr. David Evans during the teleconference. I however persist that the proposed rule would be stronger and less susceptible to contestation if the legal definition of "significant nexus" was paired with a scientific definition of "significant nexus", thus leading to a perfect translation between policy and science. This would also serve the purpose of a more transparent determination process, which is one of the goals pursued with the proposed rule. Although the Agencies made it clear that they did not want to rely on specific flow rates, etc. to define the "significance" of a nexus, it would be important to clarify the meaning of the word "significant" here. Is the significance of a nexus evaluated in terms of the magnitude of connections, frequency, duration or all of the above? What about predictability? The example of Prairie potholes and their significant nexus to downstream waters is an interesting puzzle related to that question as some body of literature has argued that potholes might attenuate "hydrological" floods but have no impact on so-called "economic" floods. In that literature, "hydrological" floods are considered by high frequency, low to medium magnitude events that occur commonly without economic damage while "economic" floods are low frequency, high magnitude events that tend to cause economic damage. If relying on that literature and on the "significant nexus" language contained in the proposed rule, I fear that it would fall on the local Agencies' shoulders to resolve the following questions/dilemma:

- Hydrological floods occur 4 out of 5 years but move relatively little water out of the potholes: there is a frequent nexus but is it significant?
- Economic floods have a 1 in 100 or 1 in 500 years recurrence interval and have catastrophic consequences downstream as water spills out of the potholes and reaches streams and rivers: there is an infrequent nexus but it is quite strong; is it, then, significant?

Another question that comes to mind is: since the CWA concerns the chemical, physical and biological integrity of (downstream) waters, do all three types of integrity need to be threatened simultaneously for the nexus to be deemed significant, non-speculative or substantial? Besides, an additional element of complexity (or uncertainty) has to do with whether the significance of a nexus should be measured in terms of socioeconomic impact as well. Indeed, under the existing regulations, ''other waters'' can be deemed jurisdictional if their use, degradation or destruction could affect interstate or foreign commerce, thus hinting towards a possible social assessment of the significance as well. At one point in the draft rule we can read that "*a case-specific analysis allows for a determination of jurisdiction at the point on the gradient in the relationship that constitutes a ''significant nexus*''. I would be in favor of more guidance being provided within the framework of the draft rule to facilitate that "critical point" or "threshold" determination and there again make the process more transparent to the public.

While the connectivity-related literature does not use the term ''significant'', this term has mathematical (or statistical) meanings and it would be important for the Agencies to assess whether they can work with those meanings/definitions or not. For instance, the concept of "statistical significance" is usually associated with a statistical test and rejecting a null hypothesis and would not be of any use here. However, another interesting concept is that of "practical significance", which basically asks the question of whether the differences between two groups of data are big enough to have **a real meaning**. I find that the concept of "practical significance" could be applied to the "significant nexus" idea as the notion of significance here is relative, i.e., the word "significant" is used to signify "with respect to" or "in comparison to" a system devoid of downstream connections. Each category (by rule) of jurisdictional water (e.g., tributaries, adjacent waters) could be associated with a very simple "Nexus Score" calculated as follows:

$$\text{Nexus Score} = \text{Score}_{Chem} + \text{Score}_{Phys} + \text{Score}_{Biol} + \text{Score}_{Comm} \quad (1)$$

The individual scores Score_{Chem}, Score_{Phys}, Score_{Biol} and Score_{Comm} appearing in Equation (1) would have been derived from a site-specific assessment done using the framework outlined in Table 1:

Table 1: Components of the Nexus Score for a given water

Does the water...	If answer is "No"	If answer is "Yes"			
		Frequency (freq) of connection	Magnitude (mag) of connection	Duration (dur) of connection	Total score
... affect the **chemical (chem)** integrity of downstream waters?	$\mathbf{Score}_{\mathbf{Chem}} = 0$	Low: $z_{freq} = 1$ Medium: $z_{freq} = 2$ High: $z_{freq} = 3$	Low: $z_{mag} = 1$ Medium: $z_{mag} = 2$ High: $z_{mag} = 3$	Low: $z_{dur} = 1$ Medium: $z_{dur} = 2$ High: $z_{dur} = 3$	$\mathbf{Score}_{\mathbf{Chem}} = z_{freq} + z_{mag} + z_{dur}$
... affect the **physical (phys)** integrity of downstream waters?	$\mathbf{Score}_{\mathbf{Phys}} = 0$	Low: $z_{freq} = 1$ Medium: $z_{freq} = 2$ High: $z_{freq} = 3$	Low: $z_{mag} = 1$ Medium: $z_{mag} = 2$ High: $z_{mag} = 3$	Low: $z_{dur} = 1$ Medium: $z_{dur} = 2$ High: $z_{dur} = 3$	$\mathbf{Score}_{\mathbf{Phys}} = z_{freq} + z_{mag} + z_{dur}$
... affect the **biological (biol)** integrity of downstream waters?	$\mathbf{Score}_{\mathbf{Biol}} = 0$	Low: $z_{freq} = 1$ Medium: $z_{freq} = 2$ High: $z_{freq} = 3$	Low: $z_{mag} = 1$ Medium: $z_{mag} = 2$ High: $z_{mag} = 3$	Low: $z_{dur} = 1$ Medium: $z_{dur} = 2$ High: $z_{dur} = 3$	$\mathbf{Score}_{\mathbf{Biol}} = z_{freq} + z_{mag} + z_{dur}$
... use, degradation or destruction affect interstate or foreign **commerce (comm)**?	$\mathbf{Score}_{\mathbf{Comm}} = 0$	$\mathbf{Score}_{\mathbf{Comm}} = 3$			

In this framework, the maximum possible Nexus Score attainable by any water would be 30. The Nexus Score equation (Equation (1)) could even be re-written by multiplying the different individual scores by different weights:

$$\text{Weighted Nexus Score} = W_{Chem} \times Score_{Chem} + W_{Phys} \times Score_{Phys} + W_{Biol} \times Score_{Biol} + W_{Comm} \times Score_{Comm} \quad (2)$$

With W_{Chem}, W_{Phys}, W_{Biol} and W_{Comm} being user-defined weights between 0 and 1. Ideally, the weights would need to make consensus either through public consultation or based on literature reviews. One could foresee that if the assessment was done in a region where downstream populations are dependent on water supply for drinking water, for example, the physical and chemical integrity scores could have a higher weight than the biological integrity score.

A decision matrix like the one in Table 2 could then be used to assess an "other water" by comparing it to well-documented jurisdictional and non-jurisdictional waters:

Table 2: Practical significance of "other water" Nexus Score

	Nexus score of the well-documented water	Nexus score of the "other water" being assessed	% difference between the well-documented water and "other water" Nexus Scores
Tributary example	24	16	-33%
Adjacent water example	20		-20%
Non-jurisdictional water example	9		+78%

The tributary, adjacent water and non-jurisdictional water examples included in Table 2 would need to be similarly situated (based on hydrologic landscape regions or ecoregions) as the “other water” being evaluated. Then, by relying on “practical significance” principles, a significant nexus could be deemed present if:

- The (unweighted) Nexus Score of the “other water” is more than 25% higher (for example) than that of the similarly situated non-jurisdictional water; or
- The (unweighted) Nexus Score of the “other water” is equal or greater than that of any of the similarly situated jurisdictional waters.

For regions that are very well documented, the Corps Districts could even forego the practical significance assessment and just decide on a threshold (or critical) Nexus Score value (between 1 and 30) above which “significance” would be deemed present.

The (very coarse) idea of a Nexus Score (weighted or unweighted) builds upon the EPA science report and the scientific literature stating that “all is connected” to a certain extent in watersheds. The (very coarse there again) practical significance assessment outlined above however has the advantage of showing how the nexus of an “other water” compares to that of jurisdictional and non-jurisdictional waters before making a decision about its significance. I do not here suggest that the rule be re-written to include methodological details similar to the ones outlined above because it is not the place to do it; however the issue of “significance” being absolute versus relative should be addressed. This might prevent the public from asking questions similar to the ones that panel members asked during the teleconference, for example:

- Why do ditches need to have perennial flow to be jurisdictional even when they are located in areas where most of the jurisdictional tributaries are less than perennial? It gives the impression that the determination is made in absolute terms for ditches but in relative terms for tributaries and suggests a lack of consistent framework.
- What is the best scientific framework for aggregation? If significance is assessed relative to surroundings (rather than in absolute terms), then the concept of “similarly situated” becomes more difficult to quantify given issues of process timescales and spatial scales and map scales. Etc.

Still on the topic of definitions within the proposed rule, beyond the word “significant”, the term “nexus” should be explained more clearly (i.e., what is a nexus, regardless of whether it is significant or not?). From the proposed rule, it is sometimes unclear to me whether nexus = connection or nexus = impact or influence? With the former definition, only connectivity is deemed important while with the latter, both connectivity and isolation can have an impact on downstream waters. At one point in the rule, we can read: “*Connectivity for purposes of interpreting the scope of ‘‘waters of the United States’’ under the CWA serves to demonstrate the ‘‘nexus’’ between upstream water bodies and the downstream traditional navigable water, interstate water, or the territorial sea*”: this statement strongly downplays the beneficial effects of the isolation of some waters from downstream waters. There again, the EPA science report made a great job in citing literature that shows that the isolation of certain “other waters” can be critical to the health/integrity of downstream waters, and it might be important to reiterate that fact by clarifying what a nexus is. The draft rule rightfully mentions that functions that might demonstrate a significant nexus include sediment trapping, retention or attenuation of flood waters, etc. and those functions all refer to isolation: those clarifications would however carry more power if they were closely associated with the definition of a "nexus" *per se*.

Lastly, about the definition of a wetland, it seems that the wording included in the draft rule is not aligned with that of the EPA science report. Indeed, the draft rule mentions that wetlands are "*areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas*". This slightly deviates from the science report which relied on the Cowardin definition and required only one out of the three Cowardin criteria to select wetland-related literature. At the time of the SAB panel discussions in Washington D.C., there were also multiple discussions regarding the use of a broader Cowardin definition (only one out of three criteria) that was not aligned with the current federal regulatory wetland definition (based on all three Cowardin criteria). The Agencies should clarify how the new wetland definition agrees with (or contradicts) not only the current federal regulatory definition but also the approach that was used in the science report that serves as a basis for the new rule.

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

Overall, I agree with all tributaries of a traditional navigable water, interstate water, the territorial seas or impoundment being jurisdictional. The scientific literature reviewed in the EPA science report supports the argument that tributaries, as a category, are involved in tremendous exchanges with downstream waters and as such, they do not need to be subject to individual case-by-case evaluations before they are deemed jurisdictional. Even though the current version of the EPA science report does not address man-made/artificial waterways, I also agree with the identified features that could qualify as jurisdictional ditches, namely natural streams that have been altered, ditches excavated in jurisdictional waters, ditches that have perennial flow and ditches that connect jurisdictional waters.

In light of one of the objectives pursued with this new rule, i.e. a more consistent and transparent determination of jurisdictional waters, I think that the inclusion of a regulatory definition of "tributary" is great. However, I am not sure that the majority of the literature supports the categorization of run-of-stream wetlands and lakes as tributaries, especially since the majority of the literature defines tributaries as longitudinal features that have directional flow. In the draft rule itself, it is somewhat confusing to define a tributary as "*a longitudinal surface feature that results from directional surface water movement and sediment dynamics demonstrated by the presence of bed and banks, bottom and lateral boundaries, or other indicators of OHWM*" and still call run-of-river wetlands and lakes tributaries when they do not fit that definition. The agencies did recognize that uncertainty and said they could rather categorize wetlands that connect tributary segments as adjacent waters rather than tributaries: I favor that option. Also, the EPA science report was well structured with 1) streams, 2) riparian and floodplain wetlands, and 3) non-riparian and non-floodplain wetlands and I think that the proposed rule should build upon that structure and consider, separately, 1) tributaries = streams, 2) adjacent waters in riparian and floodplain areas, including run-of-river features, and 3) other waters in non-riparian and non-floodplain areas.

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

I support the change from ‘‘adjacent wetlands’’ to ‘‘adjacent waters’’ in the proposed rule because it is more aligned with the contents of the EPA science report that the proposed rule relies on. By using a broader Cowardin definition to select wetland-related literature, the science report in fact considered multiple types of water bodies (e.g., oxbow lakes) located in riparian and floodplain settings. Equating the term "neighbouring" with "being located in (the same) riparian or floodplain area" is also aligned with the EPA science report.

I also agree with the statement that "*for waters outside of the riparian area or floodplain, confined surface hydrologic connections (as described above) are the only types of surface hydrologic connections that satisfy the requirements for adjacency*." To me, this does not mean that waters outside of the riparian area or floodplain and without confined surface hydrologic connections necessarily lack a significant nexus but simply that they cannot be considered as adjacent waters and rather need to be considered as "other waters" and be evaluated on a case-by-case basis.

The Agencies did request comments about how to deal with shallow subsurface flow connections when determining adjacency. They considered four options, namely:

1. Asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone of a jurisdictional water;
2. Considering only confined surface connections but not shallow subsurface connections for purposes of determining adjacency;
3. Establishing specific geographic limits for using shallow subsurface or confined surface hydrological connections as a basis for determining adjacency, including, for example, distance limitations based on ratios compared to the bank-to-bank width of the water to which the water is adjacent; or
4. Asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance.

Option (1) is the one that the proposed rule currently puts forward, and I find that it is the most aligned with the EPA science report. In my opinion, option (2) is too limiting and disregards the very large body of literature demonstrating the importance of shallow subsurface flow paths, especially in riparian and floodplain settings. Option (3) is a good idea but the ratios mentioned would likely be site-specific and may be correlated to riparian and floodplain morphology, thus making option (1) a much easier and straightforward one to implement. As for option (4), I find it to be the most impractical as it would be difficult to test the presence of unbroken, perennial or intermittent shallow subsurface connections over long distances.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The approach put forward by the proposed rule, i.e. that waters not located in riparian and floodplain settings be assessed on a case-by-case basis, is well aligned with the EPA science report: while the presence of a nexus is not contested, the demonstration of its significance has to be made.

The draft rule mentions that the agencies "*considered multiple approaches and options for how best to address whether ''other waters'' were jurisdictional under the CWA*", including determining, "*by rule, that ''other waters'' are similarly situated in certain areas of the country*". I agree that ecoregions and hydrologic landscape regions (HLRs) could be used for aggregation purposes. Those concepts are widely used for research purposes and could become powerful regulatory tools by providing a scientific equivalent to the phrase "similarly situated" that was used in previous court rulings and decisions.

Still in relation to "other waters", the draft rule mentions that the agencies considered the possibility of determining "*by rule that certain additional subcategories of waters would be jurisdictional rather than addressed with a case-specific analysis*". The draft rule builds on the examples of "*waters such as prairie potholes, Carolina and Delmarva bays, pocosins, Texas coastal prairie wetlands, and western vernal pools*" that could be deemed jurisdictional, as a category, while "*playa lakes in the Great Plains, even in combination with other playa lakes in a single point of entry watershed*" would be considered non jurisdictional for they lack a significant nexus. I am a bit reluctant about this option and do not think that the currently available scientific literature supports that approach. The draft rule goes on to say that "*the [EPA science] Report indicates that there is evidence of very strong connections in some subcategories that are not included as jurisdictional by rule*" but there again, it is unclear to me whether that very qualitative terminology ("very strong") is a synonym for "significant". Having other groups or types of waters being determined jurisdictional by rule or category would only be possible if we could rank them according to the frequency and/or magnitude and/or duration with which they actively transfer materials (or prevent the transfer of materials) to downstream waters (see coarse schematic in Figure 1).

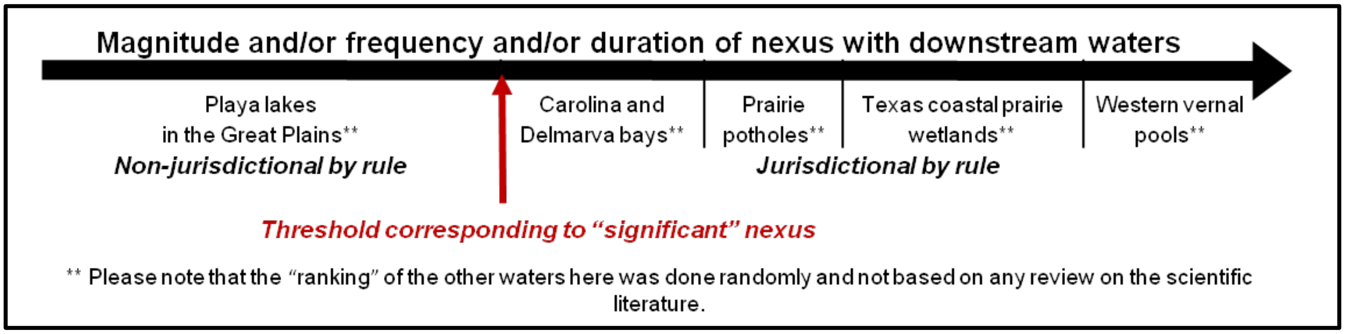

Figure 1: Hypothesized/idealized ranking of other waters according to their nexus to downstream waters

While reviewing the EPA science report, the SAB panel discussed – at length – the issue of connectivity being a gradient rather than a dichotomous property, and the issue with "other waters" is that they can be on both extremes of the spectrum (or gradient), i.e. be strongly connected or strongly isolated from downstream waters depending on the prevailing conditions. This makes the assessment of "significant nexus" particularly difficult and until (or unless) rankings or classifications similar to the one hypothesized in Figure 1 are available, I do not think that it would be possible to determine that certain additional subcategories of waters are jurisdictional by rule.

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

Just a quick comment about fill and spill hydrology: This is a detail which I do not believe has a major impact on the legal implications of the proposed rule but I do not agree with the definition of "fill-and-spill" that is used in the document. Indeed, the document reads that:

"*For the purposes of [this] rule, ''fill and spill'' describes situations where wetlands or open waters fill to capacity during intense precipitation events or high cumulative precipitation over time and then spill to the downstream jurisdictional water*."

However most of the literature on fill-and-spill deals with subsurface flow connections over irregular soil-bedrock interface or Prairie potholes and in such cases, the phrase "fill and spill" simply means that water is going over the rim of the pothole or subsurface depression; it does not necessarily mean that the water spilling over in fact discharges into a jurisdictional water. When modelling "fill and spill", most algorithms go with a four-phase sequence from dry → fill → spill → connect: the "connect" phase corresponds to a spill large enough that it actually reaches a stream. It should be clarified in the proposed rule that some spills occur very far from jurisdictional waters (i.e., in uplands) and in fact never Reach or influence downstream waters.

Dr. David Allan

Statement of J. David Allan regarding EPA's Proposed Rule "Definitions of "Waters of the United States' Under the Clean Water Act".

The Federal Register (vol 79 No. 76, April 21, 2014) reporting of the proposed rule and supporting science is excellent. It thoroughly covers the supporting science, and defines each of the elements of "significant nexus". I believe the proposed rule and its supporting language define to the greatest degree possible which waters are jurisdictional under the CWA, and set forth the criteria by which "other waters" may be determined to be jurisdictional on a case by case basis. Yet to be resolved in whether broad categories of "other waters" may be considered jurisdictional as a category.

Those waters to be excluded deserve careful scrutiny as there is no recapture provision following this rule-making. I wish to raise possible concerns regarding Exclusion b (3) and Exclusion b (5-vi).

Exclusion b (3) – "ditches that are excavated wholly in uplands, drain only uplands, and have less that perennial flow" – together, these three criteria may suffice, but the distinction between perennial and less-than-perennial flow may be a cause for concern. P 22203 states, "Under this exclusion, water that only stands or pools in a ditch is not considered perennial flow and therefore any such upland ditch would not be subject to regulation". In parts of southeast Michigan, Ohio and Indiana, topography is very flat and ditches flow primarily during times of heavy rain. Some ditches are sufficiently deep that they will pond water until the receiving river stage drops enough for water to flow from the ditch to the river. Yet such ditches commonly receive from surrounding lands, and episodically deliver, significant nutrients to downstream waters. In the aggregate, they are the source/conduit for the majority of contaminants reaching downstream waters ("most of the materials found in rivers originate outside of them." P 22247). Indeed, this situation describes much of the drainage into western Lake Erie, where harmful algal blooms due to excessive nutrient loading have caused beach closings, and in August 2014 a three-day ban on drinking water for some 400,000 of the residents in and near Toledo, OH. In short, using the criterion of "less-than-perennial" flow to exclude ditches may not be consistent with addressing nutrient and sediment loading that affects drinking water, beach use, fishing, and other uses.

Exclusion b (5-vi) – "Groundwater, including groundwater drained through subsurface drainage systems". An important pathway for some nutrients and contaminants is via subsurface drainage systems to ditches that may not have perennial flow, but which may deliver much of the nonpoint runoff to downstream waters. Thus this exclusion is a concern, and should be recognized as such.

The aggregate influence of these two exclusions can be estimated by models such as SWAT, which then might serve as a basis for determining when these exclusions have sufficient impact to be considered.

If the agencies prefer criteria related to flow regime rather than the delivery of non-point pollutants, they might consider aggregate flow during a 90-day window spanning the time of fertilizer application.

Dr. Lee Benda

Preliminary Written Comments on proposed new CWA rule.

August 18, 2014

Overall comment.

Overall, the EPA has written a very good comprehensive overview of the new CWA rule, including numerous explanatory details, that reflects the amount and care of the effort involved, including the scientific literature review (Report), the SAB's review of that document, previous and existing rules and case law. In total, I would say that the proposed new CWA rule largely reflects the state of the science as articulated in the EPA Connectivity Report and as reviewed and enlarged in the SAB panel review. However, there are several areas in the proposed rule that could be strengthened.

In addition, it appears that the Connectivity Report that is cited in the proposed rule is the original one reviewed by SAB and not a revised version in response to SAB comments. Hence, some of the text in the rule regarding scientific evidence may change in subsequent rule versions.

Question 1. *The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.*

A key element in the determination that all tributaries to all navigable rivers (including desert ephemeral headwater channels) have a significant nexus to larger downstream (navigable) waters is that they must be considered in aggregate, as a population (although the distinction between individual tributary effects and aggregate tributary effects in the science literature review, including in Appendix A, is vague). Although this aspect of channel networks was discussed and embraced by the SAB, even suggesting that EPA create a separate section covering this topic in their Connectivity Report, it appears that the aggregate concept (for wetlands specifically, but which EPA extends to tributaries and neighboring waters) also originates from Justice Kennedy's Opinion in Rapanos, in that they (wetlands) are jurisdictional, if they "either alone or in combination with similarly situated wetlands in the region, significantly affect…navigable waters". However, Justice Kennedy wrote that there needs to be "some measure of significance of the connection for downstream water quality".

The proposed CWA rule uses various terms to describe the "in combination" aspect of the argument of significantly effecting (e.g., significant nexus), including 'in combination', 'in aggregate' , 'cumulatively' and 'an integrated system'. However, the EPA proposed rule language (and the science argument behind it) could be strengthened by describing in more detail what is meant by the terms 'aggregate' and 'in combination' (e.g., what is the "measure of significance of the connection for downstream water quality" in the context of aggregate effects). In addition, the aggregate issue that covers both tributaries and neighboring waters may become a touchstone for future challenges or litigation regarding the proposed rule. For example, what proportion of headwater streams would need to be adversely impacted (or eliminated) to create a significant negative impact on larger streams and rivers? Or taken in a larger frame of reference, what is the "measure of significance" in regards to aggregation of tributary effects on the chemical, physical and biological integrity of the nation's waters, downstream (navigable)?

As we have seen in the public comments, some take issue with the concept that everything is connected to everything else, including in an aggregate sense, and that waters, including headwater tributaries, should be considered on an individual basis (e.g., such as desert ephemeral channels that are only activated once per decade or even at a lower frequency).

The EPA may consider this issue and thus could include more detail about the scientific basis of the "aggregate" concept and how it can be determined (briefly summarized from the Connectivity Report and the SAB review or even expanded upon). The aggregate function of smaller tributaries to the mainstem rivers in regards to water, sediment, organic material and nutrients is well established in the scientific literature, conceptually and quantitatively. However, calculating the effect of a single headwater tributary or water body on a larger downstream system (which may be negligible) or calculating a threshold regarding the number, or proportion, of impaired tributaries on the full functionality of a downstream system may lie outside of present science capabilities (although simulation modeling offers an avenue to address this issue).

I think it is fair to say, in stating the scientific basis for aggregate effects in the proposed rule, that there is a sound scientific basis that tributaries, in aggregate (including ephemeral, intermittent and perennial), lead to significant nexus and that it is not speculative nor insubstantial. However, given the stochastic and episodic nature of the connections between tributaries and larger (navigable) rivers, it is not currently feasible to estimate thresholds regarding the effect of various proportions of impaired/non impaired tributaries on conditions of downstream waters; thus, all tributaries fall under the jurisdiction of the waters of the United States. This argument would also be extended to neighboring waters (wetlands, ponds, oxbows) that occur in riparian areas and in floodplains. However, there should be some effort to articulate the strength of these connections (in aggregate) and how they are determined in the Scientific Evidence (Appendix A). In addition, some editing might be in order such as including "aggregation", in addition to "connectivity" as one of the foundational concepts in hydrology and freshwater ecology.

The proposed rule states that "…the tributary connection may be traced using direct observation or US Geological Survey maps, aerial photography or other reliable remote sensing information…". I would add to this "the use of digital elevation or terrain models (DEMs, DTMs) of the highest resolution available in conjunction with flow routing algorithms to generate synthetic river networks…".

Question 2. *The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.*

The issue raised about aggregate effects, in the context of significant nexus, in Question #1 also applies to Question #2 regarding all waters adjacent to rivers and tributaries.

Regarding adjacent waters, the rule states "…the agencies will also assess the distance between the water body and the tributary in determining whether or not the water body is adjacent." As the EPA indicates in the proposed rule, this issue is ambiguous and sets the stage for confusion and disagreement. There should be some measure of quantification (hydrologic connectivity) that is easily measured (in the field or using remote sensing) to reduce the ambiguity.

Question 3. *The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.*

The proposed rule states "…where effects will be analyzed in combination, the agencies will aggregate these effects…". This statement is unclear on its own and it raises the issues outlined in my comments in Question #1 about aggregate effects. This same issue comes up again in the proposed rule "…the agencies would assess the combined effects of similarly situated "other waters" in the region on the chemical, physical and biological integrity…".

The use of Level III ecoregions may be appropriate for their use in defining areas where "waters are similarly situated and aggregation could be used (Map A in docket). However, it might be prudent, unless a more comprehensive analysis is done, to not provide such lists. Rather, it might be best to provide the criteria upon which to consider "aggregation". However, the issue of "aggregation could be used" raises the complexities outlined in responses to Question #1. For example, how exactly would "aggregation" be done (e.g., conceptually, qualitatively or quantitatively)?

The term "landscape unit" is used in the context of aggregate effects and relates to similar hydrologic features and processes, or proximity of features. The EPA could consider using another term, rather than 'landscape unit' that is somewhat ambiguous, and in keeping with the science, may use terms such as similar hydrologic or geomorphic feature having similar processes.

The proposed rule in several areas raises the issue of a "desktop" analysis, presumably using remote sensing and digital data (including DEMs). The rule language might be strengthened if more definition or examples were provided of what constitutes a 'desktop analysis'.

Question 4. *The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.*

Overall, I think the addition of key definitions in the proposed rule is necessary and important. I agree with most definitions as written. However, there are a few that could use some editing.

"The term riparian area means an area bordering a water where surface or subsurface hydrology directly influence the ecological processes and plant and animal community structure in that area." This definition could be tightened up by including "…where surface or subsurface hydrology directly related to channelized flow or the associated alluvial aquifer (including hyphoreic zone) directly influence…".

"…wetlands, lakes and ponds are tributaries (even if they lack a bed and banks or ordinary high water mark…". As EPA in the proposed rule later acknowledges, the definition of wetlands, lakes and ponds as tributaries (in the case where tributaries and other waters are contiguous or overlapping such as in headwaters) may be problematic. I concur, since tributaries in the scientific literature have a specific physical description as does wetlands and ponds. I would propose that such wetlands, lakes and ponds be named something else, such as "instream wetlands", "instream ponds" etc., or some other naming convention that clearly classifies these features.

Riparian areas, as defined in the rule, could exclude those areas that strongly influence aquatic systems (regulated waters) through the flux of solar radiation, woody material and litterfall; the zone of influence is generally considered equivalent to the height of riparian vegetation, regardless of hydrological influences.

Regarding the definition of floodplains and how flood frequency (or other event frequency such as mudflows) can be used to delineate floodplains, one approach is to choose the process and frequency that dominantly controls the channel morphology in the area of interest. In lower gradient (<0.01) and larger channels, this might be the 2-year flood. In higher gradient channels with boulder beds, the channel forming flood recurrence interval may be on the order of 10-years or longer. In steeper headwaters prone to debris flows, the scour line associated with those events would define the zone of interest. This approach would be similar to what the EPA proposes, but would extend it to include event frequency - morphological dependency and non fluvial events that shape channels.

In the proposed rule there is discussion about the uppermost extent of channels or where a channel begins. The rule should include some discussion that in some landscapes (semi arid and even humid) that channel head locations can be transient. Channel heads and thus the uppermost extent of channel networks can extend upwards (by gully erosion) post wildfire or during very large storms. During a hiatus of fire or storms, the upper extent of channels can be reduced. In this context, gullies = channels, by definition.

The proposed rule states "…absolutely no uplands located in riparian areas and floodplains can ever be waters of the United States…". By definition, uplands cannot be floodplains. If I understand this wording correctly, floodplain landforms can encompass higher areas of land (uplands) that will never fall under the waters of the US rule. Perhaps, this distinction could be made clearer in the rule.

The use of the term "watershed" to inform spatial relationships between tributaries, adjacent waters and other waters and larger (navigable) rivers is appropriate. EPA indicates that this spatial scale will often be HUC 10 digit (5^{th} field) and I would suggest that they provide an example of river place names and areas associated with this watershed scale. For example, HUC 5^{th} field areas are on the order of 225 mi^2 (40,000 – 250,000 acres) or 160 to 1,000 km^2.

Dr. Emily Bernhardt

Comments on the adequacy of the scientific and technical basis of the proposed rule titled Definition of Waters of the United States Under the Clean Water Act (79FR 22188-22274)

I want to begin my comments by complimenting the authors of this new rule on preparing a cogent, clear and well reasoned set of clarifications on the critically important policy issue of the definition of waters of the United States. I believe that this rule will, as intended, greatly simplify permit application and regulatory procedures for the administration of the CWA for tributaries and for floodplain and adjacent waters. The authors have done an excellent job laying out the need for and purpose of this new rule; detailing and explaining the changes in the rule; and providing a concise and well-cited summary of the scientific literature that underpins these new guidelines.

In regards to *Question 1 – Definition of tributaries as Waters of the United States:* I am very pleased to see that the policy language is now consistent with the best available science and simple common sense. Every tributary stream of a navigable water, whether it carries permanent or occasional flow, is now explicitly recognized as a water of the United States. It is well known that the materials delivered by headwaters provide essential energy and nutrient resources to the biota of downstream waters, and also that pollutants that enter tributaries must inevitably be transported downstream. Thus in order to protect the chemical and biological integrity of major rivers, it is essential to protect the chemical, physical and biological integrity of contributing tributaries and of any bodies of water (lakes, ponds, wetlands) that are connected within these tributary networks. This section of the rule was quite clear and unequivocal and is entirely consistent with the body of scientific literature in hydrology, aquatic ecology and aquatic chemistry. I appreciate that the rule explicitly recognizes that “manmade breaks” (bridges, dikes, dams) or extreme alterations of channels (e.g. piping, damming) do not alter the potential of that water conveyance to affect downstream waters and thus do not affect its jurisdictional status. As the rule states clearly and simply “*The discharge of a pollutant into a tributary generally has the same effect downstream whether the tributary waterway is natural or manmade”*.

Given this statement (and the obvious truth behind it), I am sorry to see that the rule maintains exceptions for nearly all agricultural ditches and makes no mention of stormwater pipes. These vast systems of engineered channels have been created for the express purpose of routing water as rapidly as possible off of the landscape or fertilized agricultural fields or urban impervious surfaces. Those stormwaters bring with them any sediments that can be eroded and any chemicals that can be washed from those landscape surfaces. These exclusions may be politically necessary, but they are scientifically unjustifiable as the negative effects of agricultural and urban runoff on the quality of our surface waters has been exhaustively demonstrated in the scientific literature (see section 3.3.6 of SAB report).

In regards to *Question 2 – Definition of adjacent waters and wetlands as waters of the United States:* The newly worded rule places protections on all waters of the United States that are adjacent to (~ bordering, contiguous or neighboring) a navigable water or any of its tributaries. A critically important feature of this new wording is that any water within the riparian zone or floodplain of a stream or river is recognized as a water of the United States, even in the absence of a direct surface water connection. Since, by definition, water bodies situated within floodplains are engulfed by occasional floods, it is an important improvement to recognize that the water, biota and chemicals within these systems are at least episodically hydrologically connected to downstream waters. This argument could be further strengthened by explicitly acknowledging that water bodies alongside streams or river are quite likely to be connected to those systems through extensive subsurface hydrologic exchange. The authors should consider whether they can provide further guidance in how the term floodplain is to be defined. There are considerable differences in the scope of protection depending upon whether regulators consider a 1 year or 500 year flood return interval to delineate a floodplain. Being more explicit about how a floodplain should be defined would allow for more consistent application of the rule.

That said, I remain concerned about the vagueness of the word "adjacency" as it is used in the rule. The way that this line is drawn is critically important in evaluating whether a water body is automatically protected as an adjacent/floodplain/riparian water or whether it requires further justification as an "other water". The rule authors requested comment about how to define adjacency and specifically discount the idea of using the concept of flood risk maps. In our SAB comments on the guidance we specifically recommended discussion of using flood return intervals and flood predictions to underpin the concept of adjacency. While I understand that the rule must allow flexibility for the differences in climate and topography across U.S. regions, it seems that some discussion of the specific questions that must be answered within any region to delineate floodplains, riparian zones or neighboring waters should be more explicitly set forward.

In regards to *Question 3 – Definition of other waters on a case-by-case basis as waters of the United States:* Having clarified the status of all tributaries and all waters adjacent to tributaries as waters of the United States, the authors are left with the challenge of determining what water bodies outside of these categories must also be protected in order to maintain the physical, biological and chemical integrity of downstream waters. The rule acknowledges that as water bodies become more distant from tributaries and rivers, the extent of their connectivity also declines. It would be useful for the rule to also mention that the size of these water bodies matters as well, small water bodies far from any flowing water system are more isolated (both hydrologically and via transfers of biota) than are large water bodies that are closer. I appreciate that the rule makes a strong case for considering that the aggregate effect of many minimally connected water bodies may be critical for maintaining the biological, chemical and physical integrity of water bodies in one or both of the previous, clearcut categories of jurisdictional waters. Many watersheds have a large number of non-floodplain wetlands that are collectively responsible for the maintenance of baseflows; the attenuation of floods; the production of organic material that fuels downstream food webs; and the trapping or removal of sediments, nutrients and contaminants that would otherwise contribute to the degradation of downstream water quality. Although individually these wetlands may each have minimal connections to downstream waters, the cumulative impact of these diffuse connections is tremendously important to the maintenance of downstream biota and ecosystem integrity. Historically, the destruction of wetlands has caused serious declines in the water quality of U.S. waters and it is crucial that our CWA works to prevent similar degradation in the future. I found the list of criteria that could be used to assess whether an "other water" was connected to downstream waters was comprehensive, reasonable, and well articulated. I found the text of the rule in this section very close in spirit, substance and argument to SRB panel discussion and recommendations on this issue.

Though I am highly supportive of the overarching conceptual approach in the language regarding "other waters" I have many concerns about the applicability of the rule in actual decision making. Since the rule is intended to reduce ambiguity, it seems very important that the document set forward a more explicit set of requirements (or perhaps questions) that must be met (answered) in order to determine whether an "other water" is sufficiently "connected" to a downstream water that CWA regulations ought to apply. There are modern methods for assessing connectivity (see individual panel comments for numerous suggestions). These methods are constantly improving and being developed, thus the rule should avoid proscribing specific methods that may become outdated. Instead the rule would be improved by more explicitly stating the questions that must be answered in order to establish sufficient proof of a significant nexus or of similar situation.

The EPA requested input on how to approach the classification of "other waters" within the context of the final rule and set forward 4 options. The SAB review is clearly most consistent with the option whereby Certain subcategories of "other waters" as a class can already be recognized as having a significant nexus as a result of prior empirical research *(e.g. prairie potholes, Carolina DelMarva bays).* Outside of these "waters" that have been the subject of prior study there must be some mechanism whereby new information can be used to bring new categories of "other waters" under the CWA should they be found to have a "significant nexus" with downstream waters.

The rule authors write on p. 22217, column 1, first full paragraph *"If waters are categorized as non-jurisdictional because of a lack of science available today, the agencies request comment on how to best accommodate evolving science in the future that could indicate a significant nexus for these ''other waters.'' Specifically, the agencies request comment as to whether this should be done through subsequent rulemaking, or through some other approach, such as through a process established in this rulemaking. "*

It would seem to be quite helpful to use the rule to establish the process by which new categories of "other waters" with "significant nexus" can be established. If the rule includes explicit requirements or questions by which to determine whether a water has a significant nexus, it must also have a clear set of guidelines/questions for determining whether two or more waters are sufficiently "similarly situated" to one another to allow them to be considered in the aggregate.

The use of the word "close" in the definition of "similarly situated" implies that physical distance (or geographic isolation) is the most important aspect of this determination.

In the wording about "similarity" and "significant nexus" increased emphasis should be placed on functional similarity and functional connections.

More attention could and should be devoted to the scale of the water bodies in question (their individual and aggregated volumes and area relative to the watershed or basin size).

Other Comments:

Throughout the rule text, I hope the authors will alter the language to be more compatible with the revised guidance document and the SAB comments on that document. In particular:

- **Connectivity is 4-D (hydrologic, biological, chemical, temporal)**

  Although rule authors have been careful to describe connections beyond hydrologic ones in the preamble and in the review of the literature, the text of the rule too often loses sight of the multiple dimensions of connectivity. This was an issue that the SAB pointed out in the guidance document as well. Loose language on this topic is particularly problematic for the non-floodplain, non-riparian waters (see section 3.7.2 of SAB report).

  To remedy this the rule should scrupulously avoid confusing statements such as:

  *"**Lack of connection** does not necessarily translate to lack of impact; even **when lacking connectivity**, waters can still impact chemical, physical, and biological conditions downstream." p. 22248 top of 2nd column*

  *"Wetlands that **lack surface connectivity** in a particular season or year can, nonetheless, be **highly connected** in wetter seasons or years." p. 22248, 2nd column*

  in each case, the authors clearly intend to make the point that an "other water" can have a significant nexus to a downstream water even without a surface water hydrologic connection or with only occasionally hydrologic connections but in both cases they implicitly support the idea that only surface water hydrologic connections matter. Text such as this must be modified to address 4-D connectivity.

- The use of the new terms uni-direction and bi-directional to classify U.S. waters is confusing and overemphasizes surface water connectivity above any other connections. These terms should be avoided (see SAB comments section 3.5.2.).

Dr. Robert Brooks

Brooks comments on proposed rule: Definitions of Waters of the United States … 7-28-14

22193 (column 1)- bullet – All *impoundments*…

Does this apply only to human impoundments, or also those caused by beaver activities, substantial debris dams, and/or geological events, such as landslides or subsidences?

22193 (col. 2) – Use of the term *gradient* – is appropriate, and should be linked to our review of the science report diagram of gradients.

22193 (co. 3) – *Groundwater* is expressly excluded as a water. (Same as in rule itself:

22251(col. 1) – In this section on *vernal pools*, there is emphasis given to Western vernal pools, with accompanying citations. Eastern vernal pools seem to get short shrift, so additional literature should be included for this type of water.

22263 Sec. 328.3 Definitions – (b)(5)(vi) – Groundwater…)

This seems ill-advised because of the likely connectivity of surface flows into features such as karst sinkholes, with a potential to contaminate groundwater aquifers used for human water supplies, plus the possibility of reconnections to surface water a reasonable distance away.

22263 – *adjacent, riparian area, floodplain, tributary*

I concur with the definitions provided for the above terms. However, from 22199 (bottom column 2), I recommend including the additional description …"the term "adjacent" to includes waters located within the riparian area or floodplain of a water …". This clarifies that these waters are jurisdictional by definition without need of demonstrating a significant nexus.

General comment: Although burdensome, for consistency between the science report (and our committee's recommendations) and the proposed rule, revisions to the science report should be substituted for the text of Appendix A. For example, this will remove confusing terms such as unidirectional and bidirectional wetlands, and provide updated literature, which provides further evidence of connectivity to downstream waters.

Dr. Kurt Fausch

Revised Comments by Kurt D. Fausch on the proposed rule:
"Definition of 'Waters of the United States' Under the Clean Water Act"

I read the proposed rule published in the Federal Register, and focus my comments specifically on the portions that addressed tributaries to the Nation's waters, and on how these affect biological integrity of downstream waters. These are my areas of particular expertise.

Background:

The purpose of this rulemaking is to clarify and simplify the determination of which waters "possess a significant nexus" to the navigable waters of the U.S., and are therefore under the jurisdiction of the Clean Water Act (CWA). 'Significant nexus' was further defined by Justice Kennedy as waters that either alone or in combination with similarly situated waters significantly affect the chemical, physical, or biological integrity of navigable waters that are downgradient and downstream.

The standard of significantly affecting biological integrity **-** In the context of the CWA, biological integrity was defined in the early 1980s as the ability to support and maintain "a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region" (Karr and Dudley 1981; see also Karr 1991, Karr and Chu 1999).

Therefore, human actions that degrade or fragment habitat in tributaries, adjacent waters, and other waters and, in doing so, alter the species composition, diversity, and functional organization of the assemblages of aquatic and semi-aquatic biota in navigable waters under the jurisdiction of the CWA then meet the definition above of significantly affecting the biological integrity of the nation's waters. Given unlimited time and funds, this would be the ultimate test of the biological integrity standard – that altering habitat in, or connections to, these tributaries, adjacent waters, or other waters, significantly affects the composition, diversity, or functional organization of biota in covered waters.

Question 1: *The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.*

Response: Overall, there is abundant scientific evidence published in the peer-reviewed literature, as reviewed in the EPA Connectivity Report[1] that was evaluated by this SAB panel, to support the rule that tributaries as category of waters strongly influence the chemical, physical, and biological integrity of downstream waters. Although the SAB commented that connectivity can vary among streams, the consequences of this connectivity for the physical, chemical, and biological integrity of downstream waters are sufficiently strong that streams can be justifiably viewed as a category.

[1] *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (EPA/600/R-11/098B, September 2013, External Review Draft)

Much of the focus in the Connectivity report, the proposed rule, and comments on it by some reviewers was on the hydrological connections and their consequences for moving sediment, nutrients, and contaminants downstream. However, in their response to the EPA Connectivity Report, the SAB emphasized that effects on biological integrity can often be by organisms *moving up-gradient into tributaries to use habitats that are critical to sustain their populations*, perhaps only at certain times of year or when water flows.

Biological organisms are uniquely adapted via natural selection to use all habitable portions of waterways, including ones that are ephemeral, and may move against flow to do this. For example, larval fishes in intermittent and ephemeral streams of the Great Plains drift downstream from source areas and rear in off-channel backwaters that form only after rainstorms and later dry up (Falke et al. 2010a, 2010b). Juveniles of economically-important Chinook and coho salmon in a short Oregon coastal river move laterally into tidal marshes to feed and grow during summer and into the tiny headwater tributaries of these marshes to rear during winter, even though these headwater tributaries then dry up during summer (Bottom et al. 2005; Jones et al. 2014). Diking of these tidal marshes before the 1960s virtually eliminated several life-history types of each species, and removing the dikes has since then restored them. These unique life-history types of salmon are likely critical to the resilience of these populations (Bottom et al. 2011). Indeed, Oregon coast coho salmon are listed as threatened under the Endangered Species Act. The key role of these very small and sometimes intermittent habitats in sustaining the biological integrity of downstream waters is one of many reasons that tributaries as a category should be “jurisdictional” waters.

Overall, I found that the rule was written clearly, and identified the specific conditions by which these tributaries affect the biological integrity of downstream streams and rivers. In Appendix A, I found that these connections were well supported by relevant examples from the primary scientific literature, although I would urge the EPA to consider the comments of the SAB panel on this report.

In summary, with regard to the information supporting the assertion that tributaries as a water body type are connected to downstream waters and significantly affect their physical, chemical, and biological integrity, the rule is clearly written and this assertion is well supported by the scientific literature.

Concerns by other reviewers about including tributaries as a class:

I found that I disagreed with several statements in the initial response by Dr. Josselyn

“*The Draft Science Report cites a number of studies that focus on headwater streams, but usually within the third or fourth order, not the first or second that would be covered by the Proposed Rule definition.”*

“The Draft Science report found only two studies that included first order streams in their analysis.”

These statements in Dr. Josselyn’s response are not true, and I disagree with them. Many references in the report and the additional references cited by the panel include 1-2nd order streams (e.g., see review by Meyer and Wallace 2001, cited there). As panelist Dr. David Allan pointed out, most research on stream ecology on which much of the report is based has been done on small streams. Connectivity has been well studied and documented in these streams. I also disagree with the point made that effects on downstream systems are lowest and minimal from these small streams, because they must be considered in the aggregate as a cumulative effect.

I also disagreed with several statements in the initial response by Dr. Murphy:

> *"There is no better way of assessing the impact of a watershed connection than its potential to degrade the water quality of receiving waters or violate water quality standards for those waters. Yet no reference to either water quality standards or the science for setting them appears in the Proposed Rule"*

Although I agree that effects of tributaries on chemical and physical integrity are important, this statement ignores the potential for biological organisms to make connections that are often against the flow, and even overland (e.g., by amphibians), and hence connect tributaries to downstream jurisdictional waters in ways that significantly affect biological integrity.

> *"The scientific significance of these flowpaths is a function of the disturbance scale, which can be measured in the frequency, duration, predictability, and magnitude of the disturbance. The probability of such a disturbance having a scientifically significant disintegrative effect on a downstream ecosystem creates the gradient of connectivity described in the SAB review, as currently used by the ecological sciences."*

Here again, connections made by biological organisms may cause important effects on biological integrity that are outside of the realm of using disturbance ecology via flowpaths to understand "significant nexus" among waters. Many organisms go against the flow.

Additional comments: Several additional comments come to mind:

1. **Converted croplands –** Following on Dr. Aldous's response, I was uncertain about the case where, for example, wetlands or ditches that would previously have been covered waters, before being converted to human use, are then restored. Do these then become covered waters (which would be a good thing)? If so, would this create a backlash so that private landowners would not want to restore them (which would be a bad thing)?

2. **Ditches –** As was pointed out during the SAB teleconference, many ditches in the West divert water from jurisdictional waters, and transport fish and other biota downstream to their terminus, often to their demise. However, in some regions substantial amounts of the water in the landscape are in these ditches, and the intermittent and permanent ones constitute much of the aquatic habitat. They also raise the groundwater in their vicinity, then causing other natural ephemeral channels nearby to flow and become spring streams (e.g., called seep ditches in southeastern Colorado). As a result of the drying of the original streams in the region by diversions or groundwater pumping for irrigation, these seep ditches are used in some cases for reintroducing fishes that are listed as threatened or endangered on state lists, such as the Arkansas darter (see Groce et al. 2011), because they are the best remaining aquatic habitat in the region. As a result of these complexities, I had difficulty determining whether I could agree to excluding ditches as a category, even with the definitions made.

3. **Defining the start of a tributary –** It is clear that this definition will be difficult, as Dr. Mark Rains pointed out. Nevertheless, the inclusion of tributaries as a class is well supported, and I agree that the requirement of the Ordinary High Water Mark should be optional, because of the many cases of spring streams that lack them.

I hope these comments are useful to the standing SAB and the EPA in their efforts to clarify the rule. I commend the EPA on writing a clear and well-supported preamble and rule.

References:

Bottom DL, Jones KK, Cornwell TJ, Gray A, Simenstad CA. 2005. Patterns of Chinook salmon migration and residency in the Salmon River estuary (Oregon). Estuarine, Coastal, and Shelf Science 64:79–93.

Bottom DL, Jones KK, Simenstad CA, Smith CL. 2011. Reconnecting social and ecological resilience in salmon ecosystems. In Bottom DL, Jones KK, Simenstad CA, Smith CL, Cooper R, editors. *Pathways to Resilience: Sustaining Salmon Ecosystems in a Changing World*, 3–38. Oregon Sea Grant. Oregon State University, Corvallis.

Falke, J. A., K. R. Bestgen, and K. D. Fausch. 2010. Streamflow reductions and habitat drying affect growth, survival, and recruitment of brassy minnow across a Great Plains riverscape. Transactions of the American Fisheries Society 139:1566-1583.

Falke, J. A., K. D. Fausch, K. R. Bestgen, and L. L. Bailey. 2010. Spawning phenology and habitat use in a Great Plains, USA, stream fish assemblage: an occupancy estimation approach. Canadian Journal of Fisheries and Aquatic Sciences 67:1942-1956.

Groce, M. C., K. D. Fausch, and L. L. Bailey. 2012. Evaluating the success of Arkansas darter translocations in Colorado: an occupancy sampling approach. Transactions of the American Fisheries Society 141:825-840.

Karr, J. R. 1991. Biological integrity: a long-neglected aspect of water resource management. Ecological Applications 1:66-84.

Karr, J. R., and E. W. Chu. 1999. Restoring life in running waters. Island Press, Covelo, CA.

Karr, J. R., and D. R. Dudley. 1981. Ecological perspectives on water quality goals. Environmental Management 5:55-68.

Jones KK, Cornwell TJ, Bottom DL, Campbell LA, Stein S. 2014. The contribution of estuary-resident life histories to the return of adult *Oncorhynchus kisutch*. Journal of Fish Biology 85:52-80.

Meyer, J.L., and J.B. Wallace. 2001. Lost linkages and lotic ecology: Rediscovering small streams. In: *Ecology: Achievement and Challenge*, eds. M.C. Press, N.J. Huntly, and S. Levin, 295-317. Blackwell Science, Oxford, UK.

Dr. Siobhan Fennessy

Generally speaking I think the USEPA has done an excellent job in drafting the rule. It is based on sound science and will strengthen and clarify the regulatory scheme that protects the integrity of aquatic ecosystems. It is clearly written and its arguments cogently made. However, I was surprised about the release date of the draft rule, and to see that it does not reflect the many suggestions made by the SAB panel to strengthen the EPA Connectivity Report. While I understand the timing of the release is typical, it possibly weakens the value of the SAB process, which is designed to strengthen the scientific basis upon which the draft rule is based. I hope the draft rule can be modified to reflect the work of the SAB panel. A second, related issue is that the report does not use the connectivity gradient framework that was suggested by the SAB panel. Establishing the framework early in the draft rule would aid in the discussions about what constitutes a significant degree of connectivity, which could help define jurisdictional waters.

Q1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

I fully support this definition of tributaries as Waters of the U.S. in the draft rule. It is based on sound science (as reflected in the Connectivity and SAB Pane reports) and provides a clear and defensible policy acknowledging that tributaries, by definition, are connected to navigable waters. This recognizes their role in transporting sediment and organic matter, processing nutrients and other chemicals, and providing habitat whether or not flows are perennial. The Connectivity Report is used as a basis for this definition, where the draft rule states, "The Report concludes that the scientific literature clearly demonstrates that streams, regardless of their size or how frequently they flow, strongly influence how downstream waters function." One concern is that the Connectivity Report (Report) and the draft rule use different definitions of "tributary;" this may create unnecessary confusion as the Report is relied upon as the scientific basis of the proposed rule. The Report defines a tributary simply as:

"a stream or river that flows into a higher-order stream or river,"

while the definition in the draft rule is:

"The term tributary means a water physically characterized by the presence of a bed and banks and ordinary high water mark, as defined at 33 CFR 328.3(e), which contributes flow, either directly or through another water, to a water identified in paragraphs (a)(1) through (4) of this section. In addition, wetlands, lakes, and ponds are tributaries (even if they lack a bed and banks or ordinary high water mark) if they contribute flow, either directly or through another water to a water identified in paragraphs (a)(1) through (3) of this section. A water that otherwise qualifies as a tributary under this definition does not lose its status as a tributary if, for any length, there are one or more man-made breaks (such as bridges, culverts, pipes, or dams), or one or more natural breaks (such as wetlands at the head of or along the run of a stream, debris piles, boulder fields, or a stream that flows underground) so long as a bed and banks and an ordinary high water mark can be identified upstream of the break. A tributary, including wetlands, can be a natural, man-altered, or man-made water and includes waters such as rivers, streams, lakes, ponds, impoundments, canals, and ditches not excluded in paragraph (2)(iii) or (iv) of this definition."

The lack of specificity in the Report's definition may be problematic since it does not make clear that the full extent of the tributary network is included (e.g., headwaters, perennial/ephemeral/intermittent streams), and so the Report does not clearly support the draft rule.

I welcome the clarification that tributaries includes headwaters, and tributaries do not lose their status due to man-made or natural breaks. I also support the clarification that wetlands at the head of a stream (headwater wetlands) are included in the definition (P. 22203). This is very clearly supported by the available literature and the Report, which concludes that wetlands can (for instance) be important water sources, habitats, and exporters of organic carbon.

The draft rule asks for comments about whether wetlands that connect tributary segments and adjacent wetlands should be considered tributaries (noting that tributaries have beds, banks and OHWM), or are they best considered jurisdictional as adjacent waters. To keep the definition of tributary as clean as possible, I recommend that wetlands be removed from the definition of tributaries. Typically they do not have the features used to define tributaries (bed, banks, and OHWM). Basing their jurisdiction on adjacency is more clear, and removes ambiguity about the interpretation of what is a tributary. Wetlands that connect tributaries or sit at the top of headwater streams (headwater wetlands) would remain jurisdictional.

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

I support the definition of "adjacent waters" as Waters of the U.S. in the draft rule, and the change from the more limited inclusion of "adjacent wetlands." The definition recognizes the importance of adjacent waters to the chemical, physical, or biological functions of other waters (defined as (a)(1) to (a)(5) water bodies). The term "neighboring" is used as a means to determine adjacency. The draft rule includes definitions of "riparian area" and "floodplain" to define the lateral reach of what is "neighboring." This seems reasonable, but again relies on how the riparian areas and floodplains are identified on the ground.

Adjacent (neighboring) waters can also be defined by having a shallow subsurface hydrologic connection to a jurisdictional water (which is vaguely defined as water within or below the root zone (12") of the soil, p 22208). The draft rule goes on to say that the strength of the connection, and the determination of neighboring (adjacency), can be assessed by the distance (proximity) between water bodies and jurisdictional waters. While in some circumstances distance can serve as a proxy for the degree of connectivity, it may also be misleading, for example in considering the movement of biota (which varies temporally and by species), or the variability in water flows through shallow subsurface connections (due for example, to the availability of water, or the nature of the substrate). The definition of adjacent waters should not rest solely on either 1) geographical proximity (as suggested on p. 22209) or 2) a hydrologic connection. In particular, the movement of biota as a means to establish connectivity should be acknowledged. Limiting the definition of connectivity only to hydrologic connectivity ignores a wealth of literature, and the findings of both the Connectivity Report and the SAB report that discuss the integrated nature of physical, chemical and biological connectivity – as Justice Kennedy stated, we should consider a functional definition of how connectivity 'benefits the chemical, physical and biological integrity of the Nation's waters.' The SAB report makes many suggestions on incorporating the four dimensions of connectivity into an integrated landscape view of 'riverscapes' to aid in our understanding of waters in riparian and floodplain settings. Implementing this will require metrics for chemical and biological connectivity.

The definition of 'riparian' is problematic as it is based (once again) on hydrologic flows and not the host of other functionas that riparian areas provide. The SAB report contains extensive comments on the role of riparian zones in temperature regulation, carbon export, etc.

Finally, there are inconsistencies in how riparian/floodplain waters are described, for example by referring to them on p. 22224 as "bidirectional." The SAB panel clearly disagreed with the terms unidirectional and bidirectional, stating, " these terms do not adequately describe the four-dimensional (longitudinal, lateral, vertical, and temporal) nature of connectivity, and the SAB recommends that the Report use more commonly understood terms that are grounded in the peer-reviewed literature."

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this propose.

This definition of other waters works conceptually, and it acknowledges the cumulative effects of wetlands and other waters on downstream water integrity on a watershed basis, but I wonder how it will be put into practice. Defining waters that, 'either alone or in combination with other waters similarly situated in the region significantly affect the chemical, physical, or biological integrity of waters of the U.S. in a way that is more than speculative or insubstantial', will need substantial guidance to operationalize its implementation in the field. When is an effect more than speculative or insubstantial? Adopting the framework suggested in the SAB Panel report would help address this by recognizing the gradient of connectivity and where thresholds may be crossed. And while evaluation of 'other waters' on a case-by-case basis (with no specified criteria) does not further the goal of providing regulatory predictability, in some cases the BPJ of agencies in the field will have to be relied upon. This again will require the development of methods to determine when a nexus is significant, including metrics based on hydrologic, chemical and biological connectivity. As it stands now, the draft rule stresses hydrologic connectivity with little recognition of other vectors of connectivity such as the movement of biota. A key question is where, along the gradient of connectivity, do the effects of other waters become significant?

Basing the definition on similarly situated waters, and their cumulative contribution to the integrity of downstream waters, is a sound approach. It is well established that wetlands that share a common hydrogeomorphic setting have similar functions and make similar contributions to downstream waters. I also support the recognition in the draft rule that other waters that lack 'bidirectional hydrologic exchanges' can have important effects on the integrity of downstream waters (pg 22223), however this should be reflected more fully in the working definitions provided.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.

There are several problematic exclusions. Removing a selection of ditches from jurisdiction includes those that are excavated in uplands, drain uplands, but presumably drain into jurisdictional waters (which begs the question, where do they drain to?). For example, the exclusion of "ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow" might apply to much of northwestern Ohio, which is notoriously flat, so much so that it is difficult to move water off the land. When they do flow, they move water and much agricultural run-off to Lake Erie, resulting in this summer's HAB and the loss of drinking water Toledo and surrounding areas. These ditches clearly have an effect on downstream water quality (in the broad sense).

The exclusion of gullies and rills is also problematic. These are noted at several points in the draft rule as important conduits for moving water between jurisdictional waters, making them an important form of hydrological (and other types of) connectivity. Page 22210 says that "Examples of confined surface water hydrologic connections that demonstrate adjacency are swales, gullies, and rills. The frequency, duration, and volume of flow associated with these confined surface connections can vary greatly depending largely on factors such as precipitation, snowmelt, landforms, soil types, and water table elevation. It is the presence of this hydrologic connection which provides the opportunity for neighboring waters to influence the chemical, physical, or biological integrity of (a)(1) through (a)(5) waters." The draft rule goes on to say that they are important in "fill and spill" waters, where flows spill from other waters/wetlands through gullies to stream channels (for example). It isn't clear how or why gullies that link two jurisdictional waters can be excluded.

Dr. Michael Gooseff

Preliminary Written Comments on proposed new EPA CWA rule.

13 August 2014

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank*)

This is a reasonable linkage to make. We generally understand that headwaters flow into higher order, larger streams and eventually into rivers, moving down the river network. This obvious connectivity directly implies that the degradation of any point of the network will cause some change to the downstream parts of the network, where the covered waters are found. The converse is also true – that the improvement of quality of tributaries can also improve the quality of downstream waters. The condition of a stream or river is not solely a function of tributary conditions, but upstream tributaries provide the greatest amount of stream flow (and dissolved and suspended material loads) to downstream waters, and therefore, tributaries are generally accepted to have a significant influence on downstream conditions.

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan*)

The qualification of neighboring water bodies to covered waters is reasonable. It is rare, if ever, to find no connection between the covered water body and those that are within the riparian zone or floodplain of the water body. One challenge here, however, is that the reference to floodplains and riparian zones ultimately infers connectivity of a stream or river to water bodies within these adjacent regions. A reasonable question to ask is to what similar extent should other water bodies (e.g. lakes) have significant nexus with neighboring water bodies? Lakes, for example, may have a definable riparian zone, but rarely have "floodplains" or high water marks that induce such a dynamic change in stage and width of the surrounding area as the floodplains of streams and rivers. While great size is not necessarily a requirement of such consideration, it seems likely that the typical geomorphic position of lakes (as low points in the local area) lend themselves to physical connection via defined surface flow or shallow subsurface flow to neighboring water bodies (streams, ponds, wetlands, etc.). Biological connections are perhaps more likely among neighboring water bodies and non-stream or river waters as different water bodies may provide different habitat conditions for different life stages, prey communities, etc.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emily Bernhardt and Michael Gooseff*)

I interpret this to mean that the other waters are those that are not neighboring. When this is the case, it seems the significant nexus concept provides two extreme opportunities to determine jurisdiction of a single other water body under the CWA – 1) assume all other waters are under jurisdiction of the CWA until otherwise proven to have no significant nexus [though may have some nexus regardless], and 2) assume all other waters are not under the jurisdiction of the CWA until otherwise proven to have a significant nexus to a covered water body. The approach of the new rule provides a reasonable intermediate, that a case-specific assessment must be made to determine whether and what sort of nexus may exist between the water bodies (physical, chemical, and/or biological), and how significant the nexus is. Connections between other water bodies and covered waters may be infrequent and may be invisible at the surface because of a groundwater-mediated exchange of mass and energy between the water bodies. This may indeed prove to be either significant or less than significant after assessment. In my opinion, the case-specific analysis still provides the opportunity for the determination to go either way, rather than de facto categorization (the two cases suggested above) that would have to be overturned to determine the true state of the other water body. Ultimately, the variety of these water bodies and the potential connection types, strengths, and frequencies will determine both whether and how significant any connection could be. This variety of possibilities makes it difficult if not impossible to broadly categorize connection type and significance.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (*lead discussants are: Drs. David Allan and Mark Rains)*

The determination of waste treatment systems, converted cropland, upland ditches with no direct connection to a covered water body, reflecting pools and swimming pools, ornamental waters, and rills and gullies, and water-filled depressions from construction activities as specific exclusions of the CWA jurisdiction seem reasonable to me. I question two of these exclusions in part – 1) artificial lakes and ponds and 2) groundwater. Firstly, I recognize that artificially generated stock ponds, irrigation ponds, settling basins, or rice ponds are generated for specific anthropogenic and utilitarian reasons. However, assuming de facto that they have no connection to a downstream water without any assessment is an over simplification of most systems. What happens when any of these artificial water bodies over flow? A low frequency connection between these water body types could occur via a direct surface connection. The flux of material (solutes, sediment, etc.) may impair the receiving water body, thereby degrading the physical, chemical, and/or biological status of the receiving water, even if temporary. I am not sure of a solution to this issue, but it seems that these are likely to be similarly situated to other water bodies that may be considered adjacent without being considered to be neighboring and a case by case analysis of these may be warranted for similar reasoning. Secondly, I generally agree that groundwater, sourced from infiltration at locations distal to the covered water body is reasonably out of jurisdiction of the CWA, particularly because groundwater is regulated separately. However, it is well recognized that one often found connection between water bodies is that of a shallow subsurface flow path. Is infiltrating surface water considered groundwater or not? This is a reasonable question to debate. Hyporheic zones of streams and rivers are characterized by a mixing of two waters: surface water and groundwater. But if the surface water has left the channel by following hydraulic gradients that force it into the subsurface, is it still surface water? How long does it need to be in the subsurface to become groundwater? Infiltrating surface water carries with it the energy (i.e., temperature), chemical, and biological signatures that it had at the surface, and some of these change quickly and some change slowly in response to reactions with subsurface constituents, interactions with microbial communities, redox gradients that drive chemical species change, and mixing with groundwater (in this case, water that infiltrated from precipitation distant from the water body and floodplain and has been slowly transported through an aquifer or series of aquifers to the subsurface vicinity of the surface water body). In the case of hyporheic ***exchange***, at least some proportion of the water that left a stream channel will come back to the channel, but it will have different chemical, thermal, and biological signatures than it did when it left the channel. My sense is that some hydrologists would consider this exchanging surface water to be groundwater as soon as it leaves the channel. Is it possible to differentiate groundwaters or define a threshold of residence time in the subsurface that qualifies exchanging surface water to be surface water in the subsurface, and ***not*** groundwater?

Dr. Judson Harvey

Jud Harvey, USGS, Comments on EPA Proposed Definition of "Waters of the United States"

1. This reviewer suggests clarifying in the proposed technical definition of a tributary that tributaries have definable bed and banks and evidence of a high water mark **or other evidence of surface flow**. Variable contributing areas (VBAs) have long been recognized scientifically as the principal source of surface water runoff to headwater channels during and immediately following storms. The concern is that because VBAs may not necessarily have bed for banks, and may not necessarily have easily recognizable high water marks, and that they may not always exhibit the three characteristics normally associated with a jurisdictional wetland. Thus VBAs may not be deemed jurisdictional despite their well understood role in collecting and concentrating rainfall and shallow subsurface flow and generating shallow surface flows that transfer the waters downstream in ways that ultimately exert a strong influence on discharge and water quality of navigable waters. These areas deserve careful consideration in the definition of tributaries (through the suggested amendment of the definition shown in bold above.)

2. The technical definition of wetlands "adjacent" to navigable waters used in the proposed rule is not well defined in a manner that can accomplish the stated objective of creating "bright line" distinctions between jurisdictional and non-jurisdictional settings. This reviewer suggests clarifying the boundaries of adjacency and its relation to the term "floodplain wetlands" used in the SAB technical review document. Using "adjacency" as a criterion has the advantage of identifying wetlands that EPA clearly means to be jurisdictional (e.g. wetlands located directly upstream of a tributary channel head) that may not meet the definition of "floodplain" wetlands because such areas typically lack clear evidence of sediment erosion and accretion. However, using adjacency as a criterion has the disadvantage that it offers little useful guidance for defining the outer boundaries of adjacency. On the other hand, using floodplain extent as a useful boundary for defining adjacency is problematic as well since the spatial extent of floods varies with the timescale of flooding across the spectrum of intra-annual floods to floods with return periods of many centuries.

3. Suggest clarifying in the proposed technical definition the possible relation between ephemeral tributaries, which are proposed to be jurisdictional, and natural swales, which presently are not proposed to be jurisdictional unless they meet the strict definition of a wetland and the test of adjacency or significant nexus. Portions of natural swales often are located directly upstream of tributary channel heads often become saturated and generate overland flow during storms that creates flow in perennial streams, rivers, and downstream navigable waters. These areas have been described in the scientific literature for more than fifty years and are summarized in the SAB technical review of the EPA connectivity document as "variable contributing areas", i.e., VBAs. On page 22219 EPA asks for guidance on the possible jurisdictional nature of such swales. This reviewer suggests that the subset of swales that generate surface flow into headwaters during "typical" storm conditions, e.g. rains of intensities exceeding 0.25 inches per hour, are principal generators of the flow in headwater streams and have a major influence on hydrological and chemical conditions of headwaters and should be

considered for inclusion as part of tributaries (see bold text suggested for addition to tributary definition in point 1 above). Such inclusion is well supported by watershed science.

4. Suggest clarifying in the proposed definition why manmade ditches must have to have perennial flow to be jurisdictional whereas tributaries only must have ephemeral flow. On page 2203 the EPA seeks guidance on the appropriate flow requirements for a ditch located wholly in uplands to be jurisdictional. In particular it would appear that ditches with intermittent flow would supply considerable water, sediment, nutrients, metals such as zinc from tire wear, etc. to headwater streams and there would appear to be no reason such features should not be considered jurisdictional. Although it is true that there is only a relatively small literature on hydrological and chemical effects of manmade ditches the list is growing and is summarized in the SAB technical review of the EPA connectivity document.

Dr. Lucinda Johnson

Lucinda Johnson comments to Draft Rule

I wish to commend the authors of the proposed rule for drafting a document that largely reflects the existing science and do not expand the regulatory authority of the EPA unnecessarily. The proposed rule protects precious aquatic resources and acknowledges the important ecosystem services that are provided by waters, alone or in aggregate. One of the important features of the rule is the definition the term "significant nexus", and the acknowledgement that a connection can exist along a gradient. *("The relationship that waters can have to each other and connections downstream that affect the chemical, physical, or biological integrity of traditional navigable waters , interstate waters, or the territorial seas is not an all or nothing situation. The existence of a connection, a nexus, does not by itself establish that it is a "significant nexus."* ***There is a gradient in the relation of waters to each other****, and this is documented in the Report."* The existence of a gradient is an important component of the SAB panel's findings.

Questions

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank*)

This definition is completely consistent with the science, the conclusions of the draft report and the SAB panel findings. It is significant that this definition includes wetlands, natural, man-altered, or man-made waters that contribute flow to "water of the U.S." and that breaks such as bridges, culverts, pipes and dams) do not change the status of those waters. Streams that disappear underground as a function of human alteration or natural geology must retain their protection as they clearly contribute to the integrity of the tributaries to which they connect above-ground, and to the integrity of the downstream waters.

As noted in the SAB review report, the scale of maps used to define tributaries is a critical consideration, as the vast majority of ephemeral streams that meet the criteria of having a bed and bank and ordinary high water mark may not be depicted on most existing maps. It is critical that the appropriate agencies continue to invest in high-resolution mapping products that will facilitate the identification of these waters without on-site inspection.

Regarding the exclusion of two types of ditches: Exclusion of "Ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow", may be problematic because many such ditches now drain areas that previously would have qualified as wetlands under the Cowardin system (e.g., Midwestern U.S.). Such ditches now drain uplands, and may not experience perennial flow, but rather, may pond water without flow except under heavy precipitation events or during snowmelt, or may contain water and flow only during wet conditions. Because such ditches exist in heavily agricultural areas which are subject to runoff containing high concentrations of sediments, nutrients, and pesticides, these features may be important for certain ecosystem services such as attenuation nonpoint source pollution. It may be necessary to define a category of ditch that is embedded in a landscape that was previously flooded, but is now considered upland. Historical evidence of "upland" status should include historic reconstructions from surveyor's notes.

Exclusion of ephemeral features located on agricultural land that do not possess a bed and bank due to past farming practices seem to grant an unnecessary and potentially harmful exclusion and should be reconsidered. Because of the relative ease in which tile drains can now be installed, ephemeral channels without a bed and bank could easily be eliminated from jurisdiction. When ephemeral channels within farm fields are tiled, these waters deliver nutrient and pesticide-laden waters directly to downstream waters and increase flashy flows by reducing infiltration potential. Increased flows increase erosion and along with increased nutrients and pesticides, degrade water and habitat quality and biotic integrity of downstream waters.

The science, the EPA report, and the SAB panel all support the definition of headwater wetlands as jurisdictional, whether they are regarded as a tributary or under the definition of adjacent waters. To provide clarity for the definition, the inclusion of such wetlands as jurisdictional under the definition of "adjacent" waters seems the most practical, while still affording the protection necessary for these features. To further clarify this definition and afford protection to the full population of wetlands in this category, the definition of such wetlands should be based on the Cowardin classification rather than necessitating the presence of all three components of the Cowardin definition. If the agency is not able to apply this expanded definition to this class of wetland, it should maintain the current definition of headwater wetlands as tributaries, which entails defining such water bodies through their location in the network, rather than through their physical structure as possessing a bed and bank and OHWM. That said, the presence of extensive biological connections between these headwater wetlands and downstream jurisdictional waters should be sufficient to establish a "significant nexus". As discussed extensively by the EPA's SAB panel, the presence of biological connections should be considered equivalent to hydrologic connections. Such biological connections can be direct, e.g., through movement along corridors connection the wetlands to downstream flowing waters; they also can be more indirect, through microbial processes that alter nutrients, thereby sequestering them in sediments or in the food chain, or converting them to alternate forms.

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan*)

See comments on headwater wetlands above.

This definition is well supported by the science, the EPA report and the SAB's panel review. In particular it should be noted that the vast majority of waters that are adjacent to jurisdictional waters have with a shallow subsurface connection, or a biological connection that would quality as a "significant nexus". I did not see the term "shallow subsurface" defined in the rule document. This should be added to the set of definitions to ensure consistent application of this concept.

The agency is requesting comments regarding options for providing clarity for connections through confined surface or subsurface hydrology. "Options could include:

1. asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance;
2. asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone of a jurisdictional water;

3. considering only confined surface connections but not shallow subsurface connections for purposes of determining adjacency;
4. establishing specific geographic limits for using shallow subsurface or confined surface hydrological connections as basis for determining adjacency, including, for example, distance limitations based on ratios compared to the bank-to-bank width of the water to which the water is adjacent."

I feel that the only practical, and scientifically valid choice is # 1. The science supports the contention that waters outside the riparian zone and floodplain connected via shallow groundwater connections OR biological connections can be significant, thus # 2 is not a reasonable option. (Note the references contained in the SAB panel report for support of the biological connection argument.) Similarly, the science strongly supports the contention that shallow subsurface connections are important to the chemical and physical integrity of downstream waters by contributing to baseflow, influencing chemical and biological processes. There is a vast scientific literature on the hyporheic zone on this topic. Finally, geographic limits do not seem like a practical option since the importance of these is likely to vary seasonally and over periods of low to high moisture regimes. Furthermore, the distance criterion would not account for differences in permeability and hydraulic gradient between the channel and source areas. Highly permeable sediment may contribute flow over longer distances than nearby areas with less permeable sediments.

Tools that can be used to quantify the contributions (or at minimum the presence of connections) between areas with shallow subsurface flows include chemical analysis of ions or isotopes to assess chemical signatures of the two water bodies. Since biological connections are not addressed in this portion of the rule, but are deemed important by the SAB panel, these connections also should be considered. Analysis of the biological communities and food webs (with appropriate genetic markers) may reveal the extent of biological connections.

Consideration of connectivity via the definition of adjacency through a shallow subsurface connection appears to contradict the statement "Waters located near an adjacent water but which are not themselves (independently) adjacent to an (a)(1)through (a)(5) water would, under the proposed rule, not be regulated under(a)(6). However, waters, including wetlands, that are adjacent to a wetland that meets the definition of a tributary would be considered adjacent waters." This condition must be examined through the lens of the presence or absence of a shallow subsurface connection for this determination to be made. In the absence of a shallow subsurface connection, a biological connection should be considered as per the SAB panel recommendations. As the SAB panel has noted, biological connections contribute in many significant ways to the integrity of downstream waters through transport of energy, nutrients, introduction of disease vectors, and provision of habitat for biota *("…the bulk exchange of materials via biota, e.g., energy (Lowe et al. 2005; Norlin 1967; Mason and MacDonald 1982; Polis et al. 1997; Sabo and Power 2002; Baxter et al. 2005; Spinola et al. 2008; Pearse et al. 2011); the movement of nutrients by biota (McColl and Burger 1976; Johnston and Naiman 1987; Davis 2003; Vrtiska and Sullivan 2009); the introduction of disease vectors (Blanchong et al. 2006); and the provisioning of habitat essential for biological integrity and completion of life cycles of downstream species (Brooks et al. 1998; Miyazano et al. 2010; Julian et al. 2013).*" Pg 53 SAB panel report.

Similarly, the statement "It is the presence of this hydrologic connection which provides the opportunity for neighboring waters to influence the chemical, physical, o0r biological integrity of (a)(1) through (a)(5) waters." Does not account for the possibility of significant biological connections, whose importance and existence is noted above.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emily Bernhardt and Michael Gooseff*)

"Other Waters"
Based on the science and the SAB's panel findings, consideration must be given to both the presence and the absence of a significant hydrologic connection; furthermore, biological connections must also be considered in the criteria to establish a "significant nexus" (see comments and citations for CQ2). Biological factors that might be added to the potential criteria (i.e., increasing size and decreasing distance, increased density of the "other water" in similarly situated areas) might include evidence of genetic similarity in key biotic assemblages; evidence of transfer of biotic materials (e.g., propagules, disease vectors) among "other waters, similarly situated), evidence of biota (that contribute to biological integrity of downstream waters) that require the downstream waters to complete their life cycle (life cycle dependency). The science suggests that some non-resident migratory species may significantly influence downstream waters (a)(1)-(a)(3) waters through a significant transfer of disease vectors, nutrients or biomass (*e.g., energy (Lowe et al. 2005; Norlin 1967; Mason and MacDonald 1982; Polis et al. 1997; Sabo and Power 2002; Baxter et al. 2005; Spinola et al. 2008; Pearse et al. 2011); the movement of nutrients by biota (McColl and Burger 1976; Johnston and Naiman 1987; Davis 2003; Vrtiska and Sullivan 2009); the introduction of disease vectors (Blanchong et al. 2006); and the provisioning of habitat essential for biological integrity and completion of life cycles of downstream species (Brooks et al. 1998; Miyazano et al. 2010; Julian et al. 2013)*." Pg 53 SAB panel report) in addition to the examples listed.

It is exactly true that the determination of these waters may be resource-intensive. Thus it would behoove the agencies to establish a set of baseline criteria that would enable a hierarchically structured decision framework that would first establish the potential for hydrologic connections via surface, shallow subsurface, or groundwater flowpaths. The SAB panel recognized that such connections occur across a gradient that varies through time. Yet hydrologic modeling and / or spatial modeling in conjunction with satellite remote sensing and aerial photography may provide the basis for determining the presence of physical connections over time frames that include long duration wet regimes (c.f. Winter and Rosenberry 1998). Such an empirical depiction of "connected" landscapes could form the starting point for further assessments that would be followed by more rigorous analyses of subsurface flow paths, and subsequently biological studies that would establish whether the observed connections meet the standard of a "significant nexus". While the SAB panel recognized that over space and time most water bodies are connect, they acknowledged that such connections may not significantly affect the integrity of jurisdictional waters (a)(1) – (a)(3) and thus would not meet the standard of a "significant nexus".

Determine by rule that ''other waters'' are similarly situated in certain areas of the country.
Response: Ecoregions are not appropriate spatial units over which to determine the issues of whether or not a region is deemed to be "similar". Ecoregions were mainly developed based on terrestrial vegetation communities, in combination with soils and climate. These units are not meant to reflect hydrologic regions. The SAB panel recommended the use of Hydrologic Landscape Regions as a more appropriate base from which to delineate similar regions.

Determine by rule that certain additional subcategories of waters would be jurisdictional rather than addressed with a case-specific analysis, and that other subcategories of waters would be non-jurisdictional.

Response: Some specific wetland types and regions have been sufficiently well-studied to determine that they should be considered jurisdictional, e.g., Prairie Potholes, Carolina bays, coastal prairie wetlands. The agency should accelerate efforts to further establish the basis for such determinations for other classes of waters. I especially suggest that the in addition to western vernal ponds, that vernal ponds on the east coast and the upper Midwest be considered. Recent efforts to map vernal pools in northern Minnesota reveal that the density far exceeds previous estimates.

I do not support the proposal that remaining "other waters" automatically be classified as non-jurisdictional; rather, there should be an established protocol that establish the decision framework for such a decision. The more structured and spatially-relevant this decision framework can be, the fewer resources each case by case determination will require.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (*lead discussants are: Drs. David Allan and Mark Rains)*

I have some concern about the blanket exclusion of the “prior converted cropland” exclusion due to the fact that there is not timeframe defining the term ”prior”, and it is unclear how the EPA would operationalize this definition. The US has lost millions of acres of wetlands to cropland conversion, and losses continue as the technology for installing drain tiles has made it increasingly easy for individual land owners to install drain tiles. Wetlands perform clearly documented roles in holding flood waters, recharging water tables, removing sediments and nutrients, and proving essential habitat for biota that contribute to the integrity of downstream waters. These water bodies perform functions that benefit society at large, and not just the landowner. The collective loss of wetlands has resulted in millions of dollars of direct and indirect economic losses.

Comments repeated from response to CQ 1 above.
Regarding the exclusion of two types of ditches: Exclusion of “Ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow”, may be problematic because many such ditches now drain areas that previously would have qualified as wetlands under the Cowardin system (e.g., Midwestern U.S.). Such ditches now drain uplands, and may not experience perennial flow, but rather, may pond water without flow except under heavy precipitation events or during snowmelt, or may contain water and flow only during wet conditions. Because such ditches exist in heavily agricultural areas which are subject to runoff containing high concentrations of sediments, nutrients, and pesticides, these features may be important for certain ecosystem services such as attenuation nonpoint source pollution. It may be necessary to define a category of ditch that is embedded in a landscape that was previously flooded, but is now considered upland. Historical evidence of “upland” status should include historic reconstructions from surveyor’s notes.

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

Dr. Michael Josselyn

SAB Connectivity Panel
Comments on Adequacy of the Science to Support Proposed Rule
Dr. Michael Josselyn
August 21, 2014

My comments relating to the charge questions focus in three main areas: (1) definitions used in the proposed rule differ from those used in the Draft Science Report and could lead to differences in the interpretation of the science as it relates to the proposed legal definitions; (2) the concept of connection versus the degree of connectivity (e.g. gradient) and its relevance to a determination of significant effect on "navigable waters" needs to be clarified; and (3) the concept of aggregation of similarly situated waters and wetlands needs further analysis in order to inform a Final Rule.

<u>Proposed definition of "waters of the US" to include all tributaries</u>

Definitions

Under the proposed rule, all tributaries of navigable waters would be included as "waters of the United States" and subject to regulation based on their effects on navigable waters. It is important to note that the Draft Science Report utilizes a different definition of tributaries (e.g. streams and rivers) that relies on the presence of flowing water (of varying volume) whereas the Proposed Rule includes any feature that possesses certain indicators of an 'ordinary high water mark'. The indicators used by the Corps and EPA to determine the 'ordinary high water' mark (e.g. natural line on the shore, matted vegetation, sediment sorting) can be observed in very small drainages that are not usually considered in the scientific studies that deal with headwater streams.

These low order features may have flow for only a few hours or days following storm events and are the most likely candidates for being on the low end of the gradient where effects on downstream systems are lowest or minimal. Because of the importance of the issue on the extent of federal jurisdiction in these headwaters, the science needs to be more substantial than currently demonstrated in the Draft Science Report (see comments below). The uncertainty and limits of the scientific knowledge should be discussed related to these features in the Science Report and where information is lacking, it should acknowledged.

Term	Draft Science Report	Proposed Rule
Tributary	"a stream or river that flows into a higher order stream or river"	"a water physically characterized by the presence of a bed and banks and ordinary high water mark, as defined at 33 CFR 328.3(e), which contributes flow, either directly or through another water, to a water identified in paragraphs (1)(i) through (iv) of this definition. In addition, wetlands, lakes, and ponds are tributaries (even if they lack a bed and banks or ordinary high water mark) if they contribute flow, either directly or through another water to a water identified in paragraphs (1)(i) through (iii) of this definition. A water that otherwise qualifies as a tributary under this definition does not lose its status as a tributary if, for any length, there are one or more man-made

Term	Draft Science Report	Proposed Rule
		breaks (such as bridges, culverts, pipes, or dams), or one or more natural breaks (such as wetlands at the head of or along the run of a stream, debris piles, boulder fields, or a stream that flows underground) so long as a bed and banks and an ordinary high water mark can be identified upstream of the break. A tributary, including wetlands, can be a natural, man-altered, or man-made water and includes waters such as rivers, streams, lakes, ponds, impoundments, canals, and ditches not excluded in paragraph (2)(iii) or (iv) of this definition."
River	"A relatively large 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 associated floodplain and riparian areas."	Not defined. However, it is stated that tributaries include rivers and that some rivers are considered "navigable waters".
Stream	"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 with associated floodplain and riparian areas."	Not defined.

The tributary definition in the Proposed Rule also includes other features such as flood control channels, some ditches, underground stormwater drainage works that are not part of, nor discussed in, the Draft Science Report. Presumably such man-made features may alter the functions associated with the tributary or alter the water quality considerably—either beneficially (sediment deposition in reservoirs) or adversely (addition of urban storm water). The Draft Science Report focused on research from natural systems and therefore does not provide sufficient information on which to discuss the role of these man-made features. The Panel recommended that more information be provided in the Science Report on the effect of man-made features on connectivity—either elimination or enhancement of connectivity. In urban environments where water flows are largely in man-made structures, this information will be necessary to support the conclusion that impacts to upstream features not part of the urban infrastructure would have a significant impact on navigable waters, when in fact the urban infrastructure itself is the cause of the impact to water quality.

Connectivity Gradient

Both the Draft Science Report and the Proposed Rule state that "connectivity is the degree to which components of a system are joined, or connected, by various transport mechanisms and is determined by the characteristics of both the physical landscape and the biota of the specific system". The Panel took considerable time to address this issue and acknowledged that for tributary systems there is strong evidence for a high degree of connectivity; however, also recognized that there is a gradient for streams based on frequency, magnitude, and duration of flows. As stated above, the extent of the federal jurisdiction under the Proposal Rule would be based on indicators that can be observed in very small features that may flow for only a few hours or days following a rain event. The Draft Science Report acknowledged that most databases and maps do not portray these features (Page 4-2 lines 32-36). While they comprise a significant percentage of total stream length, the primary differences are that they exhibit very low durations of flow and the frequency between flow events, especially in the arid west, may be measured in years. As a result, while no one would argue that they are not connected via water flow at some time, their function and role in biological integrity of navigable waters should be considered on a gradient.

The Draft Science report found only two studies that compared functions between various stream orders for headwater streams. One composite analysis that reviewed a number of studies found that nitrogen nutrient cycling increased with stream order (Ensign and Doyle 2006). Another study on fish diversity (Harrel *et al*. 1967) showed a direct correlation between higher stream order and fish diversity. Obviously, the presence of microbiota involved in nutrient transformation and occurrence of fish would be directly related to the duration and frequency of flow as would other ecological functions within these very low order drainages. Most of the other studies cited in the Draft Science Report dealt with higher order streams and it is assumed that the processes occurring in these systems also apply to the low (1^{st} and 2^{nd}) order streams. Some Panel members during the August discussion disagreed with this finding and stated that studies for Hubbard Brook Ecosystem Study should be cited. I did not have sufficient time to investigate all reports from this extensive research project; however, the one study that related to stream order found a gradient in the processes studied (Paul and Hall, 2002). Panel members also referred to Dr. Meyer's work small streams (Meyer *et al* 2007). This review paper provided good evidence that headwater streams contribute to downstream biodiversity, but that gradients can and do exist for some biological organisms (e.g. fish). A reference in the Meyer paper also observed gradients among first to third order streams in primary production, invertebrate productivity, and fish (Lotrich 1973).

I was also asked if there were any papers where headwater streams were found not to be important. Confirmation of such a null hypothesis is not generally published and is a known constraint to evaluating the scientific literature. My point during the discussion was not that connectivity has not been demonstrated; but whether such connectivity meets the standard of being more than "insubstantial" and that all tributaries should be jurisdictional "by rule". The charge questions asked if the science is sufficient to reach a conclusion on making all tributaries jurisdictional by rule because they all have an effect on the biological integrity of the navigable waters. I encourage other Panel members and the EPA to provide additional references that reject the null hypothesis that there is no difference in function related to headwater streams. However, if the science demonstrates a gradient in ecological function, there would be some situations in which low order streams, in and of themselves, should have a significant nexus evaluation rather than being assumed.

Aggregation

The Proposed Rule states that "the agencies conclude that tributaries, including headwaters, intermittent, and ephemeral streams, and especially when all tributaries in a watershed are considered in combination, have a significant nexus to traditional navigable waters….and when considered at a watershed scale, the scientific evidence supports a legal determination that they meet the "significant nexus" standard". The Proposed Rule contains no definition of watershed, but does discuss the term "region" as the basis upon which to base the aggregation of similarly situated waters and define the "region" as the watershed of the nearest navigable water. Obviously, this could be a very large area that may drain significant portions of a single State[2]. It would be hard to argue that including all the streams within such a large area in one grouping would not have an effect on the downstream water.

The Draft Science Report states that the "watershed scale is the appropriate context for interpreting technical evidence about individual watershed components" (Page 3-1) and defines a watershed as the area drained by a stream, river, or other water body, typically divided between one water body and another". While this would

[2] The Proposed Rule also states that in the Arid West it may use a 10 digit hydrologic unit code watershed to deal with especially large watersheds; however, this issue may extend to other parts of the US.

include a watershed defined by the point of entry to a navigable water, most of the studies have focused on much smaller watersheds. There is considerable geologic, vegetative, and topographic variation within such a large area and the determination of what constitutes similarity among the tributaries within that region would be difficult. The Panel Report requested that the Corps and EPA "more explicitly address the cumulative effects of streams and wetlands on downstream waters and the spatial and temporal scales at which functional aggregation should be evaluated" and I recommend that this be re-emphasized in our review of the Proposed Rule.

<u>Proposed definition of adjacent wetlands and other "waters"</u>

Definitions

The Panel discussed the issue of the difference between the definitions of wetlands as applied in the Draft Science Report and as regulated under the Clean Water Act and recommended that the EPA consider and explain how the differences between those definitions may affect the interpretation of the science to regulated features. In particular, the wetland definition used in the Draft Science Report is much broader than the wetland definition in the Proposed Rule. It is important to note that the Proposed Rule combines both wetlands (as defined below) and "other waters" as defined by the "ordinary high water mark" as subject to the same interpretation. The Draft Science Report, on the other hand, does not demonstrate, at present, the similarity in function and role that such features have when making its case in using the Cowardin definition. It is necessary that the Draft Science Report provide more scientific documentation on the functional similarities and differences between vegetated wetlands and open waters within floodplains and, in particular, how the scientific literature addresses their role in affecting biological integrity in downstream waters.

Term	Draft Science Report	Proposed Rule
Adjacent	Not defined	Means bordering, contiguous, or neighboring. Waters, including wetlands, separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent waters"
Wetland	An area that generally exhibits at least one of the following three attributes (Cowardin et al. 1979): (1) is inundated or saturated at a frequency sufficient to support, at least periodically, plants adapted to a wet environment, (2) contains undrained hydric soil; or (3) contains nonsoil saturated by shallow water for part of the growing season.	Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
Floodplain	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.	An area bordering inland or coastal waters that was formed by sediment deposition from such water under present climatic conditions and is inundated during periods of moderate and high water flows. In Preamble, it states that the agencies will use "best professional judgment" to determine which flood interval to use (for example 10 to 20 year flood interval zone).
Riparian	Transition areas or zones between terrestrial and aquatic ecosystems that are distinguished by gradients in biophysical conditions, ecological processes, and biota. They are areas which surface and subsurface hydrology	An area bordering a water where surface or subsurface hydrology directly influence the ecological processes and plant and animal community structure in that area. Riparian areas are transitional areas between aquatic and

Term	Draft Science Report	Proposed Rule
	connect water bodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significant influence exchanges of energy and matter with aquatic ecosystems.	terrestrial ecosystems that influence the exchange of energy and materials between these ecosystems.

Connectivity

By definition, all wetlands within the floodplain would be considered jurisdictional under the Proposed Rule. However, there is ambiguity in the definition of floodplain within the Draft Science Report and the Proposed Rule—both of which state that it is an area of sediment deposition and subject to flooding during moderate to high flood events. However, at present, there is no definition of what that flooding frequency means except the brief statement in the Proposed Rule that the agencies will use Best Professional Judgment and generally use something between a 10 and 20 year flood event. In another section, the Proposed Rule also states that "floodplain as defined in today's proposed rule does not necessarily equate to the 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA). However, the FEMA defined floodplain may often coincide with the current definition proposed in this rule." Thus, there is considerable confusion over what the Proposed Rule is stating would be included within the category of floodplain wetlands subject to jurisdiction. Some panel members stated that perhaps best professional judgment is acceptable; however, it would run contrary to EPA's position to provide more certainty to jurisdictional determinations.

This is an area where science could address what is an appropriate degree of connectivity between floodplain wetlands and downstream waters. As the Panel has stated, over long time frames, everything is connected; however, the question for regulators is more limited and focuses on the measureable effects on biological integrity of downstream waters. Flooding frequency is a statistical analysis and should be easily equated to such effects and where the science is available, should be evaluated in the Final Science Report. Otherwise, there will be considerable confusion and uncertainty under the guidance currently contained in the Proposed Rule. I recommend that the Science Panel be charged by the EPA with providing more guidance, based on the scientific literature, how best to approach this issue.

Aggregation

Because all wetlands within floodplains are considered jurisdictional under the Proposed Rule, an analysis of similarly situated wetlands is not required. The change that is proposed is to define "neighboring" such that it would include wetlands with a confined surface water connection or a shallow groundwater connection within the definition of adjacent. The Proposed Rule is requesting further clarification as to what types of connections would suffice to make a determination that the wetland was adjacent to a regulated tributary. The Panel's recommended Conceptual Framework could assist in this determination; however, it does not specifically address the temporal or spatial issues necessary to determine whether the wetland (or "other water") has a significant effect on biological integrity of navigable waters downstream. For example, a groundwater connection may be the result of a very slow infiltration rate and not have any immediate effects to the adjacent tributary. As Izbicki (2007) found for streams in the arid west such connections may be measured in thousands of years. This is an area where science can provide some guidance; however, it may also be an area of uncertainty that the Draft Science Report should recognize.

<u>Proposed rule related to wetlands and "waters" related to case specific analysis</u>

Definitions

The Panel Report found that non-floodplain wetlands can have an effect on the biological integrity of downstream waters as shown in the scientific literature; however, the degree of that effect will vary on numerous factors and should be viewed on a gradient. The Proposed Rule requires a case-by-case analysis for these types of wetlands and proposes a definition for a determination of a significant nexus. The elements included in a significant nexus determination are from the Supreme Court decision and is not necessarily a hypothesis that has been tested in the scientific literature.

Term	Draft Science Report	Proposed Rule
Significant Nexus	Not defined; not considered a scientific term	A water, including wetlands, either alone or in combination with other similarily situated waters in the region (i.e. the watershed that drains to the nearest water identified in paragraphs (1)(i) through (iii) of this definition significantly affects the chemical, physical, or biological integrity of the water. For an effect to be significant, it must be more than speculative or insubstantial. Other waters, including wetlands, are similarly situated when they perform similar functions and are located sufficient close together or sufficiently close to a "water of the United States" so that they can be evaluated as a single landscape unit with regard to their effect on the chemical, physical, or biological integrity of a water identified in the definition.

Connectivity

The Proposed Rule states that a variety of functions would need to be evaluated, including "sediment trapping, nutrient cycling, pollutant trapping and filtering, retention or attenuation of flood flows, runoff storage, export of organic matter, export of food resources, and provision of aquatic habitat". The Proposed Rule presents a number of lines of evidence that can be used to assess such a connection. However, the Proposed Rule focuses on finding evidence of a connection; not evidence that such a connection actually plays a role in affecting the biological integrity of the navigable water in question. The agencies indicate that they are seeking additional information on how to make these judgments especially on how the analysis can be more than just speculative or insubstantial. A section may need to be added to the Final Science Report that addresses what type of connections should be evaluated and the methods by which these connections can be measured. The vagueness of the term "insubstantial" is more difficult to address in the Final Science Report but is an important question that will require quantification on a case-by-case basis. I concur with an approach that is more quantitative as proposed in Dr. Ali in her comments.

Aggregation

The Proposed Rule acknowledges that there are many issues that have not been resolved by the Draft Science Report on how similarly situated wetlands may be addressed and proposes a number of ways to either classify wetlands into various types or to use ecoregions. These aggregations have the advantage of being simple to apply by regulators; however, they are likely not entirely valid from a scientific standpoint. The Panel's recommended Conceptual Model can be very useful in this type of analysis and examined these processes on a watershed approach.

I believe that the scientific literature has been largely organized by watershed analysis and depending upon the size of the watershed, there is a similarity in geology, vegetation types, and flow paths. The appropriate watershed may vary depending upon the geographic region of the country and the topography. The Proposed Rule suggests using the HUC 10 watershed unit in the arid west and this may be appropriate for other regions of the country. Watershed units are also a basis for much of the planning of TMDLs and for wetland restoration and rehabilitation in the US. I do not agree with the concept of "region" as proposed as it is artificial based on the presence of a navigable water and can result in a large area of very different wetlands being aggregated.

I disagree with an option that would categorize certain wetlands as being jurisdictional by rule as this would "freeze" the science, so to speak. Given how difficult it has been to get the rule to this point, I doubt that these would be revisited and as mentioned by some panel members it would be difficult to figure out what categories would be set up and how various types of wetlands within categories would be best represented.

Proposed definitions and exclusions

The proposed exclusions are largely androgenic features which are not addressed by the Draft Science Report. It is not clear, except by precedent, why other features are not also excluded such as stormwater quality basins, bioswales, detention basins, industrial water processing and/or treatment facilities, desalination brine storage basins, cooling systems, oil and gas tank basins, fish farms, rice paddies, and the like. It seems that such facilities, even though water is present, would deserve similar exclusions due to their specific use for water treatment or their isolation from navigable waters. The Panel recommended that the Draft Science Report discuss how human alterations may affect connectivity—either by promoting connectivity or further isolating tributaries and wetlands from downstream navigable waters. However, the Science Report might also discuss how some man-made features are designed to avoid connectivity in order to protect the environment from toxic or polluted water sources that are present in some of these features. The construction of any facility designed to retain, store, pond, treat, or process water used in industrial processes and to assure that such liquids do not enter the environment should be excluded from jurisdiction as a matter of rule.

The exclusion for ditches seems quite narrow. If it is meant to exclude roadside ditches, for example, the ditch must be entirely constructed in uplands and drain only uplands. This could mean that a highway drainage ditch, even though constructed mostly through wetlands, but perhaps impacting wetlands or streams along 1-2% of its length would then be considered a "water of the US". The Draft Science Report did not address this issue as it focused on natural streams and wetlands. Ditches, especially vegetated ditches, can have functions similar to wetlands. Yet to regulate such features would place a considerable burden on public and private landowners and, in some cases, on public safety where these ditches are needed to drain floodwaters.

Other comments/issues

The Panel's recommended Conceptual Model includes surface and groundwater flows as a means to consider connectivity. The Proposed Rule only uses shallow groundwater flow as a means to address jurisdiction under the Clean Water Act, especially between wetland features. The Final Science Report should more fully address differences between shallow groundwater connections and how they are defined.

I understand that these comments are to be appended to a Summary Report on our discussions held on August 20-21st. However, the Summary Report has not been distributed to the Panel members for review prior to submission to the SAB nor is a separate report as was prepared for the Charge Questions related to the Draft Science Report been prepared. Given the importance of the science to the Proposed Rule, the lack of time for deliberate consultation by the Panel members diminishes the value of our expertise in responding to these Charge Questions. Additional time should have been allocated to this process as Panel members were specifically requested during the review of the Draft Science Report to not discuss the Proposed Rule itself.

References

Izbicki, J.A. 2007. Physical and temporal isolation of mountain headwater streams in the western Mojave Desert, Southern California. JAWRA 43(1) 26-40.

Victor A. Lotrich 1973. Growth, Production, and Community Composition of Fishes Inhabiting a First-, Second-, and Third-Order Stream of Eastern Kentucky. Ecological Monographs 43:377–397.

Meyer, J.L. et al. 2007. The contribution of headwater streams to biodiversity in river networks. JAWRA 43(1): 86-103

Paul, M.J. and R.O.Hall 2002. Particle transport and transient storage along a stream-size gradient in the Hubbard Brook Experimental Forest. J.N. Am. Benthol. Soc. 21(2) 195-205.

Dr. Latif Kalin

I think EPA and the Corps have done a fantastic job. I really enjoyed reading it. The proposed rule is written very clearly, is comprehensive and relies on scientific evidence. Obviously, when this draft rule was prepared the SAB's review of the Report was still going on (which is now complete). I would assume and hope that the draft rule will consider many of the recommendations in that review. For instance the SAB review does not recommend the use of the terms unidirectional and bidirectional, yet these terms appear in the draft rule. I will ignore those recommendations and list few of things I realized in the ruling that think need further clarification, improvement or rewording. In few places I disagree with the ruling.

I have seen comments on not enough emphasis on biological connectivity. If there is a clear significant hydrologic nexus, then that water will be considered WOTUS. Additional evidences of significant biological, chemical and physical nexus will only make the case stronger only. Therefore, biological connectivity should be concern for "other waters", where the strength of the hydrologic connectivity is harder to prove. I believe the rule has enough emphasis on biological, chemical and physical connectivity under the "other waters" section.

The two critical areas in the draft rule that need in-depth scrutiny are "other waters of the US" and the "excluded waters".

Below are my specific comments

1. I do not recommend considering wetlands as tributaries. The type of wetlands discussed in the rule (e.g. headwater wetlands) should still be under adjacent water body theme.
2. The report uses the term "artificially irrigated areas". I suggest deleting the word "artificially". Scientifically there is no such a term. Irrigation itself is artificial application of water.
3. On page 22213, last paragraph it is stated that "Functions of waters that might demonstrate a significant nexus include sediment trapping, nutrient recycling, pollutant trapping and filtering, retention or attenuation of flood waters, runoff storage, export of organic matter, export of food resources, and provision of aquatic habitat." I suggest removing "nutrient cycling" and "export of organic matter" from this list. Nutrient cycling happens everywhere. Consider an agricultural field for example. The full N, and P cycles (mineralization, denitrification, immobilization, etc.) always take place. Organic matter can be exported from excluded waters too (e.g. agricultural ditches).
4. Page 22214, middle column: "Information derived from field observation is not required in cases where a "desktop" analysis can provide sufficient information to make the requisite findings." Does the term "desktop analysis" mean analysis with simple tools (usually called screening tools), or computer models. I suggest rewriting this statement.
5. The rule solicits information on whether ecoregions or HLRs could be used in determining similarly situated other waters. For biological connectivity maybe level IV ecoregions could be

used (level III is too coarse), but this is not my expertise. I would say no to the use of HLRs, because it does not have a flowpath framework.

6. The draft rule suggests excluding "Ditches that are excavated wholly in uplands, drain only uplands, and have less than perennial flow." I disagree with this, because it totally ignores potential significant biological nexus.

Dr. Kenneth Kolm

Comments Regarding the Adequacy of the Scientific and Technical Basis of the Proposed Rule Titled Definition of Waters of the United States Under the Clean Water Act (79FR 22188-22274) Submitted on August 13, 2014

I have thoroughly and critically read the Rule and attached documentation, and have noted the text that needs addressing. In order to coordinate the SAB's efforts with the suggested changes to the Rule, i have cross referenced the original EPA Draft Report comments and the current (7-7-14) Draft Report comments with the suggested changes. The comments may appear repetitious, but the appropriate comments will be best determined during the teleconferences.

The broader request make in the Rule is made on Page 22198:

" In addition to the proposed ‘‘other waters’’ approach in this rule, the agencies are requesting comment on a range of alternate approaches to inform their decision on how best to address ‘‘other waters.’’ The agencies will consider the full administrative record, including comments requested and received, and the final Report, as revised in response to the SAB review, when developing the final rule, and may adopt one of the alternative approaches or combination of approaches and the proposal."

This is more difficult to address since these approaches are usually not found in the "refereed literature" due to being too "applied" or not fitting the format of "single-variable" research that is more favored. However, there are approaches that are exactly what the agency is requesting and these approaches with case histories are written up in various Proceedings at State of the Art Meetings. i could provide a listing of these references if the SAB thinks this would help the Rule and Agency. The basis of these approaches are referenced:

"These elements, in context with the HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998)."

The multi-temporal and multi-scale approach is called Hydrologic and Environmental Systems Analysis (HESA) for holistic Conceptual Site Model development, and has been applied to mine and resource development and mined-land restoration, municipal management of groundwater system supply and pollution, watershed and site-scale pollution prevention and Superfund cleanup, and water rights and water quality expert witness and litigation support. The most high profile case history written up in the literature is based on an NSF long term study where the paleohydrologic system of the Anasazi living in the Four Corners Region of the Colorado Plateau was assessed in the context of societal collapse:

Kolm, K.E. and S.M. Smith. 2012. Chapter 5. Modeling Paleohydrological System Structure and Function. In Emergence and Collapse of Early Villages: Models of Central Mesa Verde Archaeology. Edited by T.A. Kohler and M.D. Varien, University of California Press; Los Angeles, CA., pp. 73-83.

Essentially, the collapse of the Ancient One's society was hypothesized to be the connectivity of the surface water and ground water systems and the relation to climate change (drought) and land use. Using HESA and Mathematical modeling, the connectivity of the surface water and ground water systems was established and quantified. However, the hypothesized collapse of the society based on water resources was found to not be true.

HESA is exactly what the agency is calling for in the Rule to determine connectivity or nexus, however, the refereed book that documents the approach is not yet completed for publication.

Questions

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank*)

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Tributaries, even when seasonally dry, are the dominant source of water in most rivers, rather than direct precipitation or groundwater input to main stem river segments.

In the arid and semi-arid lands, this statement is not necessarily true, and groundwater is the dominant source of flow to both tributaries and the main stem river segments. For example, various gaining reaches of the Meadow Creek Wash (Nevada, Las Vegas region, Basin and Range Province) and the Virgin River (Utah, Zion National Park and St. George region, Colorado Plateau Province) sustain the middle and lower reaches of their watersheds. In some volcanic and karst regions, springs and gaining streams are the dominant source of flow for both tributary and main stem river segments. For example, the middle section of the Snake River including the Twin Falls and Boise, Idaho region of the Snake River Plain Province is mostly sustained by groundwater, and various sections of the Green River in Kentucky are sustained in the Karst region near Mammoth Cave National Park. Vast sections of the Rio Grande River and its tributaries in southern Colorado through central New Mexico (Taos, Santa Fe, and Albuquerque) are sustained mostly by groundwater.

In general, the role of regional groundwater systems is not addressed by this Rule and leaves the waters of the US vulnerable. The Rule focuses primarily on the site and subregional scales, perhaps due to the legal aspects. This tends to either ignore or at least downplay the potential significance of regional-scale hydrologic connectivity, especially as it relates to ground water. This is a problem because regional ground water flows commonly interact with the surface environment at sinks and springs. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops (see Sun et al. 1997 and references therein). To provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, the SAB recommends that the EPA also consider using the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996). To better characterize regional-scale ground water connectivity, the SAB recommends that the EPA also consider using findings from the U.S. Geological Survey Regional Aquifer Systems Analysis (RASA) Program. An understanding of regional ground water flow systems is critical to the understanding of four-dimensional hydrologic connectivity on both the local and regional scales. Understanding ground water flow in unique hydrogeologic settings, including the Floridan aquifer system (karst systems), the High Plains aquifer system (semi-arid systems), and the Snake River Plain and Rio Grande Rift aquifer systems (volcanic bedrock systems), is especially important. These and other unique hydrogeological settings are covered by the RASA Program (Sun et al. 1997).

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The agencies are seeking comment on whether it would provide greater regulatory clarity to exclude such wetlands from the definition of ''tributary'' because they generally lack
a defined bed, bank and OHWM.

Wetlands in this landscape are a continuum with the tributary and\or main stem stream, and should NOT be excluded in this context, particularly if the main weg or flowpath is directly through the wetland from one upstream channel to a downstream channel. This goes along with the SAB flowpath concept: "The definition of connectivity in the Report should be extended to the entire landscape through a broad vision of local- to landscape-scale physical, chemical, and biological exchanges."

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan*)

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An alternate approach would be to clarify that wetlands that connect tributary segments are adjacent wetlands, and as such are jurisdictional waters of the United States under (a)(6). In this approach, a tributary would be defined as having a bed and bank and OHWM, and the upper limit of the tributary would be defined by the point where these features cease to be identifiable.
(Note that natural or manmade breaks would still not sever jurisdiction if a tributary segment with a bed and bank and OHWM could be identified upstream of the break.) Wetlands would not be considered tributaries, but would remain jurisdictional as adjacent waters. Wetlands that contribute flow, for example at the upper reaches of the tributary system, would be considered adjacent waters.

This approach would work as well as the straight tributary approach and would split off the geomorphic bed, bank, OHWM measurement scheme to a flowpath analysis scheme. If this adds these wetlands to the jurisdiction, this would be adequate for legal purposes. To clarify the connectivity of wetlands to "waters of the US", the SAB recommends that a conceptual framework be established expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds from top to bottom, and therefore connecting waters and wetlands to downgradient waters. The flowpath framework should highlight the four-dimensional nature of connectivity, because four-dimensional connectivity scaled in a habitat-to-catchment context is a foundational aspect of freshwater ecology (e.g., Ward 1989). The flux and transformation of water, materials, and organisms – which fundamentally control the integrity of downgradient freshwater ecosystems – occur at varying rates primarily determined by climate, geology, topographic relief, and biology and are expressed in terms of surface water and ground water storage and flow through the landscape (e.g., uplands, wetlands, lakes, rivers, and floodplains). Therefore, these flowpaths are inherently four-dimensional (i.e., longitudinal, lateral, vertical, and through time).

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Waters, including wetlands, determined to have a shallow subsurface hydrologic connection or confined surface hydrologic connection to an (a)(1) through (a)(5) water would also be ''waters of the United States'' by rule as adjacent waters falling within the definition of ''neighboring.''

This should be added to the adjacent waters ruling. However, why just "shallow subsurface hydrologic connection"? Why not deep connections as well? "Deep" could include bedrock or unconsolidated groundwater systems, and should include shallow, subregional, and regional systems if these waters proved critical to maintaining the integrity of the "waters of the United States". Examples of this type of adjacent waters ruling should include the case histories of the arid and semi-arid western US systems, and the Karst, Fractured Rock, Sedimentary Rock, and Volcanic bedrock systems well studied across the US. Is interflow determined to be part of this process? Interflow is definitely a process for connectivity.

In general, the role of regional groundwater systems in neighboring systems is not addressed by this Rule and leaves the waters of the US vulnerable. The Rule focuses primarily on the site and subregional scales, perhaps due to the legal aspects. This tends to either ignore or at least downplay the potential significance of regional-scale hydrologic connectivity, especially as it relates to ground water in adjacent and /or neighboring systems. This is a problem because regional ground water flows commonly interact with the surface environment at sinks and springs. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops (see Sun et al. 1997 and references therein). To provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, the SAB recommends that the EPA also consider using the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996). To better characterize regional-scale ground water connectivity, the SAB recommends that the EPA also consider using findings from the U.S. Geological Survey Regional Aquifer Systems Analysis (RASA) Program. An understanding of regional ground water flow systems is critical to the understanding of four-dimensional hydrologic connectivity on both the local and regional scales. Understanding ground water flow in unique hydrogeologic settings, including the Floridan aquifer system (karst systems), the High Plains aquifer system (semi-arid systems), and the Snake River Plain and Rio Grande Rift aquifer systems (volcanic bedrock systems), is especially important. These and other unique hydrogeological settings are covered by the RASA Program (Sun et al. 1997).

To clarify the connectivity of adjacent waters to "waters of the US", the SAB recommends that a conceptual framework be established expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds from top to bottom, and therefore connecting waters and wetlands to downgradient waters. The flowpath framework should highlight the four-dimensional nature of connectivity, because four-dimensional connectivity scaled in a habitat-to-catchment context is a foundational aspect of freshwater ecology (e.g., Ward 1989). The flux and transformation of water, materials, and organisms – which fundamentally control the integrity of downgradient freshwater ecosystems – occur at varying rates primarily determined by climate, geology, topographic relief, and biology and are expressed in terms of surface water and ground water storage and flow through the landscape (e.g., uplands, wetlands, lakes, rivers, and floodplains). Therefore, these flowpaths are inherently four-dimensional (i.e., longitudinal, lateral, vertical, and through time).

Ground water connectivity, in particular, could be better represented in the Rule. The U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996).

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In circumstances where a particular water body is outside of the floodplain and riparian area of a tributary, but is connected by a shallow subsurface hydrologic connection or confined surface hydrologic connection with such tributary, the agencies will also assess the distance between the water body and tributary in determining whether or not the water body is adjacent. ''Adjacent'' as defined in the agencies' regulations has always included an element of reasonable proximity.

Distance to water body frequently is not the story. Regarding groundwater connectivity, the hydrogeologic framework and properties (thickness, continuity, for example), including hydraulic conductivity and storativity/storage; and the subsurface source, pathway, and discharge region are important for relevance in protecting "waters of the US". We need to know the hydrogeologic framework and groundwater flow system for connectivity. Is interflow determined to be part of this process? Interflow is definitely a process for connectivity. The U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996).

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Therefore, the determination of whether a particular water meets the definition of ‘‘neighboring’’ because the water is connected by a shallow subsurface or confined surface hydrologic connection is made in the context of the terms ‘‘neighboring’’ and ‘‘adjacent’’ as used in the regulation.

Why just shallow subsurface? Is this groundwater or interflow or both? Distance to water body frequently is not the story. Regarding groundwater connectivity, the hydrogeologic framework and properties (thickness, continuity, for example), including hydraulic conductivity and storativity/storage; and the subsurface source, pathway, and discharge region are important for relevance in protecting “waters of the US”. Need to know the hydrogeologic framework and groundwater flow system for connectivity. Is interflow determined to be part of this process? Interflow is definitely a process for connectivity. The U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996).

To clarify the connectivity of neighboring waters to “waters of the US”, the SAB recommends that a conceptual framework be established expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds from top to bottom, and therefore connecting waters and wetlands to downgradient waters. The flowpath framework should highlight the four-dimensional nature of connectivity, because four-dimensional connectivity scaled in a habitat-to-catchment context is a foundational aspect of freshwater ecology (e.g., Ward 1989). The flux and transformation of water, materials, and organisms – which fundamentally control the integrity of downgradient freshwater ecosystems – occur at varying rates primarily determined by climate, geology, topographic relief, and biology and are expressed in terms of surface water and ground water storage and flow through the landscape (e.g., uplands, wetlands, lakes, rivers, and floodplains). Therefore, these flowpaths are inherently four-dimensional (i.e., longitudinal, lateral, vertical, and through time).

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While the agencies' best professional judgment has always been a factor in determining whether a particular wetland is ''adjacent'' under the existing definition, the agencies recognize that this may result in some uncertainty as to whether a particular water connected through confined surface or shallow subsurface hydrology is an ''adjacent'' water. The agencies therefore request comment on whether there are other reasonable options for providing clarity for jurisdiction over waters with these types of connections.

Regarding shallow subsurface hydrology of an "adjacent water', the U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996). Future efforts to determine whether a particular wetland is "adjacent" and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of "flood pulses" (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998; Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003;

Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

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Options could include asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance; asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone of a jurisdictional water; considering only confined surface connections but not shallow subsurface connections for purposes of determining adjacency; or establishing specific geographic limits for using shallow subsurface or confined surface hydrological connections as a basis for determining adjacency, including, for example, distance limitations based on ratios compared to the bank-to-bank width of the water to which the water is adjacent. The agencies note that under the proposed rule any waters not fitting within (a)(1) through (a)(6) categories would instead be treated as ''other waters.'' Options could include asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance; asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone of a jurisdictional water; considering only confined surface connections but not shallow subsurface connections for purposes of determining adjacency; or establishing specific geographic limits for using shallow subsurface or confined surface hydrological connections as a basis for determining adjacency, including, for example, distance limitations based on ratios compared to the bank-to-bank width of the water to which the water is adjacent. The agencies note that under the proposed rule any waters not fitting within (a)(1) through (a)(6) categories would instead be treated as ''other waters.''

Regarding shallow subsurface connections, the U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996). Future efforts to assert jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of "flood pulses" (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998; Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

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A shallow subsurface hydrologic connection is lateral water flow through a shallow subsurface layer, such as can be found, for example, in steeply sloping forested areas with shallow soils, or in soils with a restrictive layer that impedes the vertical flow of water, or in karst systems, specially karst pans. K.J. Devito, *et al.*, ''Groundwater-Surface Water Interactions in Headwater
Forested Wetlands of the Canadian Shield,'' *Journal of Hydrology* 181:127–47 (1996); M.A.'Driscoll, and R.R. Parizek, ''The Hydrologic Catchment Area of a Chain of Karst Wetlands in Central Pennsylvania, USA,'' *Wetlands* 23:171–79 (2003); B.J. Cook, and F.R. Hauer, ''Effects of Hydrologic Connectivity on Water Chemistry, Soils, and Vegetation Structure and Function in an Intermontane Depressional Wetland Landscape,'' *Wetlands* 27:719– 38 (2007). A shallow subsurface connection also exists, for example, when the adjacent water and neighboring (a)(1) through (a)(5) water are in contact with the same shallow aquifer. Shallow subsurface connections may be found both within the ordinary root zone and below the ordinary root zone (below 12 inches), where other wetland delineation factors may not be present. A combination of physical factors may reflect the presence of a shallow subsurface connection, including (but not limited to) stream hydrograph (for example, when the hydrograph indicates an increase in flow in an area where no tributaries are entering the stream), soil surveys (for example, exhibiting indicators of high transmissivity over an impermeable layer), and information indicating the water table in the stream is lower than in the shallow subsurface.
Shallow subsurface connections are distinct from deeper groundwater connections, which do not satisfy the requirement for adjacency, in that the former exhibit a direct connection to the water found on the surface in wetlands and open waters. Water does not have to be continuously present in the confined surface or shallow subsurface hydrologic connection and the flow between the adjacent water and the jurisdictional water may move in one or both directions. While they may provide the connection establishing jurisdiction, these shallow subsurface flows are not ''waters of the United States.'' For waters outside of the riparian area or floodplain, confined surface hydrologic connections (as described above) are the only types of surface hydrologic connections that satisfy the requirements for adjacency. Waters outside of the riparian area or floodplain that lack a shallow subsurface hydrologic connection or a confined surface hydrologic connection would be analyzed as ''other waters'' under paragraph (a)(7) of the proposed rule.

Saturated zone groundwater and interflow must be clearly defined. This definition allows for both if SHALLOW. However, as indicated with the Karst references, deep groundwater should be included as well for connectivity and include not only Karst, but certainly sedimentary systems, fractured rock systems, and volcanic systems as well. Many regional groundwater systems sustain the navigable waters and should be included. The real issue is both temporal and spatial as the SAB has clearly and thoroughly discussed. Also, magnitude issues need to be considered.

The U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996).

There are methods for quantification regarding connectivity of these types of systems – both physical (fluids) and chemical (transport), and biological. Future efforts to assert jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of "flood pulses" (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998; Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

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When determining whether a water is located in a floodplain, the agencies will use best professional judgment to determine which flood interval to use (for example, 10 to 20- year flood interval zone). The agencies request comment on whether the rule text should provide greater specificity with regard to how the agencies will determine if a water is located in the floodplain of a jurisdictional water.

Besides the 10 to 20- year flood interval, the major connectivity could be shallow groundwater, which may be ongoing. The flood plain can be defined geomorphically and hydrologically, via groundwater connection. If there is a "permanent" or even seasonal water table that connects the floodplain waters to the surface waters in the channels, the concept of actual flood frequency is a moot point. If the water table exists naturally for some part of the year, the systems are connected.

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The agencies intend to similarly interpret the new definition of ''neighboring.'' This new definition is designed to provide greater clarity by identifying specific areas and characteristics for jurisdictional adjacent waters, but the agency's request comment for additional clarification. Commenters should support where possible from scientific literature any suggestions for additional clarification of current explicit limits on adjacency, such as a specific distance or a specific floodplain interval. The agencies seek comment on specific options for establishing additional precision in the definition of ''neighboring'' through: explicit language in the definition that waters connected by shallow subsurface hydrologic or confined surface hydrologic connections to an (a)(1) through (a)(5) water must be geographically proximate to the adjacent water; circumstances under which waters outside the floodplain or riparian zone are jurisdictional if they are reasonably proximate; support for or against placing geographic limits on what waters outside the floodplain or riparian zone are jurisdictional; determining that only waters within the floodplain, only waters within the riparian area, or only waters within the floodplain and riparian area (but not waters outside these areas with a shallow subsurface or confined surface hydrologic connection) are adjacent; identification of particular floodplain intervals within which waters would be considered adjacent; and any other scientifically valid criteria, guidelines or parameters that would increase clarity with respect to neighboring waters.

The basis should also include groundwater connectivity which may not need a frequency basis. There are methods for quantification regarding connectivity of these types of systems – both physical (fluids) and chemical (transport), and biological. Future efforts to assert jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of "flood pulses" (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998; Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emily Bernhardt and Michael Gooseff*)

Page 22211:

For purposes of analyzing whether an ''other water'' has a significant nexus, the agencies are proposing that ''other waters'' are similarly situated if they perform similar functions and they are either (1) located sufficiently close together so that they can be evaluated as a single landscape unit with regard to their effect on the chemical, physical, or biological integrity of a water identified in paragraphs (a)(1) through (a)(3), or (2) located sufficiently close to a ''water of the United States'' for such an evaluation of their effect. These criteria are explained in a subsequent section. Consistent with Justice Kennedy's opinion in *Rapanos*, the agencies propose today and are soliciting comment on establishing a case-specific analysis of whether ''other waters,'' including wetlands, that do not meet the criteria for any of the proposed jurisdictional categories in (a)(1) through (a)(6) and are not proposed to be excluded by rule under section (b),
are susceptible to a case-specific analysis of whether they alone, or in combination with other similarly situated waters, have a significant nexus to a traditional navigable water, an interstate water, or the territorial seas, and therefore are ''waters of the United States.''

This Rule is still reliant on distance and needs to be flow path oriented with spatial and temporal components! To clarify the connectivity of "other waters" to "waters of the US", the SAB recommends that a conceptual framework be established expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds from top to bottom, and therefore connecting other waters and wetlands to downgradient waters. The flowpath framework should highlight the four-dimensional nature of connectivity, because four-dimensional connectivity scaled in a habitat-to-catchment context is a foundational aspect of freshwater ecology (e.g., Ward 1989). The flux and transformation of water, materials, and organisms – which fundamentally control the integrity of downgradient freshwater ecosystems – occur at varying rates primarily determined by climate, geology, topographic relief, and biology and are expressed in terms of surface water and ground water storage and flow through the landscape (e.g., uplands, wetlands, lakes, rivers, and floodplains). Therefore, these flowpaths are inherently four-dimensional (i.e., longitudinal, lateral, vertical, and through time).

Page 22212:

The agencies also request comment and information below on how the science could support other approaches that could provide greater regulatory certainty regarding the jurisdictional status of ‘‘other waters’’

There are methods for quantification regarding connectivity of these types of systems specifically the “other waters” – both physical (fluids) and chemical (transport), and biological. Future efforts to assert jurisdiction over “other” waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of “flood pulses” (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998; Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

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Water sheds are used solely, the effects of regional groundwater systems or basins is ignored! Connectivity via regional groundwater systems needs to be considered! In general, the role of regional groundwater systems in neighboring systems is not addressed by this Rule and leaves the waters of the US vulnerable. The Rule focuses primarily on the site and subregional scales, and on watershed boundaries. This tends to either ignore or at least downplay the potential significance of regional-scale hydrologic connectivity, especially as it relates to ground water in adjacent and /or neighboring systems. This is a problem because regional ground water flows commonly interact with the surface environment at sinks and springs. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops (see Sun et al. 1997 and references therein). To provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, the SAB recommends that the EPA also consider using the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996). To better characterize regional-scale ground water connectivity, the SAB recommends that the EPA also consider using findings from the U.S. Geological Survey Regional Aquifer Systems Analysis (RASA) Program. An understanding of regional ground water flow systems is critical to the understanding of four-dimensional hydrologic connectivity on both the local and regional scales. Understanding ground water flow in unique hydrogeologic settings, including the Floridan aquifer system (karst systems), the High Plains aquifer system (semi-arid systems), and the Snake River Plain and Rio Grande Rift aquifer systems (volcanic bedrock systems), is especially important. These and other unique hydrogeological settings are covered by the RASA Program (Sun et al. 1997).

To clarify the connectivity of other waters to “waters of the US”, the SAB recommends that a conceptual framework be established expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds from top to bottom, and therefore connecting waters and wetlands to downgradient waters. The flowpath framework should highlight the four-dimensional nature of connectivity, because four-dimensional connectivity scaled in a habitat-to-catchment context is a foundational aspect of freshwater ecology (e.g., Ward 1989). The flux and transformation of water, materials, and organisms – which fundamentally control the integrity of downgradient freshwater ecosystems – occur at varying rates primarily determined by climate, geology, topographic relief, and biology and are expressed in terms of surface water and ground water storage and flow through the landscape (e.g., uplands, wetlands, lakes, rivers, and floodplains). Therefore, these flowpaths are inherently four-dimensional (i.e., longitudinal, lateral, vertical, and through time).

Ground water connectivity, in particular, could be better represented in the Rule. The U.S. Geological Survey (USGS) has published numerous reports and learning tools on ground water connectivity, including examples of flowpath frameworks expressed in block diagrams (Heath 1983, 1984; Winter et al. 1998), that contain flows through floodplains. Care should be taken not to imply that bedrock is impermeable because ground water flows through bedrock are important flowpaths that connect hydrologic landscapes over long distances and often across watershed boundaries (e.g., Roses et al. 1996).

Page 22213:

In determining whether other waters are sufficiently close to each other or to a water of the United States, the agencies would also consider hydrologic connectivity to each other or
a jurisdictional water.

In determining whether groups of other waters perform ‘‘similar functions’’ the agencies would also consider functions such as habitat, water storage, sediment retention, and pollution sequestration. These and other relevant considerations would be used by the agencies to document the hydrologic, geomorphic and ecological characteristics and circumstances of the water.

The agencies solicit comment regarding this approach to ‘‘other waters,’’ recognizing that a case-specific analysis of significant nexus is resource intensive for the regulating agencies and the regulated community alike. In addition, the agencies solicit comment on additional scientific research and data that might further inform decisions about ‘‘other waters.’’ In particular the agencies solicit information about whether current scientific research and data regarding particular types of waters are sufficient to support the inclusion of subcategories of types of ‘‘other waters,’’ either alone or in combination with similarly situated waters, that can appropriately be identified as always lacking or always having a significant nexus.

The agencies acknowledge that there may be more than one way to determine which waters are jurisdictional as ‘‘other waters.’’ This proposal is for a case-specific analysis of whether ‘‘other waters,’’ including wetlands, alone, or in combination with other similarly situated waters located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. The agencies make this proposal based on an analysis of the current state of the science available to them. In this proposal, the agencies continue to solicit additional science (peer-reviewed whenever possible) that could lead to greater clarity, certainty, and predictability of which waters are and are not within the jurisdiction of the CWA.

There are methods for quantification regarding connectivity of these types of systems specifically the “other waters” – both physical (fluids) and chemical (transport), and biological. Future efforts to assert jurisdiction over “other” waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of “flood pulses” (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998;

Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

Page 22215:

Ecoregion discussion:

In general, the role of regional groundwater systems is important for the Ecoregion discussion and approaches particularly for the potential significance of regional-scale hydrologic connectivity, especially as it relates to ground water in adjacent and /or neighboring systems. Regional ground water flows commonly interact with the surface environment at sinks and springs and control many of the ecoregion -scale structures and functions. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops (see Sun et al. 1997 and references therein). To provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, the SAB recommends that the EPA also consider using the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996). To better characterize regional-scale ground water connectivity and ecoregion analysis, the SAB recommends that the EPA also consider using findings from the U.S. Geological Survey Regional Aquifer Systems Analysis (RASA) Program. An understanding of regional ground water flow systems is critical to the understanding of four-dimensional hydrologic connectivity on both the local and regional scales. Understanding ground water flow in unique hydrogeologic settings, including the Floridian aquifer system (karst systems), the High Plains aquifer system (semi-arid systems), and the Snake River Plain and Rio Grande Rift aquifer systems (volcanic bedrock systems), is especially important. These and other unique hydrogeological settings are covered by the RASA Program (Sun et al. 1997).

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The factors the agencies used in developing the list above are:
a. Density of ‘‘other waters’’ such that there can be periodic surface hydrologic connections among the waters, for example in West Coast vernal pools.
b. Soil permeability and surface or shallow subsurface flow such that the ‘‘other waters’’ can be considered hydrologically connected, such as many Texas coastal prairie wetlands.
c. Water chemistry which indicates that the ‘‘other waters’’ are part of the same system and influenced by the same processes.
d. Physical capacity of ‘‘other waters’’ to provide flood and sediment retention; this is a case where several small wetlands together may have a different effect than a single large wetland providing the same function, for example prairie potholes in the Missouri Coteau.
e. Co-location of waters to each other or similarly to the tributary system such that their cumulative and additive effects on pollutant removal through parallel, serial, or sequential processing are apparent, such as the role of pocosins in maintaining water quality in estuaries.

f. ''Other waters'' that are sufficiently near each other or the tributary system and thus function as an integrated habitat that can support the life cycle of a species or more broadly provide habitat to a large number of a single species.

The agencies request comment on the factors above and whether this list of factors is appropriate, and whether there are other factors that should be included or excluded from this list. Comments should address the science that supports each comment.

Factors restated from above:

There are methods for quantification regarding connectivity of these types of systems specifically the "other waters" – both physical (fluids) and chemical (transport), and biological. Future efforts to assert jurisdiction over "other" waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity can be informed by the wide variety of conceptual models and quantitative tools that have been developed to evaluate the connectivity of both surface and subsurface hydrological systems in different settings, including non-floodplain wetlands. The standard approach involves first characterizing the surface and subsurface elements of landscapes. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998). Of course, the approach to quantifying hydrologic connectivity is not identical across systems, and careful attention must be given to identifying the most appropriate techniques (Healy et al. 2007; Bracken et al. 2013) and metrics (Ali and Roy 2010).

Other examples can be found in the literature related to water quantity and quality modeling (Appel and Reilly 1994; Sun et al. 1997; Harbaugh 2005; Parkhurst et al. 2010; Cunningham and Schalk 2011), and integrated surface water ground water modeling (Markstrom et al. 2008; Ely and Kahle 2012; Huntington and Niswonger 2012; Woolfenden and Nishikawa 2014), sediment transport modeling (Nelson et al. 2003; McDonald et al. 2005), and watershed and biological/habitat/landscape modeling (Kinzel et al. 1999; Kinzel et al. 2005; Hunt et al. 2013). Approaches have also been developed to quantify linkages due to ground water movement and storage (Heath 1983) and the effects of "flood pulses" (Kolm et al. 1998). Likewise, the role of chemical movement and storage to ground water systems in floodplains has been quantified by flow and transport modeling (Winter et al. 1998; Markstrom et al. 2008; Woolfenden and Nishikawa 2014) as well as with steady-state and transient analyses that simulate temporal changes (Appel and Reilly 1994; Winter et al. 1998; Nelson et al. 2003; Conaway and Moran 2004; Harbaugh 2005; McDonald et al. 2005; Markstrom et al. 2008; Huntington and Niswonger 2012).

Page 22216:

Discussion of Hydrologic-Landscape Regions. Then:

The agencies seek comment on the technical bases for using ecoregions and hydrologic-landscape regions under this option. Commenters may also address whether some other method or combination of methods (certain ecoregions and hydrologic-landscape regions, for example) of mapping geographic boundaries is better supported by the science. Comments should also address whether and how this option is consistent with the science and the caselaw.

Using Hydrologic-Landscape Regions and Ecoregions as a basis for determining the connectivity of hydrologic and biologic systems to “waters of the U.S.” is an excellent first step in understanding the holistic nature of these systems in any location when combined with the standard approach that involves characterizing the surface and subsurface elements of landscapes to determine flowpath networks at multiple temporal and spatial scales. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements, in context with the HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998).

Page 22217:

3. Additional ‘‘other waters’’ approaches. The agencies request comment on additional ‘‘other waters’’ approaches considered, but not proposed by the agencies.

Restated and note references: Using Hydrologic-Landscape Regions and Ecoregions as a basis for determining the connectivity of hydrologic and biologic systems to “waters of the U.S.” is an excellent first step in understanding the holistic nature of these systems in any location when combined with the standard approach that involves characterizing the surface and subsurface elements of landscapes to determine flowpath networks at multiple temporal and spatial scales. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements, in context with the HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998).

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (*lead discussants are: Drs. David Allan and Mark Rains)*

Page 22203:

The agencies specifically seek comment on the appropriate flow regime for a ditch excavated wholly in uplands and draining only uplands to be included in the exclusion of paragraph (b)(3). In particular, the agencies seek comment on whether the flow regime in such ditches should be less than intermittent flow or whether the flow regime in such ditches should be less than perennial flow as proposed.

Waters and wetlands are "connected" in the sense that they are integrated into the broader hydrological landscape and therefore can play important roles in maintaining the chemical, physical, and biological integrity of downgradient waters. They perform a variety of functions (which are broadly classified in the Report as source, sink, lag, transformation, and refuge functions) at rates that are a characteristic of where these waters and wetlands are located on the gradient of connectivity. Therefore, downgradient waters might suffer consequences if the degree of connectivity is altered by human activities. Alterations can be of three types: some can directly decrease connectivity, such as dams (Ward and Stanford 1983) and ground water pumping that lowers local water tables and causes surface-water connections to cease (Haag and Pfeiffer 2012); some can directly increase connectivity, such as ditches (Min et al. 2010) and tile drains (Randall et al. 1997); and some can indirectly change the frequency, magnitude, timing, duration, and/or rate of change of connectivity, such as impervious surfaces in the contributing watershed (Walsh et al. 2012). Each of these types of human alterations affect connectivity and therefore can impact the chemical, physical, and biological integrity of the downgradient waters.

As surface water features, ditches and canals function as either perennial or intermittent streams or tributaries and should be legally treated as such. Regardless of source, these ditches convey or store water and chemical/physical/biological sediment and materials spatially on a temporal basis (rate, magnitude, and frequency).

The water from ditches can leak to provide groundwater recharge to the sediments or bedrock beneath the ditch, or accumulate groundwater discharge in its flow (serve as a drain) or both. These functions can be temporal (seasonal) and spatial. In all, the ditch impacts many of the hydrologic systems in the vicinity of its location, and is connected.

Land use and water rights changes affect the function of the ditch and can be critical to the "waters of the US". In the western US, land use changes are mostly from agriculture to urbanization, and the ditches are frequently "shut off" as water is passed downstream to thirsty cities, and local aquifers "dry up" since irrigation and ditch leakance is reduced. This, in turn, affects the local tributaries and springs, many of which had water rights partitioned during the agricultural times.

Page 22218:

The following features are exempt:

Artificially irrigated areas that would revert to upland should application of irrigation water to that area cease;
Artificial lakes or ponds created by excavating and/or diking dry land and used exclusively for such purposes as stock watering, irrigation, settling basins, or rice growing;
Artificial reflecting pools or swimming pools created by excavating and/or diking dry land;
Small ornamental waters created by excavating and/or diking dry land for primarily aesthetic reasons;
Water-filled depressions created incidental to construction activity;
Groundwater, including groundwater drained through subsurface drainage systems; and
Gullies and rills and non-wetland swales.

In no cases should groundwater that is shown to be connected to "waters of the US" be exempt (see comments above). Each of these features listed may be connected to "waters of the US" depending on the hydrogeologic framework that is underneath the features, and the hydrologic system that the features are constructed within. Artificial lakes or ponds, or reflection pools, etc., created by excavation, diking, or construction may be directly connected to the "waters of the US" by shallow or deeper groundwater, therefore, a "blanket" exemption is not recommended. Each feature should be cleared by a systematic hydrologic system analysis. These exemptions may invite multiple abuses to the Rule, particularly when land ownership and land use are changed with time.

Page 22220:

The agencies request comment on how they could provide greater clarity on how to distinguish between erosional features such as gullies, which are excluded from jurisdiction, and ephemeral tributaries, which are categorically jurisdictional.

A gully that has been allowed to become permanent and minimally ephemeral, such as gullies observed throughout the Western US caused by over grazing of livestock, should be in the jurisdiction of the waters of the US. The landowner should have a specified amount of time to correct the situation, or the conversion is permanent.

The agencies request comment on how they could provide greater clarity on how to distinguish swales, which are excluded from jurisdiction, and ephemeral tributaries, which are categorically jurisdictional.

A distinction between natural and human-made swales is necessary, and the functions of the swales should be determined on a case by case basis regarding the effects on the chemical, physical, and biological aspects of the system.

The agencies request comment on this formulation of the ditch exclusion. The agencies specifically seek comment on the appropriate flow regime for a ditch excavated wholly in uplands and draining only uplands to be covered by the exclusion in paragraph (b)(3). In particular, the agencies seek comment on whether the flow regime in such ditches should be less than intermittent flow or whether the flow regime in such ditches should be less than perennial flow as proposed.

Constructed ditches change the hydrologic flow paths of local and subregional hydrologic systems. Ditches are perennial, intermittent, or ephemeral water conveyors, and should be regulated as such. See discussion above on changing land use and ground water recharge that flows to jurisdiction waters, which is an issue in the Western US. A classic example is the gutters on houses in the Western US – water can be harmlessly deflected off the houses as long as the runoff is allowed to reach the streams via drains, sewers, etc. If individuals collect the runoff and water their gardens, it is a direct violation of water law (Milagro Bean Field War). However, our laws do not cover the increase of impermeable structures that prevent groundwater recharge where our houses are built.

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

To restate, there is a tremendous understatement of the role of groundwater in connectivity particularly in the adjacent water bodies and other waters sections of the Rule, and the exemptions of the Rule; this leaves the waters of the US vulnerable. The Rule focuses primarily on the site and subregional scales, perhaps due to the legal aspects. This tends to either ignore or at least downplay the potential significance of regional-scale hydrologic connectivity, especially as it relates to ground water. This is a problem because regional ground water flows commonly interact with the surface environment at sinks and springs. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops (see Sun et al. 1997 and references therein). To provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, the SAB recommends that the EPA also consider using the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996).

EPA's Proposed Rule

The following sections of the proposed rule may be most relevant for your review:

Preamble (explains the basis and purpose for the proposed rule)

The agencies acknowledge that there may be more than one way to determine which waters are jurisdictional as ''other waters.'' To best meet their goals and responsibilities, the agencies request comment on alternate approaches to determining whether ''other waters'' are similarly situated and have a ''significant nexus'' to a traditional navigable water, interstate water, or the territorial seas. In the discussion of ''other waters'' later in the preamble, the agencies seek comment on these other approaches and whether they could better meet the goals of greater predictability and consistency through increased clarity, while simultaneously fulfilling the agencies' responsibility to the CWA's objectives and policies to protect water quality, public health, and the environment.

Commenters will specifically be asked to comment on whether and how these alternate approaches may be more consistent with the goal of clarity, and the CWA, the best available science, and the case law. In particular, the agencies are interested in comments, scientific and technical data, case law, and other information that would further clarify which ''other waters'' should be considered similarly situated for purposes of a case-specific significant nexus determination. The agencies seek comment on a number of alternative approaches. These alternatives include potentially determining waters in identified ecological regions (ecoregions) or hydrologic-landscape regions are similarly situated for purposes of evaluating a significant nexus, as well as the basis for determining which ecoregions or hydrologic-landscape regions should be so identified.

Restated from above and note references: Using Hydrologic-Landscape Regions and Ecoregions as a basis for determining the connectivity of hydrologic and biologic systems to "waters of the U.S." is an excellent first step in understanding the holistic nature of these systems in any location when combined with the standard approach that involves characterizing the surface and subsurface elements of landscapes to determine flowpath networks at multiple temporal and spatial scales. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements, in context with the HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998).

II. Background -- Page 22190

A. Executive Summary -- Page 22190

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Under the proposed first section of the regulation, section (a), the agencies propose to define the ''waters of the United States'' for all sections (including sections 301, 311, 401, 402, 404) of the CWA to mean:

• All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
• All interstate waters, including interstate wetlands;
• The territorial seas;
• All impoundments of a traditional navigable water, interstate water, the territorial seas or a tributary;
• All tributaries of a traditional navigable water, interstate water, the territorial seas or impoundment;
• All waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment or tributary; and
• On a case-specific basis, other waters, including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water or the territorial seas.

Nexus definition is weak on groundwater connectivity. Please see comments in previous sections. To restate, there is a tremendous understatement of the role of groundwater in connectivity particularly in the adjacent water bodies and other waters sections of the Rule, and the exemptions of the Rule; this leaves the waters of the US vulnerable. The Rule focuses primarily on the site and subregional scales, perhaps due to the legal aspects. This tends to either ignore or at least downplay the potential significance of regional-scale hydrologic connectivity, especially as it relates to ground water. This is a problem because regional ground water flows commonly interact with the surface environment at sinks and springs. For example, the Floridan aquifer underlies all of Florida as well as portions of Mississippi, Alabama, Georgia, and South Carolina and commonly interacts with the surface environment through sinks, springs, and outcrops (see Sun et al. 1997 and references therein). To provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, the SAB recommends that the EPA also consider using the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996).

Page 22194:

The proposed section (b) excludes specified waters and features from the definition of ''waters of the United States.'' Waters and features that are determined to be excluded under section (b) of the proposed rule will not be jurisdictional under any of the categories in the proposed rule under section (a), even if they would otherwise satisfy the regulatory definition. Those waters and features that would not be ''waters of the United States'' are:….. groundwater including groundwater drained through subsurface drainage systems; and…

See comments in text above. In no cases should groundwater that is shown to be connected to "waters of the US" be exempt (see comments above). Each of the features listed in (b) may be connected to "waters of the US" depending on the hydrogeologic framework that is underneath the features, and the hydrologic system that the features are constructed within. Artificial lakes or ponds, or reflection pools, etc., created by excavation, diking, or construction may be directly connected to the "waters of the US" by shallow or deeper groundwater, therefore, a "blanket" exemption is not recommended. Each feature should be cleared by a systematic hydrologic system analysis. These exemptions invited multiple abuses to the Rule, particularly when land ownership and land use are changed with time.

Page 22195:

EPA and the Corps are very interested in identifying other emerging technologies or approaches that would save time and money and improve efficiency for regulators and the regulated community in determining which waters are subject to CWA jurisdiction. The agencies specifically invite comment on this topic.

Restated from above and note references: Using Hydrologic-Landscape Regions and Ecoregions as a basis for determining the connectivity of hydrologic and biologic systems to "waters of the U.S." is an excellent first step in understanding the holistic nature of these systems in any location when combined with the standard approach that involves characterizing the surface and subsurface elements of landscapes to determine flowpath networks at multiple temporal and spatial scales. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements, in context with the HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998).

B. Background on Scientific Review and Significant Nexus Analysis – Page 22195

Page 22198:

In addition to the proposed ''other waters'' approach in this rule, the agencies are requesting comment on a range of alternate approaches to inform their decision on how best to address ''other waters.'' The agencies will consider the full administrative record, including comments requested and received, and the final Report, as revised in response to the SAB review, when developing the final rule, and may adopt one of the alternative approaches or combination of approaches and the proposal.

To clarify the connectivity of "other waters" to "waters of the US", the SAB recommends that a conceptual framework be established expressed as continuous hydrological (surface and subsurface), chemical, and biological flowpaths connecting watersheds from top to bottom, and therefore connecting other waters and wetlands to downgradient waters. The flowpath framework should highlight the four-dimensional nature of connectivity, because four-dimensional connectivity scaled in a habitat-to-catchment context is a foundational aspect of freshwater ecology (e.g., Ward 1989). The flux and transformation of water, materials, and organisms – which fundamentally control the integrity of downgradient freshwater ecosystems – occur at varying rates primarily determined by climate, geology, topographic relief, and biology and are expressed in terms of surface water and ground water storage and flow through the landscape (e.g., uplands, wetlands, lakes, rivers, and floodplains). Therefore, these flowpaths are inherently four-dimensional (i.e., longitudinal, lateral, vertical, and through time).

Using Hydrologic-Landscape Regions and Ecoregions as a basis for determining the connectivity of hydrologic and biologic systems to "waters of the U.S." is an excellent first step in understanding the holistic nature of these systems in any location when combined with the standard approach that involves characterizing the surface and subsurface elements of landscapes to determine flowpath networks at multiple temporal and spatial scales. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements, in context with the

HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). This approach has been extended to biological connectivity and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998).

III. Proposed Definition of Waters of the United States – Page 22198

Page 22199: Primary source of connectivity is groundwater, yet:

CWA Exclusions: groundwater, including groundwater drained through subsurface drainage systems.

Restated from above text: In no cases should groundwater that is shown to be connected to "waters of the US" be exempt (see comments above). Each of the features listed for exemptions to the Rule may be connected to "waters of the US" depending on the hydrogeologic framework that is underneath the features, and the hydrologic system that the features are constructed within. Artificial lakes or ponds, or reflection pools, etc., created by excavation, diking, or construction may be directly connected to the "waters of the US" by shallow or deeper groundwater, therefore, a "blanket" exemption is not recommended. Each feature should be cleared by a systematic hydrologic system analysis. These exemptions can invite multiple abuses to the Rule, particularly when land ownership and land use are changed with time.

Appendix A. Overview of the Scientific Literature on Aquatic Resource Connectivity and Downstream Effects -- Page 22222

Comments listed above by category.

The regulatory text of the proposed rule -- Page 22262.

Comments listed above by category.

Additional Comments Regarding the Adequacy of the Scientific and Technical Basis of the Proposed Rule Titled Definition of Waters of the United States Under the Clean Water Act (79FR 22188-22274)

Kenneth E. Kolm, Ph.D.
Submitted on August 25, 2014

Questions

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank*)

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan*)

Page 22203:

An alternate approach would be to clarify that wetlands that connect tributary segments are adjacent wetlands, and as such are jurisdictional waters of the United States under (a)(6). In this approach, a tributary would be defined as having a bed and bank and OHWM, and the upper limit of the tributary would be defined by the point where these features cease to be identifiable.
(Note that natural or manmade breaks would still not sever jurisdiction if a tributary segment with a bed and bank and OHWM could be identified upstream of the break.) Wetlands would not be considered tributaries, but would remain jurisdictional as adjacent waters. Wetlands that contribute flow, for example at the upper reaches of the tributary system, would be considered adjacent waters.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of wetlands to “waters of the US” (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22207:

Waters, including wetlands, determined to have a shallow subsurface hydrologic connection or confined surface hydrologic connection to an (a)(1) through (a)(5) water would also be ‘‘waters of the United States’’ by rule as adjacent waters falling within the definition of ‘‘neighboring.’’

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of adjacent waters to “waters of the US (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22207:

In circumstances where a particular water body is outside of the floodplain and riparian area of a tributary, but is connected by a shallow subsurface hydrologic connection or confined surface hydrologic connection with such tributary, the agencies will also assess the distance between the water body and tributary in determining whether or not the water body is adjacent. ‘‘Adjacent’’ as defined in the agencies’ regulations has always included an element of reasonable proximity.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of adjacent waters to "waters of the US (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22208:

Therefore, the determination of whether a particular water meets the definition of ''neighboring'' because the water is connected by a shallow subsurface or confined surface hydrologic connection is made in the context of the terms ''neighboring'' and ''adjacent'' as used in the regulation.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of neighboring waters to "waters of the US (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22208:

While the agencies' best professional judgment has always been a factor in determining whether a particular wetland is ''adjacent'' under the existing definition, the agencies recognize that this may result in some uncertainty as to whether a particular water connected through confined surface or shallow subsurface hydrology is an ''adjacent'' water. The agencies therefore request comment on whether there are other reasonable options for providing clarity for jurisdiction over waters with these types of connections.

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of adjacent waters to "waters of the US (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22208:

Options could include asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance; asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone of a jurisdictional water; considering only confined surface connections but not shallow subsurface connections for purposes of determining adjacency; or establishing specific geographic limits for using shallow subsurface or confined surface hydrological connections as a basis for determining adjacency, including, for example, distance limitations based on ratios compared to the bank-to-bank width of the water to which the water is adjacent. The agencies note that under the proposed rule any waters not fitting within (a)(1) through (a)(6) categories would instead be treated as ''other waters.'' Options could include asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance; asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone of a jurisdictional water; considering only confined surface connections but not shallow subsurface connections for purposes of determining adjacency; or establishing specific geographic limits for using shallow subsurface or confined surface hydrological connections as a basis for determining adjacency, including, for example, distance limitations based on ratios compared to the bank-to-bank width of the water to which the water is adjacent. The agencies note that under the proposed rule any waters not fitting within (a)(1) through (a)(6) categories would instead be treated as ''other waters.''

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used for asserting jurisdiction over all waters connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22208:

A shallow subsurface hydrologic connection is lateral water flow through a shallow subsurface layer, such as can be found, for example, in steeply sloping forested areas with shallow soils, or in soils with a restrictive layer that impedes the vertical flow of water, or in karst systems, specially karst pans. K.J. Devito, *et al.*, ''Groundwater-Surface Water Interactions in Headwater Forested Wetlands of the Canadian Shield,'' *Journal of Hydrology* 181:127–47 (1996); M.A.'Driscoll, and R.R. Parizek, ''The Hydrologic Catchment Area of a Chain of Karst Wetlands in Central Pennsylvania, USA,'' *Wetlands* 23:171–79 (2003); B.J. Cook, and F.R. Hauer, ''Effects of Hydrologic Connectivity on Water Chemistry, Soils, and Vegetation Structure and Function in an Intermontane Depressional Wetland Landscape,'' *Wetlands* 27:719– 38 (2007). A shallow subsurface connection also exists, for example, when the adjacent water and neighboring (a)(1) through (a)(5) water are in contact with the same shallow aquifer. Shallow subsurface connections may be found both within the ordinary root zone and below the ordinary root zone (below 12 inches), where other wetland delineation factors may not be present. A combination of physical factors may reflect the presence of a shallow subsurface connection, including (but not limited to) stream hydrograph (for example, when the hydrograph indicates an increase in flow in an area where no tributaries are entering the stream), soil surveys (for example, exhibiting indicators of high transmissivity over an impermeable layer), and information indicating the water table in the stream is lower than in the shallow subsurface.

Shallow subsurface connections are distinct from deeper groundwater connections, which do not satisfy the requirement for adjacency, in that the former exhibit a direct connection to the water found on the surface in wetlands and open waters. Water does not have to be continuously present in the confined surface or shallow subsurface hydrologic connection and the flow between the adjacent water and the jurisdictional water may move in one or both directions. While they may provide the connection establishing jurisdiction, these shallow subsurface flows are not ''waters of the United States.'' For waters outside of the riparian area or floodplain, confined surface hydrologic connections (as described above) are the only types of surface hydrologic connections that satisfy the requirements for adjacency. Waters outside of the riparian area or floodplain that lack a shallow subsurface hydrologic connection or a confined surface hydrologic connection would be analyzed as ''other waters'' under paragraph (a)(7) of the proposed rule.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used for asserting jurisdiction over all waters connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22209:

The agencies intend to similarly interpret the new definition of ‘‘neighboring.’’ This new definition is designed to provide greater clarity by identifying specific areas and characteristics for jurisdictional adjacent waters, but the agency’s request comment for additional clarification. Commenters should support where possible from scientific literature any suggestions for additional clarification of current explicit limits on adjacency, such as a specific distance or a specific floodplain interval. The agencies seek comment on specific options for establishing additional precision in the definition of ‘‘neighboring’’ through: explicit language in the definition that waters connected by shallow subsurface hydrologic or confined surface hydrologic connections to an (a)(1) through (a)(5) water must be geographically proximate to the adjacent water; circumstances under which waters outside the floodplain or riparian zone are jurisdictional if they are reasonably proximate; support for or against placing geographic limits on what waters outside the floodplain or riparian zone are jurisdictional; determining that only waters within the floodplain, only waters within the riparian area, or only waters within the floodplain and riparian area (but not waters outside these areas with a shallow subsurface or confined surface hydrologic connection) are adjacent; identification of particular floodplain intervals within which waters would be considered adjacent; and any other scientifically valid criteria, guidelines or parameters that would increase clarity with respect to neighboring waters.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of neighboring waters to “waters of the US (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emily Bernhardt and Michael Gooseff*)

Page 22211:

For purposes of analyzing whether an ‘‘other water’’ has a significant nexus, the agencies are proposing that ‘‘other waters’’ are similarly situated if they perform similar functions and they are either (1) located sufficiently close together so that they can be evaluated as a single landscape unit with regard to their effect on the chemical, physical, or biological integrity of a water identified in paragraphs (a)(1) through (a)(3), or (2) located sufficiently close to a ‘‘water of the United States’’ for such an evaluation of their effect. These criteria are explained in a subsequent section. Consistent with Justice Kennedy’s opinion in *Rapanos,* the agencies propose today and are soliciting comment on establishing a case-specific analysis of whether ‘‘other waters,’’ including wetlands, that do not meet the criteria for any of

the proposed jurisdictional categories in (a)(1) through (a)(6) and are not proposed to be excluded by rule under section (b),
are susceptible to a case-specific analysis of whether they alone, or in combination with other similarly situated waters, have a significant nexus to a traditional navigable water, an interstate water, or the territorial seas, and therefore are ''waters of the United States.''

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of "other waters" to "waters of the US" (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22212:

The agencies also request comment and information below on how the science could support other approaches that could provide greater regulatory certainty regarding the jurisdictional status of ''other waters''

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of "other waters" connected through a shallow subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity to "waters of the US" (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22212:

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to provide a better understanding of ground water connectivity, and the way that ground water connectivity might vary spatially, based on the ASTM D5979-96 *Standard Guide for Conceptualization and Characterization of Ground Water Systems* (ASTM 1996; Kolm et al. 1996) to "waters of the US" (also Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22213:

In determining whether other waters are sufficiently close to each other or to a water of the United States, the agencies would also consider hydrologic connectivity to each other or
a jurisdictional water.

In determining whether groups of other waters perform ''similar functions'' the agencies would also consider functions such as habitat, water storage, sediment retention, and pollution sequestration. These and other relevant considerations would be used by the agencies to document the hydrologic, geomorphic and ecological characteristics and circumstances of the water. The agencies solicit comment regarding this approach to ‘‘other waters,’’ recognizing that a case-specific analysis of significant nexus is resource intensive for the regulating agencies and the regulated community alike. In addition, the agencies solicit comment on additional scientific research and data that might further inform decisions about ‘‘other waters.’’ In particular the agencies solicit information about whether current scientific research and data regarding particular types of waters are sufficient to support the inclusion of subcategories of types of ‘‘other waters,’’ either alone or in combination with similarly situated waters, that can appropriately be identified as always lacking or always having a significant nexus.

The agencies acknowledge that there may be more than one way to determine which waters are jurisdictional as ‘‘other waters.’’ This proposal is for a case-specific analysis of whether ‘‘other waters,’’ including wetlands, alone, or in combination with other similarly situated waters located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. The agencies make this proposal based on an analysis of the current state of the science available to them. In this proposal, the agencies continue to solicit additional science (peer-reviewed whenever possible) that could lead to greater clarity, certainty, and predictability of which waters are and are not within the jurisdiction of the CWA.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of “other waters” to “waters of the US” (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22216:

The factors the agencies used in developing the list above are:
a. Density of ‘‘other waters’’ such that there can be periodic surface hydrologic connections among the waters, for example in West Coast vernal pools.
b. Soil permeability and surface or shallow subsurface flow such that the ‘‘other waters’’ can be considered hydrologically connected, such as many Texas coastal prairie wetlands.
c. Water chemistry which indicates that the ‘‘other waters’’ are part of the same system and influenced by the same processes.
d. Physical capacity of ‘‘other waters’’ to provide flood and sediment retention; this is a case where several small wetlands together may have a different effect than a single large wetland providing the same function, for example prairie potholes in the Missouri Coteau.
e. Co-location of waters to each other or similarly to the tributary system such that their cumulative and additive effects on pollutant removal through parallel, serial, or sequential processing are apparent, such as the role of pocosins in maintaining water quality in estuaries.
f. ‘‘Other waters’’ that are sufficiently near each other or the tributary system and thus function as an integrated habitat that can support the life cycle of a species or more broadly provide habitat to a large number of a single species.

The agencies request comment on the factors above and whether this list of factors is appropriate, and whether there are other factors that should be included or excluded from this list. Comments should address the science that supports each comment.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of "other waters" connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity to "waters of the US" (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

Page 22216:

Discussion of Hydrologic-Landscape Regions. Then:

The agencies seek comment on the technical bases for using ecoregions and hydrologic-landscape regions under this option. Commenters may also address whether some other method or combination of methods (certain ecoregions and hydrologic-landscape regions, for example) of mapping geographic boundaries is better supported by the science. Comments should also address whether and how this option is consistent with the science and the caselaw.

Modify paragraph to state:

Using Hydrologic-Landscape Regions and Ecoregions as a basis for determining the connectivity of hydrologic and biologic systems to "waters of the U.S." is an excellent first step in understanding the holistic nature of these systems in any location when combined with the HESA approach that involves characterizing the surface and subsurface elements of landscapes to determine flowpath networks at multiple temporal and spatial scales. Important elements include climate, geology, topographic relief, and the amount, distribution and types of waters and wetlands. These elements, in context with the HLRs and Ecoregions, can then be integrated to create a flowpath network that describes connectivity (Heath 1983; ASTM 1996; Kolm et al. 1996; Winter et al. 1998). The HESA approach has been extended to biological connectivity, paleohydrologic analysis (Kolm and Smith 2012), and hydrogeomorphic (HGM) wetland classifications (e.g., Kolm et al. 1998).

Page 22217:

3. Additional ''other waters'' approaches. The agencies request comment on additional ''other waters'' approaches considered, but not proposed by the agencies.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of "other waters" connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity to "waters of the US" (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (*lead discussants are: Drs. David Allan and Mark Rains)*

Page 22203:

The agencies specifically seek comment on the appropriate flow regime for a ditch excavated wholly in uplands and draining only uplands to be included in the exclusion of paragraph (b)(3). In particular, the agencies seek comment on whether the flow regime in such ditches should be less than intermittent flow or whether the flow regime in such ditches should be less than perennial flow as proposed.

The agencies request comment on this formulation of the ditch exclusion. The agencies specifically seek comment on the appropriate flow regime for a ditch excavated wholly in uplands and draining only uplands to be covered by the exclusion in paragraph (b)(3). In particular, the agencies seek comment on whether the flow regime in such ditches should be less than intermittent flow or whether the flow regime in such ditches should be less than perennial flow as proposed.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of ditches or other exempted features, including those features connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance, and to quantify feature connectivity to "waters of the US" (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

EPA's Proposed Rule

Preamble (explains the basis and purpose for the proposed rule)

The agencies acknowledge that there may be more than one way to determine which waters are jurisdictional as ''other waters.'' To best meet their goals and responsibilities, the agencies request comment on alternate approaches to determining whether ''other waters'' are similarly situated and have a ''significant nexus'' to a traditional navigable water, interstate water, or the territorial seas. In the discussion of ''other waters'' later in the preamble, the agencies seek comment on these other approaches and whether they could better meet the goals of greater predictability and consistency through increased clarity, while simultaneously fulfilling the agencies' responsibility to the CWA's objectives and policies to protect water quality, public health, and the environment.

Commenters will specifically be asked to comment on whether and how these alternate approaches may be more consistent with the goal of clarity, and the CWA, the best available science, and the caselaw. In particular, the agencies are interested in comments, scientific and technical data, caselaw, and other information that would further clarify which ‘‘other waters’’ should be considered similarly situated for purposes of a case-specific significant nexus determination. The agencies seek comment on a number of alternative approaches. These alternatives include potentially determining waters in identified ecological regions (ecoregions) or hydrologic-landscape regions are similarly situated for purposes of evaluating a significant nexus, as well as the basis for determining which ecoregions or hydrologic-landscape regions should be so identified.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of “other waters” connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity to “waters of the US” (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

II. Background -- Page 22190

C. Executive Summary -- Page 22190

Page 22195:

EPA and the Corps are very interested in identifying other emerging technologies or approaches that would save time and money and improve efficiency for regulators and the regulated community in determining which waters are subject to CWA jurisdiction. The agencies specifically invite comment on this topic.

Add:

HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of “adjacent waters”, “neighboring waters”, and “other waters” connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity to “waters of the US” (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

D. Background on Scientific Review and Significant Nexus Analysis – Page 22195

Page 22198:

In addition to the proposed ‘‘other waters’’ approach in this rule, the agencies are requesting comment on a range of alternate approaches to inform their decision on how best to address ‘‘other waters.’’ The agencies will consider the full administrative record, including comments requested and received, and the final Report, as revised in response to the SAB review, when developing the final rule, and may adopt one of the alternative approaches or combination of approaches and the proposal.

Add:

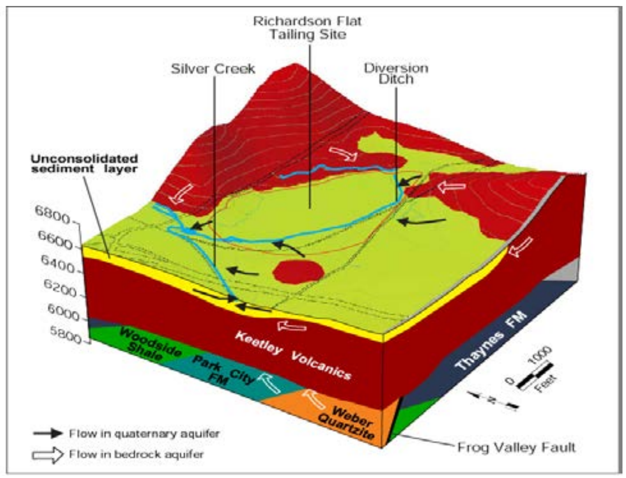
HESA is an approach that is based on four-dimensional flowpaths and can be used to clarify the connectivity of "other waters" connected through a shallow or deep subsurface hydrologic connection or confined surface hydrologic connection regardless of distance and to quantify connectivity to "waters of the US" (ASTM 1996; Kolm et al. 1996; Kolm et al. 1998; Kolm and Smith 2012; see description below).

The following description of HESA is modified from or described in ASTM Standard D5979. "Standard Guide for Conceptualization and Characterization of Groundwater Systems." (ASTM 1996); Kolm et al. (1996); Kolm et al. (1998); and Kolm and Smith (2012):

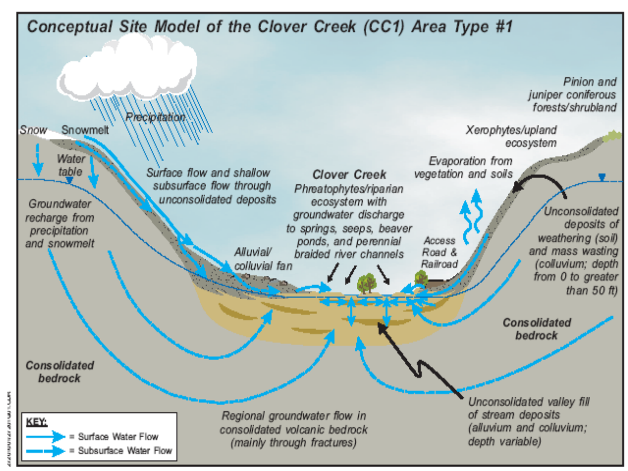
DESCRIPTION OF HYDROLOGIC SYSTEMS ANALYSIS (HESA)

APPROACH

HESA is an approach used to conceptualize and characterize relevant features of hydrologic and environmental systems, integrating relevant considerations of climate, topography, geomorphology, groundwater and surface water hydrology, geology, ecosystem structure and function, and the human activities associated with these systems into a holistic, three-dimensional dynamic conceptual site model (CSM). Using HESA, all relevant controlling factors of a particular environment can be identified at the planning/characterization stage, leading to more focused, cost effective strategies and better decision-making throughout a project or study.



HESA is completed by an interdisciplinary expert science and engineering team to ensure a rapid, cost-effective analysis resulting in cutting-edge regional and site-scale conceptual modeling and characterization of the hydrologic and environmental systems. This approach adds breadth and depth to standard modeling by identifying formerly unobserved relationships and interconnections at the micro, macro, and regional scales. This approach can be used during all stages of the project to develop a rigorous understanding of the past, present, and future behaviors of systems and processes. The resulting multi-temporal and multi-scale views allow for the users to reduce costs and incorporate sustainable practices in site decision-making through development of improved engineering solutions and mitigation of long-term environmental liabilities.



DOCUMENTED APPLICATIONS

HESA is used for mine and resource development and mined-land restoration, local and regional development and protection of groundwater and surface water supplies, watershed and site-scale pollution prevention and regulatory cleanup, and water rights and water quality regulation, expert witness and litigation support.

- Site-scale analysis for water resource characterization, remediation, modeling, and/or management
- Wetlands analysis for characterization and/or remediation – restoration, pollution prevention, cleanup
- Watershed-scale analysis for urbanization, water supply and quality, pollution, and superfund cleanup applications
- Multiple-scale analysis for environmentally sensitive resource development and mine/petroleum site closure applications
- Connectivity or Nexus of water bodies

SELECTED REFEREED REFERENCES

Kolm, K.E. and S.M. Smith. 2012. Chapter 5. Modeling Paleohydrological System Structure and Function. *In* Emergence and Collapse of early Villages: Models of Central Mesa Verde Archaeology. Edited by T.A. Kohler and M.D. Varien, University of California Press; Los Angeles, CA., pp. 73-83.

Kolm, K.E., and W.H. Langer. 2001. Hierarchical systems analysis in karst terrains: Part A. Approaches and applications to environmental characterization. U.S. Geological Survey Open File Report 00-429A, CD-ROM.

Langer, W.H., and K.E. Kolm. 2001. A systems approach to characterize and evaluate environmental impacts from aggregate mining, in Kuula-Väisänen, P., and R. Uusinoka, (eds). Aggregate 2001 – Environment and economy. Tampere University of Technology Publication no. 51, pp. 401–406.

Langer, W.H., and K.E. Kolm. 2001. Hierarchical systems analysis in karst terrains: Part B. Analysis of environmental impacts of aggregate mining. U.S. Geological Survey Open File Report 00-429B, CD-ROM.

Kolm, K.E., R.M. Harper-Arabie, and J.C. Emerick. 1998. A stepwise, integrated hydrogeomorphic approach for the classification of wetlands and assessment of wetland hydrological and geochemical function in the Southern Rocky mountains of Colorado. Colorado Geologic Survey, Colorado Department of Natural Resources Technical Report, Denver, CO.

Kolm, K.E. 1996. Conceptualization and characterization of ground-water systems using geographical information systems. In: Remote Sensing and GIS for Site Characterization: Applications and Standards, ASTM STP 1279, V.H. Singhroy, D.D. Nebert, and A.L. Johnson (eds). American Society for Testing and Materials, West Conshohocken, PA. pp. 120–134.

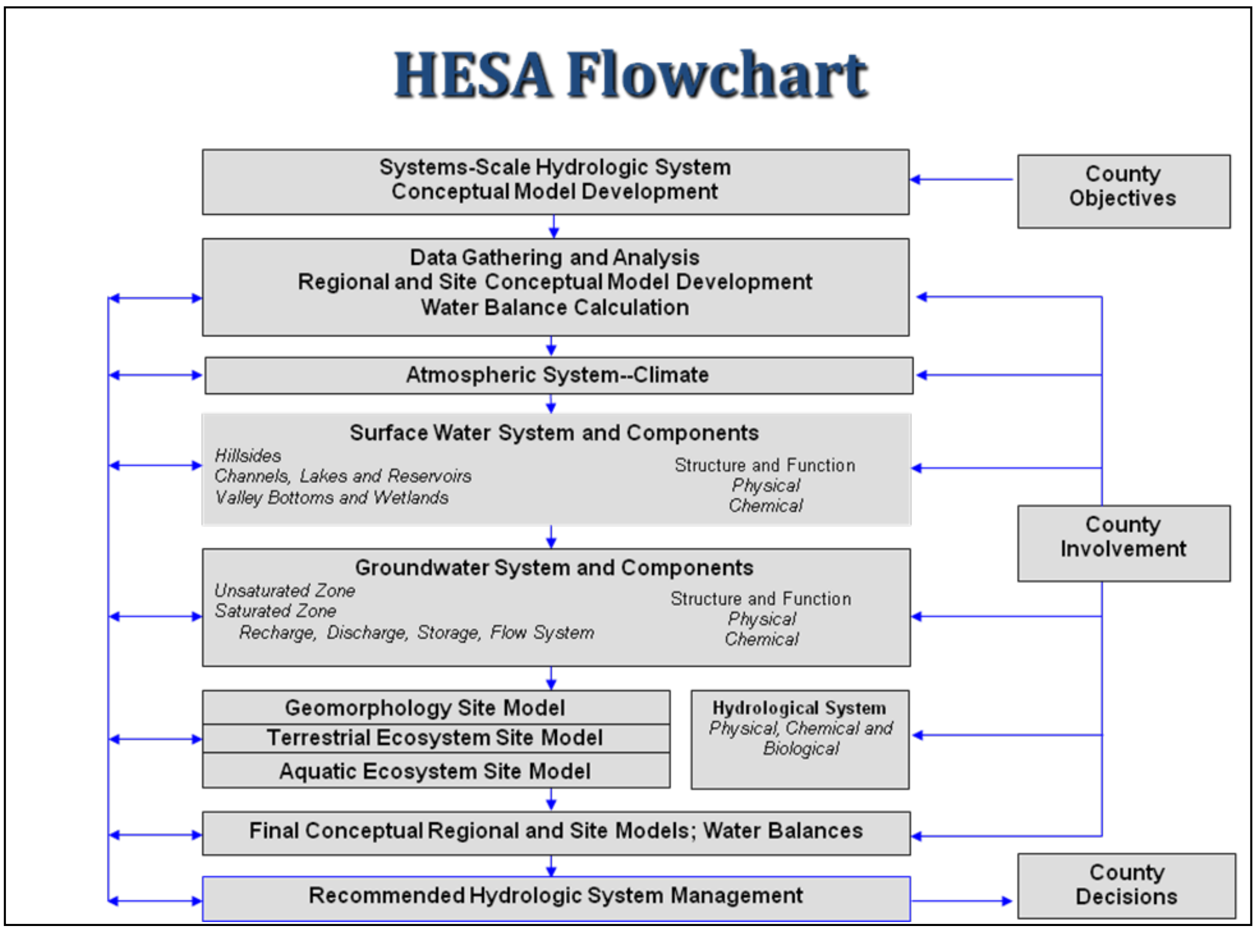
Kolm, K.E. 1996. Conceptualization and characterization of ground-water systems using geoscientific information systems. In: Special Issue: Advanced Techniques for Solving Groundwater Contaminant Problems. J. May, and K.E. Kolm (eds). *Engineering Geology* 42:(2–3):111–118.

Kolm, K.E., P.K.M. van der Heijde, J.S. Downey, and E.D. Gutentag. 1996. Conceptualization and characterization of ground-water flow systems. In: Subsurface Fluid-Flow (Ground-Water and Vadose Zone) Modeling, Ritchey, J.D., and J.O. Rumbaugh (eds). ASTM STP 1288, American Society for Testing and Materials, West Conshohocken, PA., pp. 61–80.

Talbot, W.R., and K.E. Kolm. 1996. Application of a step-wise, integrated method of characterizing hydrologic systems using GIS: A site-specific case study at an NPL site near Cheyenne, Wyoming. In: Special Issue: Advanced Techniques for Solving Groundwater Contaminant Problems. J. May and K.E. Kolm (eds). *Engineering Geology* 42(2-3):139–153.

May, J., and K.E. Kolm (eds). 1996. Special Issue: Advanced Techniques for Solving Groundwater Contaminant Problems: *Engineering Geology* 42(2-3):109–215.

The following logic chart, developed for applications regarding municipality water management (the word "county" could be replaced by "agency", for example), is modified from Kolm and Smith (2012):



Dr. Judith Meyer

Comments from Dr. Judy Meyer

I will not be able to participate in the teleconferences to be held this week, but look forward to being able to provide comments on the resulting report. I have read the proposed rule as well as the comments provided by other panel members. Since I won't be on the call, I am providing some brief comments in a slightly different form, namely as thoughts on the comments provided by other panel members in response to question 1, which covers my area of expertise. Essentially I am writing down some of the points I would have made had I been able to participate in the call.

I agree with the statements of most panel members that EPA and the Corps should be congratulated because of the clarity with which the strong scientific support for the proposed rule has been presented.

I agree with the statements of most panel members that the inclusion of all tributaries is consistent with best available science. Several panel members have provided extensive explanations of the scientific support for the inclusion of tributaries, and these explanations should be incorporated into our report.

Dr. Aldous raises what seems to be a legitimate concern about whether spring-fed tributaries with constant flow meet the OHWM requirement, but others with more experience with designation of OHWM in these types of streams may be able to clarify how OHWM is determined in these systems. Presumably if flow is that constant, the OHWM would simply be the current water level.

Dr. Allan and Dr. Johnson both raise important concerns about the exclusion of ditches that are in uplands. Dr. Tank's point that the flow regime in identified ditches be less than intermittent rather than less than perennial has merit. In addition to these important points raised, I wonder if the term "upland" has been adequately defined.

I do not agree with Dr. Josselyn's comments on the absence of scientific support for inclusion of headwater streams. Considerable scientific research has been done on first and second order headwater streams; the scientific research supporting the inclusion of tributaries is not limited to third and fourth order streams as he has stated.

I agree with several panel members who noted the scientific support for inclusion of human-altered channels in the definition of tributaries.

Dr. .Johnson makes an important point about the need for high resolution mapping products that should be part of our report.

Dr. Mark Murphy

Date: August 13, 2014

Subject: EPA Proposed Rule; Definition of ''Waters of the United States'' Under the Clean Water Act; 40 CFR Parts 110, 112, 116, et al.[1]

I have read and considered the Proposed Rule, as requested by the Chair of the SAB. I appreciate the opportunity to represent the technical community in this extended dialogue on the matter of Clean Water Act (CWA) applicability. This is a subject that my colleagues and I have pondered for many years and we welcome EPA's attempt to provide clarity. The complexities and subtleties of how to interpret the CWA are formidable. I might add as a disclosure, that I am a strong supporter of the CWA and have seen numerous examples of its protective power. My encouragement and criticisms over the course of this process only reflect my desire to establish a solidly defensible rule that can add to this power.

In this light, I must say I am puzzled as to why EPA has decided to release the Proposed Rule before receipt of our review of the Connectivity Report (EPA 2013). While I was told at our December 2013 meeting that a draft rule was in preparation, I hardly expected that the draft would be released to the public before our review. The usual protocol in science is not to release a report before the review is complete, the purpose being to allow a frank and honest appraisal of the work before positions are 'hardened' and reputations are placed in jeopardy. The sequence employed by EPA suggests to the public that there is no critical input needed by the SAB - - just a few minor additions. If I believed this to be the case, I would be very dismayed.

In point of fact, the SAB Review suggested that some *major* additions be made to the Connectivity Report. The most fundamental conclusion of the review was that a dichotomous, binary approach to connectivity is not supported by the existing scientific literature. As was stated in the letter to the EPA Administrator,

> "The (Connectivity) Report often refers to connectivity as though it is a binary property (connected versus not connected) rather than as a gradient. In order to make the Report more technically accurate, the SAB recommends that the interpretation of connectivity be revised to reflect a gradient approach that recognizes variation in the frequency, duration, magnitude, predictability, and consequences of those connections." (EPA 2014)

[1]Revised following 8/21/14 SAB teleconference. See final page.

Nature rarely gives yes or no answers. For this reason, jurisdiction by rule based upon dichotomous categories is simply not scientifically valid and appears to be based upon legal convenience. Jurisdiction by rule, as applied in the Proposed Rule, is not supported by the best available science.

The legal record also seems to support this conclusion. A gradient in connectivity is clearly directed by a common-sense reading of the Rapanos decision. The Proposed Rule states in several places that the term 'significant nexus,' used in the decision, is not a scientific term. That may be correct in the sense that the term is not found in the scientific literature; however, the phrase should be examined in the context of Justice Kennedy's next several comments,

> "The required nexus must be assessed in terms of the statute's goals and purposes. Congress enacted the law to 'restore and maintain the chemical, physical, and biological integrity of the Nation's waters.'"
>
> Rapanos v. United States, 547 U.S. 715 (2006)

Justice Kennedy, here and elsewhere, repeatedly relates the term 'nexus' and 'significant nexus' to 'chemical, physical, and biological integrity,' which *are* scientific terms. Nexus is defined by Webster as a connection and a connection of one part of an ecosystem to the chemical, physical, and biological integrity of another ecosystem, directly requires a cause-and-effect relationship to be a *consequence*. Therefore, significant nexus, scientifically defined, clearly requires that there be a cause-and-effect, connective relationship between the water body under examination and some downstream aquatic ecosystem, 'traditionally navigable' if we continue with Justice Kennedy's opinion.

The term 'significant' still needs better clarity. Non-technical significance is a vague concept, whether legally or politically approached. It is never defined in the Proposed Rule other than to say that it's not 'speculative' or 'insubstantial.' Scientific significance is not at all vague, as any first-year grad student quickly learns. The definition of significance in science is directly dependent upon a proposed cause-and-effect hypothesis and the repeated testing of the explanatory adequacy of that hypothesis. For example, if I flip a coin, I hypothesize that it will land as either heads or tails. Repeated trials of the coin-flipping experiment show the repeatability of the results and the adequacy of my explanation. If the coin always comes up heads or tails, then the 'always' part of the result is the 'significance' of the hypothesis, which can be quantified in many ways using statistical methodologies (Ellison 1996, Johnson 2014).

In actuality, the coin could actually land on its edge. I've never seen that happen, but it could happen. However, if the statistically based likelihood of this outcome is less than some accepted level, the hypothesis of a non-heads-or-tails outcome is called 'insignificant.' This is not the same as creating a dichotomous model of the coin flipping hypothesis; it simply states that most of the time coins come up heads or tails. Using this simple example, jurisdiction by rule is akin to saying the coin will *never* land on its edge - - a reasonable conclusion only if we know the 'one in a million' statistical data for the coin flipping experiment. And in Nature, the experiments are almost never this simple.

In any case, if the term 'significant' has any scientific relationship to 'chemical, physical, and biological integrity' there would be a hypothetical cause for the consequential harm to that integrity. Repeatable trials (or more likely in ecology, observations) of that cause- and-effect hypothesis would demonstrate the ***scientific*** significance of its power to explain the downstream effect.

During the SAB Review, the panel was explicitly told not to discuss the definition of significance; however, the cause-and-effect based definition discussed above is clearly implied throughout. For example, in section 3.1 of the SAB Review, the authors state:

> "As noted in the many public comments to the SAB, the binary perspective in the (Connectivity) Report implies that any connectivity must *significantly affect* the biological, physical, or chemical integrity of downstream waters. Although connectivity is known to be ecologically important even at the lower end of the gradient, the frequency, duration, predictability, and magnitude of connectivity will ultimately determine the *consequences* to downstream waters." (EPA 2014)

This must be the approach used by the Proposed Rule, if it is to have a defensible basis in science. The significance of the connection must be defined by the likelihood of a measurable effect, which is controlled by the transport mechanism and pathway through the watershed.

This concept of a gradient of connectivity and downstream consequences is taken from the science of disturbance ecology (Fisher 1983, Resh et al 1988, Poff et al 1997, Stanley et al 2010), which was not characterized in the Connectivity Report and is not represented in the Proposed Rule. Given a cause in the watershed, disturbance ecology characterizes the downstream effect on the physical, chemical and biological integrity of the affected community.

These effects are scientifically related to the magnitude (the absolute or relative size of the disturbance), the duration (how long the disturbance lasts), the frequency (how often does it return) and the predictability (how regularly the disturbance returns). Effects upon the geological morphology of a stream, the watering of the riparian plant community, the life cycle of fish or invertebrates and the biodegradation of chemical pollutants can be characterized as effective or trivial based upon established dependencies between harm to physical, chemical and biological integrity of the downstream ecosystem and the values of these four data. For example, in the case of an ecological risk assessment, these metrics could define the exposure risk of a target organism to a chemical stressor (EPA 1998).

Any hypothesis of a upstream disturbance cause and downstream disintegrative effect can be tested for scientific significance using these four parameters, in addition to, or combination with, other factors specific to the target population. These four parameters establish the temporal scale of scientific significance, in this case, and it is the lack of this fundamental ecological concept that causes the Proposed Rule to be flawed.

Where the spatial scale is conflated with the temporal scale, these flaws become even more damaging. For example, on page FR22263 and subsequent pages the term 'floodplain' is defined as:

> ". . . an area bordering inland or coastal waters that was formed by sediment deposition from such water under present climatic conditions and is inundated during periods of moderate to high water flows."
>
> - FR, vol.79, no.76, p.22263

While this definition might work for a casual description of a local stream, it is not otherwise useful. This definition would include my backyard - - far outside of the hydrologically defined floodplain of my local watercourse (Painted Hills Wash), inundated by water as I type this because of a cloudburst. Such a definition would have no scientific utility unless there was a way to incorporate a temporal and spatial scale for the disturbing 'high water flow' that would exclude a summer thunderstorm.

The curious thing about the Proposed Rule is that the need to establish the disturbance scale and its scientific significance to downstream traditional waters *is* discussed in the section on 'adjacent' and 'other' waters. There is no scientific justification presented in the Proposed Rule to explain this abrupt shift away from the dichotomous definition of connectivity used elsewhere. For example, the preamble states:

> "Examples of confined surface water hydrologic connections that demonstrate adjacency are swales, gullies, and rills. The frequency, duration, and volume of flow associated with these confined surface connections can vary greatly depending largely on factors such as precipitation, snowmelt, landforms, soil types, and water table elevation. It is the presence of this hydrologic connection which provides the opportunity for neighboring waters to influence the chemical, physical, or biological integrity of (a)(1) through (a)(5) waters."
>
> - FR, vol.79, no.76, p.22210

This statement admits that disturbance parameters ('frequency, duration, and volume of flow') and other spatially and temporally variable factors ('precipitation, snowmelt, landforms, soil types, and water table elevation') provide the opportunity for influence, not the simple existence of a channel (i.e., swales, gullies or rills), which in this case are exempted by rule.

Further, on page FR22214, the preamble states, in reference to 'other waters:'

> "When evaluating an ''other water'' individually or cumulatively for the presence of a significant nexus to an (a)(1) through (a)(3) water, there are a variety of factors that can be considered that will influence the chemical, physical, or biological connections the ''other water'' has with the downstream (a)(1) through (a)(3) water. The likelihood of a significant connection is greater with increasing size and decreasing distance from the identified (a)(1) through (a)(3) water, as well as with increased density of the ''other waters'' for ''other waters'' that can be considered in combination with similarly situated waters."
>
> - FR, vol.79, no.76, p.22202

The preamble then goes into specifics on the physical, chemical and biological basis for determining the 'likelihood of significant connection,' which in each case resembles a simplistic disturbance analysis conducted to ascertain the scientific significance of a cause-effect hypothesis for an aquatic ecosystem.

Such a 'likelihood of significant connection' is well understood and utilized across regulatory science, including EPA's National Center for Environmental Assessment (NCEA). NCEA is a professional leader in research on the quantitative and predictive risk-based effects of human disturbance on ecosystems. It is inconceivable that the Proposed Rule would have no input from the nearly 40 years of connective ecological risk research conducted by NCEA.

The consequences of measurable effects due to disturbance are also well researched by EPA, under the Office of Water, Water Quality Standards and Criteria program. Water quality criteria are an explicit result of measuring what constitutes a scientifically significant nexus between a surface water pathway exposure and a resident aquatic species. There is no better way of assessing the impact of a watershed connection than its potential to degrade the water quality of receiving waters or violate water quality standards for those waters. Yet no reference to either water quality standards or the science for setting them appears in the Proposed Rule.

There is no scientific justification for applying case-by-case jurisdiction to 'adjacent' and 'other' waters and not applying it to *all* potentially jurisdictional waters. The SAB review suggested that the EPA apply a pathway model to establish a scientifically significant nexus, to wit:

> "The conceptual framework in the Connectivity Report should generally express the importance of climate, geology (surface and subsurface), topographic relief, and biology on flow and transport. The resulting three-dimensional structure should show potential surface, near surface, and subsurface *pathways*, which then can be analyzed in terms of hydrological, chemical, and biological connectivity in four dimensions (i.e., with the temporal dimension included)." (EPA

2014, Italicized for emphasis)

This is the approach that has been followed by the US Army Corps of Engineers in their jurisdictional determinations for many years. It is the only way that is compatible with current scientific theory and practice.

A good example can be found in the arid Southwestern US. It is interesting that the preamble specifically mentions the Southwest, to wit:

> "Also, in many intermittent and ephemeral tributaries, including dry-land systems in the arid and semi-arid west, OHWM (ordinary high water mark) indicators can be discontinuous within an individual tributary due to the variability in hydrologic and climatic influences. The agencies proposed definition of ''tributary'' addresses these circumstances and states that waters that meet the definition of tributary remain tributaries even if such breaks occur."
>
> - FR, vol.79, no.76, p.22202

The fact is that OHWM indicators are discontinuous because *flow paths* are discontinuous and connectivity across them can drop to a near-zero scientific significance. For example, the bed and banks of the Santa Cruz River are quite clear where Painted Hills Wash leaves my neighborhood and joins the river and there would be little difficulty in establishing that a disturbance in the wash, which flows a couple of times a year, has a scientifically significant nexus to the Santa Cruz River ecosystem. However, the river completely loses all physical, chemical and biological character about 40 miles south of the wash on the Santa Cruz Flats. According to Webb and co-workers (2014),

> "Little if any sediment entrained upstream of Marana (immediately north of Tucson) makes it through the Santa Cruz Flats to the Gila River, except during rare, large floods. Indeed, most maps do not show a channel crossing this nearly featureless plain. Most of the time, the lower Santa Cruz valley functions as a closed basin, with all the water and sediment from the Tucson Basin trapped on the alluvial plain downstream of Marana."

Given this, it is unclear, and scientifically unjustified, why the jurisdictional determination of 'adjacent and other waters' needs to consider the 'likelihood of significant connection,' yet the Santa Cruz River at Tucson is included by rule, as a tributary of the Colorado River, a traditionally navigable water of the US.

In the case of some waters (probably the vast majority of perennial, intermediate and ephemeral streams, floodplain and non-floodplain wetlands) a pathway analysis would be simple and beyond dispute. In other cases, the results would be less clear. These other cases may be the subject of intense scientific debate. But such is science when it properly serves the public good. Case-by-case evaluation may be legally inconvenient; however Nature is rarely respectful of the Law.

1.0 SPECIFIC COMMENTS:

1.1 The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment.

As stated in my introductory comments, the inclusion by rule of all tributaries to traditional navigable waters is not scientifically justified by the published literature, the Connectivity report or the SAB review. Inclusion by rule violates the conclusion of the SAB review that connectivity exists as a gradient of causal phenomena that operate variably over flowpaths, and result in consequential disturbances in the watershed. These consequences contribute to or harm the integrity of the physical, chemical and biological functions supporting the affected ecosystem to a highly varied degree. The scientific significance of these flowpaths is a function of the disturbance scale, which can be measured in the frequency, duration, predictability, and magnitude of the disturbance. The probability of such a disturbance having a scientifically significant disintegrative effect on a downstream ecosystem creates the gradient of connectivity described in the SAB review, as currently used by the ecological sciences.

1.2 The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary.

The definition of and inclusion by rule of adjacent waters also is inconsistent with the published literature, the Connectivity report or the SAB review. Once again, the concepts of 'connectivity,' 'spatial and temporal scale,' 'connective flowpaths,' 'disturbance ecology' and 'ecological function' are implicitly defined as dichotomous conditions or parameters and this violate the idea of a gradient in connectivity that is found throughout the SAB and at the heart of ecological theory and practice. The definition of significant nexus used in the Proposed Rule is scientifically flawed and does not employ modern concepts of scientific significance and statistical inference.

1.3 The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas.

This part of the Proposed Rule has the closest conformity to existing scientific practice, admitting in numerous places the validity of the conclusions of the SAB review that connectivity is a gradient and not dichotomous property of a watershed and that jurisdiction by rule is not scientifically valid. The suggested defeat of EPA in addressing 'other waters' is only reasonable given that they did not take the same approach as the SAB members, namely,

> "If the goal of defining and estimating connectivity is to protect downstream waters, the interpretation must move from a dichotomous, categorical distinction (connected vs. not connected) towards a gradient approach that recognizes variation in the strength, duration and magnitude and effect of those connections. The SAB recommends that an integrated systematic approach be taken to conceptualize the structure and function of non-floodplain wetlands." (EPA 2014)

which is taken from section 3.8 addressing non-floodplain wetlands (aka 'other waters') of the SAB review. The gradient approach to connectivity is recommended twenty-eight times in the SAB review and ten times in sections 3.7 and 3.8 with regard to other waters. If an approach is used that recognizes that the temporal and spatial variation in transport properties *fundamentally* produces this gradient in connectivity, EPA could define the level of connectivity that would be protective or non-protective of downstream traditional waters of the US and have a fully workable definition. Stated briefly, a jurisdiction by rule of 'other waters' is intractable because science does not support such a distinction.

1.4 The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.

In general, the excluded waters defined in the Rule seem reasonable but are vague in definition. For example, it is important to distinguish between artificial or natural systems that are still within the wastewater treatment train and receiving waters of the US. There is currently no general demarcation made between treatment wetlands versus receiving waters and this causes a great deal of confusion in the regulated community. For example, requiring compliance of constructed treatment wetlands to the same standards as wetlands defined as waters of the US may impede the treatment techniques employed by the constructed wetlands and degrade their protective function. Once again, the scientifically significant effect on downstream traditional waters of the US needs to be technically established in order for this distinction to have meaning, particularly in the case of constructed wetlands that have been engineered to be isolated during treatment.

The exclusion of ditches by rule is a good first step. There is some uncertainty about the requirement that excluded ditches that:

> "do not contribute flow, either directly or through another water, to a water identified in paragraphs (a)(1) through (4) of this section."
>
> - FR, vol.79, no.76, p.22263

Once again, this is a dichotomous distinction and is not consistent with either the SAB review or published scientific opinion. Given enough rain, all ditches have the potential to contribute flow to a downslope waterbody, even in a topographically closed basin. Thus, it would be impossible to meet these criteria, unless some gradation, based upon scientifically significant effects, was established in the Proposed Rule.

It is not obvious why ditches that flow only in response to rainfall runoff, aka ephemeral ditches, are excluded by rule yet ephemeral streams are included by rule. This seems to imply that there are mitigating factors in the construction of ditches that make them more protective of downstream waters. This may be the case; however, without further discussion there is no technical reason in the Proposed Rule to presume this, in general. The exclusion of rills and gullies by rule is also an excellent proposal. Much regulatory and industry effort has been expended on defining rills and gullies, particularly in the surface mining industry. Some progress has been made on the technical definition of rills and gullies, aka, temporary erosional features. It is important to understand that there is a distinction between transitory rills and gullies that lead to a stable, integrated hillslope drainage system and destructive rills and gullies that indicate faulty slope design or unintended changes in hillslope rainfall/runoff behavior. It is the latter that usually produces degradation of the physical and biological ecosystem. Once again, a gradient in the temporal and spatial scale is critical to the definition of a jurisdictional exclusion by either rule or on a case-specific basis. It is important for the Proposed Rule to define excluded rills and gullies with temporal and spatial criteria of landscape stability that can be refined by the agencies in regulation or guideline.

2.0 REFERENCES CITED

Ellison, A.M. (1996). An introduction to Bayesian inference for ecological research and environmental decision-making. Ecol. Appl., 6, 1036–1046.

EPA, U.S. Environmental Protection Agency

EPA (1998) Guidelines for Ecological Risk Assessment. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/630/R095/002F

EPA (2013) Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence EPA/600/R-11/098B, September 2013, External Review Draft

EPA (2014), Science Advisory Board Draft Report on the Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence (7/14/14)

Fisher, S. G. (1983). Succession in streams. In Stream Ecology (pp. 7-27). Springer US.

Johnson, V. E. (2013). Revised standards for statistical evidence. Proceedings of the National Academy of Sciences, 110(48), 19313-19317.

Poff, N. L., Allan, J. D., Bain, M. B., Karr, J. R., Prestegaard, K. L., Richter, B. D., ... & Stromberg, J. C. (1997). The natural flow regime. BioScience, 769-784.

Resh, V. H., Brown, A. V., Covich, A. P., Gurtz, M. E., Li, H. W., Minshall, G. W., ... & Wissmar, R. C. (1988). The role of disturbance in stream ecology. Journal of the North American Benthological Society, 433-455.

Stanley, E. H., Powers, S. M., & Lottig, N. R. (2010). The evolving legacy of disturbance in stream ecology: concepts, contributions, and coming challenges. Journal of the North American Benthological Society, 29(1), 67-83.

Webb, R.H., J.L. Betancourt, R.R. Johnson, R.M. Turner. (2014) Requiem for the Santa Cruz: An Environmental History of an Arizona River, The University of Arizona Press, Tucson, AZ, xvi+296 pp.

Statement added for clarification: Responding to the DFO's request to modify comments, if necessary, I don't wish to change any of the preceding comments; however, I do wish to respond to one comment made by a fellow SAB member. During the discussion of issue 1, regarding tributaries to navigable waters, Dr. Josselyn was asked if he could provide any scientific papers that supported the idea that headwater streams in the arid West were 'not important' to downstream waters. I think both Dr. Josselyn and I were taken aback since this question suggested such a fundamental misunderstanding of our shared position - - that it was scientifically unsupported to claim that ALL headwater streams, particularly in the arid West, had a significant nexus with downstream waters. Disagreement with this claim certainly does not include the converse to the Proposed Rule, that NO headwater streams have a significant nexus to downstream waters. Some do and some clearly do not.

As both Dr. Josselyn and I pointed out in our comments, the SAB report and the ecological literature consistently indicate that connectivity exists on a gradient and for the arid West, because of the abundance of ephemeral streams, that gradient varies strongly in space and time. This ecological fact differs fundamentally from studies of the more mesic regions of the country, for example, Hubbard Brook Experimental Forest (Fisher et al 1982, Graf 1988, Benke 2000, Osterkamp & Friedman 2000, Stromberg 2001, RWRD 2002, Levick et al 2008, Arriana Brand 2011). This variation occurs in the magnitude, duration, frequency and predictability of flow in ephemeral streams and creates a strong gradient in the effects of headwater ephemeral streams on downstream jurisdictional waters.

The misapprehension of this fact by EPA in developing the rule is suggested in the Power Point slide presented in the August 21st teleconference, which stated:

'Streams are "hydraulic highways" transporting materials, chemicals, organisms'

No, they are not. Streams, and particular watersheds, are not unbroken transport engines, regularly churning out water and nutrients. I would point out that the 'streams as highways,' analogy is the kind of simplistic thinking that brought the country such ecological disasters as the Los Angeles River, the Peripheral Canal and the Kissimmee River. Watersheds are better served by the Gaia analogy, a living organism, constantly adapting to changes in weather and geology. In the arid West, streams reflect a quite different geographical environment than the White Mountains of New Hampshire.

In summary, while ephemeral headwater streams in the arid West are always 'important,' their effects on downstream waters are scaled by temporal and spatial variability in the transport of mass and energy and the magnitude, frequency, duration and predictability of flow events. This variation supplies the scientific basis of their significance to downstream jurisdictional waters. For this reason, inclusion by rule of all ephemeral tributaries, 'regardless of size or flow duration,' is not scientifically justified.

Dr. Duncan Patten

Patten Response to Questions Re: Scientific adequacy of draft policy of Waters of the US.

Question 1 response. The development of scientific support for there being a significant nexus between tributaries and traditional "waters" is more than adequate. The proposed rule explains how tributaries both individually and in aggregate can influence the physical, chemical and biological integrity of traditional waters. This is true as the tribs are shown to be an integral part of the watersheds that "feed" traditional waters. The science demonstrates that this is true whether the tributaries are perennial, intermittent or ephemeral.

Question 2 response. The significant nexus related to adjacent waters (including wetlands) to traditional waters is based on the science of hydrology and the demonstration of shallow aquifer connections. Without the shallow aquifer connections the wetlands would tend to fall into the "isolated" wetlands category and not be connected. Ecological science shows limited biological connections but these are important aspects of the connectivity and can be demonstrated scientifically through studies of the hyporheic zone.

Question 3 response. This description of a significant nexus of other waters that have to be considered on a case-specific basis requires a strict understanding of the actual connection that can be satisfied through relationships to other waters. Without the significant nexus which requires a thorough understanding of physical, chemical or biological connectivity, the connection will not hold. Thus, the qualifier of this condition is the need for scientific studies of each case and a general discussion of significant nexus in the policy and its supporting science is inadequate.

Question 4 response. The exclusion of specified waters in the policy where that exclusion occurs is generally sound and the science that supports these exclusions is also adequate to make such exclusions. Most of the exclusions are not interstate waters and are modified by human activity. Where modifications are made of traditional waters, those waters continue to be considered Waters of the US and though scientific studies might show the connectivity has been altered the status remains.

Question 5 response. The following text was prepared during a general review of the draft policy and might have several points that can be used in the discussion of the scientific adequacy of the policy.

General Comments:

The document uses the scientific foundation established in the "review of literature" document reviewed by the SAB panel. This whole document was included in the Federal Register document for draft policy. The document also bases some of its recommendations on interpretations of the several US Supreme Court decisions, thus both science and legal standing are a foundation of the draft policy.

The document lists what are recognized presently as Waters of US, i.e., interstate waters, navigable waters, tidal waters…how other waters relate to these, i.e., physical, biological and chemical influence (i.e., "connections to and interactions with"). These are then used to define and explain what are or will be considered Waters of US in the future and thus open to regulation.

The importance of the aggregated influence by water bodies on recognized Waters of the US is used throughout the document and science is used as the foundation for this. This, along with use of watershed as a spatially integrating entity, ecologically helps expand the concept of what might be defined as Waters of the US.

The document lists many water bodies that are not considered Waters of US and justification (science and legal) for these exclusions is sound and adds strength to justification for those water bodies that are included under this new policy.

In an attempt to explain "significance", which is described as a non-scientific term "in light of law and science", the document side steps to the use of "relative strength of downstream effects" to inform conclusions of significance; however, there is no clear explanation of what "relative strength" means or how it might be developed or determined. One assumes that use of "information" from the scientific literature review will address this, but this is not clear and a gradient of strength of connection should be developed as an influence of a water body on recognized Waters of the US that is small may be as important as one that is great.

Later in the document, "significant nexus" is explained as waters (including wetlands), either alone or in combination that significantly affects chemical, biological or chemical integrity of recognized Waters of US. Use of "significantly" in the definition of "significant nexus" is bothersome and there is little or no explanation (science or legal) of what "significant effect" means.

The document offers good and sound explanations of chemical, physical and biological connectivity which support other discussion points on these issues. Under physical connectivity there is some mention of "depth to water table" which is not clear. Under biological connectivity emphasis is placed on "life cycle dependency" on the aquatic resource which rightly eliminates many biological connections that are transitory, such as migratory birds that have no life cycle dependency of the water body.

Specific Comments:

Tributaries as Waters of the US. The document presents several ways nearly all tributaries are included as waters of the US and answers its own question of "why conclude all tributaries are Waters of the US?" These include:

A. Those the flow directly into recognized Waters of US.

B. Those that flow into or through tributaries included in A above.

C. Those that in aggregate influence the Waters of US.

When tributaries are considered "Waters of US", the document uses both science and legal concepts of "significant nexus" to demonstrate that the tributaries can be perennial, intermittent or ephemeral. This is a legitimate use of these water types as they all are scientifically shown to influence the physical, chemical or biological integrity of recognized Waters of US. This is explained in the text and demonstrated in the literature review. The importance of their being included as Waters of US is supported when the document states "the effects of small water bodies in a watershed need to be considered in aggregate" which emphasizes the importance of integration of effects from several water bodies. The proposed definition of waters of the US also emphasizes the importance of tributaries that "flow directly or indirectly" to a recognized water of the US. These waters would become "Waters of the US"… this legitimately builds on the concept of tributaries being Waters of US if they flow into or through tributaries that are recognized as "Wters of US". Science included in the literature review section supports this integration of the cumulative effects of several water bodies.

Other waters: the document mentions that there are "other waters" (than those already described as waters of US), which includes tributaries, that may be considered but emphasizes that these will be considered on a case specific basis. The use of case specific approach was much more common in earlier definitions of Waters of US and thus those being considered on a case-specific basis are fewer than earlier.

Concept of "adjacent" and/or "neighbor" appears to be used to support wetlands and riparian areas that are next to Waters of US, especially if there are shallow subsurface hydrological connections. This concept is confusing as in the past riparian areas were not included as "waters of US", so does this mean that they will be in the new policy? Wetlands as sources of water of parts of tributaries do become "Waters of US" under new policy. This is scientifically defensible because they are influencing hydrology and ecology of recognized Waters of US.

Ditches. The document discusses ditches that are not excluded. One such ditch, those with perennial flow is included but the source of this perennial flow should be considered as a part of accepting this kind of ditch as a Water of US.

Other water bodies mentioned: Playa lakes are discussed. They are excluded unless they are interstate bodies of water. This appears to be the only way "geographically isolated wetlands" are included under Waters of the US. These types of waters are fully described in Tiner's Wetland paper, "Geographically Isolated Wetlands of the United States" which describe the importance of these water bodies but also their isolation from recognized waters of the US. Is there science (hydrologic and/or ecologic) that should be considered that may make some of these isolated waters (wetlands) Waters of the US in addition to the interstate rule?

Dr. Mark Rains

Comments of the Proposed Definition of Waters of the United States

These comments are focused on and organized around the proposed definition of Waters of the United States, hereafter referred to as waters of the US. However, these comments in many cases resonate throughout the other sections of the proposed rule.

Summary

In general, the proposed rule is well-reasoned and adheres to the core conclusions in *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence* (EPA/600/R-11/098B, September 2013, External Review Draft), hereafter referred to as the *Connectivity Report*. To date, the SAB has recommended numerous revisions to the *Connectivity Report*. These recommended revisions are largely aimed at strengthening the *Connectivity Report*, rather than at changing the core conclusions of the *Connectivity Report*. Therefore, the proposed rule does not require major revisions. However, there are remaining issues that could be better addressed in the proposed rule and therefore better enable to regulated community to understand the scope of the proposed rule.

Type (a)(1) Waters: Traditional Navigable Waters

The Constitution and legal statutes provide clear authority for the federal government to regulate this type of water of the US. No further comment is offered.

Type (a)(2) Waters: Interstate Waters

The Constitution and legal statutes provide clear authority for the federal government to regulate this type of water of the US. No further comment is offered.

Type (a)(3) Waters: Territorial Seas

The Constitution and legal statutes provide clear authority for the federal government to regulate this type of water of the US. No further comment is offered.

Type (a)(4) Waters: Impoundments

The *Connectivity Report* and other literature clearly establish that impounding waters affects the chemical, physical, and biological integrity of both downgradient and upgradient waters. Downgradient effects are well established in the literature, with fundamental effects on ecosystem structure and function extending well downstream of the impoundment (e.g., Ward and Stanford 1995; Stanford and Ward 2001). In the upgradient direction, impoundments obviously inundate the impounded area, but also can have substantive effects further upgradient of the impounded area, such as raising groundwater and changing vegetation in adjacent wetland areas (e.g., Rains et al., 2004) and restricting upstream migration of anadromous fish (Raymond 1979). Therefore, there is a well-established and well-reasoned justification for defining these waters as waters of the US.

Type (a)(5) Waters: Tributaries

The *Connectivity Report* and other literature clearly establish that tributaries affect the chemical, physical, and biological integrity of downgradient waters. However, the definition of tributary remains somewhat unclear. This is typical of any effort to classify continuous landscapes (e.g., flowpaths from ridges to reefs) into discreet categories (e.g., hillslopes, headwater streams, mainstem rivers, nearshore marine environments). Still, this is an extremely important classification, especially on the upgradient edge where there is a transition from "not a water of the US" (e.g., hillslope) to "water of the US" (e.g., tributary). This "edge", of course, is not an edge at all – rather, it is a transitional area that changes in time.

The time element is particularly problematic, because the areas over which runoff is generated change in time. These "variable source areas" expand and contract and therefore change the way that landscapes connect through storms and seasons (Dunne and Black 1970). This has particularly important implications in regards to both infiltration-excess and saturation-excess overland flow, both of which being highly variable in space and time. It is through variable source area expansion and contraction that waters can be surface-water isolated at times to being the headward extent of tributaries at other times (e.g., Rains et al. 2008). In many landscapes, especially the arid and semi-arid western US, these intermittent or ephemeral connections are critical, providing much of the connectivity that facilitates the transport of mass, energy, and organisms to downgradient waters (e.g., Izbicki 2007).

Given these complexities, I think it important to clearly define the headward extent of tributaries. The proposed rule tries to do so, and does an admirable job of trying to draw that bright line. However, I think it important for the proposed rule to clearly discuss the difficulty of drawing such a bright line on a continuous landscape, allowing the flexibility to for field personnel to define functional tributaries, even where those functional tributaries might lack obvious indicators of bed and bank (e.g., alluvial deposits on the bed of a headwater stream in a humid mountain setting) but have less obvious indicators of tributary flows (e.g., directionally bent herbaceous vegetation and subtle debris lines in swales connecting vernal pools to downstream waters in arid and semi-arid settings). One way to do so would be to allow the use of additional indicators and/or field data (e.g., stage or flow data, or the equivalent) in the absence of clearly defined bed-and-bank features.

Type (a)(6) Waters: Adjacent Waters

The *Connectivity Report* and other literature clearly establish that adjacent waters affect the chemical, physical, and biological integrity of downgradient waters. However, the Connectivity Report and this proposed rule could go a step further, defining adjacent waters as part of the waters to which they are adjacent. Rivers are not just channels – rather, rivers are channels and adjacent riparian areas, including all adjacent wetlands (Ward and Stanford 1995). Therefore, the proper functioning of the river, and therefore the chemical, physical, and biological integrity of downgradient waters, is a function of both channel and adjacent riparian areas, including all lateral exchanges of mass, energy, and organisms between the channel and the riparian area. While it may be convenient to separately define channels as type (a)(1) or type (a)(5) waters and adjacent wetlands as type (a)(6) waters, it is nevertheless important to acknowledge that this is a matter of convenience and that these are in fact one continuous and interconnected hydrologic system. Such an explanation would help justify the extension of the definition of waters of US to include these adjacent wetlands.

The proposed rule clears some existing confusion as to the meaning of "bordering, contiguous, or neighboring" by defining riparian area and floodplain consistent with the literature and common scientific usage and further explaining that short, surface and shallow subsurface connections can connect wetlands outside the immediate riparian area and/or floodplain to the river. The proposed rule should consider stating that wetlands in the riparian area and/or on the floodplain are always adjacent, while wetlands outside the riparian area and the floodplain might or might not be adjacent, depending upon a significant nexus determination. (See "Other Waters", below for further discussion about case-by-case decisions.)

Type (a)(7) Waters: Other Waters

The *Connectivity Report* and other literature clearly establish that other waters can affect the chemical, physical, and biological integrity of downgradient waters, though they do so on a gradient from having negligible to important effects. The proposed rule therefore will treat these not as waters of the US by definition but, rather, as waters of the US on a case-by-case basis if there proves to be a significant nexus between the other wetland or group of wetlands and the chemical, physical, and biological integrity of downgradient waters. While the science supports this as a general approach, it will be important to carefully define what is meant by "case-by-case", and what happens following a case in which specific other wetland or group of wetlands are determined to be waters of the US.

The proposed rule defines a group of wetlands geographically, grouping wetlands only within a given watershed. The proposed rule then defines watershed as all land from which surface water could drain to the nearest single entry point to a type (a)(1)-(a)(3) water. Such a definition has some problems.

There could be innumerable groups on uplands directly adjacent to a linear type (a)(1)-(a)(3) water. Imagine, for example, a navigable river running along the toe of a hillslope with innumerable seeps and springs, each of which or small groups of which discharging at different single points of entry to the river. Further imagine that the seeps and springs are a single hydrologic system, recharging due to infiltration of precipitation at the ridgetop and expressing along a linear geologic contact that outcrops at a common elevation all along the hillslope. By the proposed definition of watershed, one might conclude that a significant nexus assessment would need to be conducted above every single point of entry, thereby conducting a significant nexus assessment many times over on the same hydrologic system. This would be a clear waste of effort, because a single, well-designed and well-conducted significant nexus assessment would likely suffice. And, if a single, well-designed and well-conducted significant nexus assessment would likely suffice in the case above, then the logical extension might be that a single, well-designed and well-conducted significant nexus assessment might also likely suffice for any single type of hydrologic system, if such a type of hydrologic system were well defined.

Consider, for example, vernal pools in the Sacramento Valley. Both east and west sides of the Sacramento Valley are draped with Pleistocene to Pliocene alluvial fans terminating at the Holocene basin floor along the Sacramento River. These alluvial fans are nearly level to undulating but gently slope toward the basin floor. They have well-developed drainage networks, being dissected by streams and rivers tributary to the Sacramento River. Major geologic formations include the Riverbank and Red Bluff formations, with the Riverbank formation being 130K-450K BP in age and the Red Bluff formation being 450K-1.08M BP in age (Helley and Harwood, 1985), both of which being old enough for substantive pedogenic processes to have occurred (Helley and Harwood, 1985; Smith and Verrill, 1998). The USDA–Natural Resources Conservation Service has mapped several soil series with silica- and iron-cemented duripans on these formations, including the Redding series. These formations are also old enough for substantive subaerial erosion to have occurred, so microtopographic relief also is well developed, with mound-depression topography and irregular to coherent and intermittent to seasonal drainage networks commonly connecting depressions to streams and rivers tributary to the Sacrament o River (Smith and Verrill, 1998). The vernal pools and swales that occur on these hardpan soils have been extensively studied (e.g., Rains et al. 2006; 2008). Wherever they occur, they have common hydrological, geochemical, and biological attributes and processes, with such attributes and processes a function of the underlying geologic setting. This geologic setting does not only occur in a small, closely centered area – rather, this geologic setting repeats in mappable units all over both sides of the Sacramento Valley. If a significant nexus assessment is done on these types of vernal pools in one location, then it quite likely suffices for another similarly situated location.

The summary of this is that case-by-case should not be defined simply by proximity. Such a definition is inconsistent with scientific understanding of the controls on hydrological, geochemical, and biological structure and function. Such a definition also would place an undue burden on the regulated public, who would be required to repeatedly perform significant nexus assessments on the same types of wetlands. It would therefore be better to have a clear pathway by which entire classes of wetlands can be determined to have a significant nexus with the chemical, physical, and biological integrity of downstream waters and can thereafter be considered waters of the US by definition.

Not Waters by Rule

The proposed rule proposes that many features be non-waters by rule. A few of these are concerning.

The proposal that certain types of ditches be non-waters by rule is particularly concerning. The proposed rule proposes that tributaries be waters by definition because the *Connectivity Report* and other literature clearly establish that tributaries affect the chemical, physical, and biological integrity of downgradient waters. Any ditch connected to any water of the US effectively acts like a tributary, whether it is a channelized natural tributary or a ditch wholly excavated in uplands (e.g., Jones and Grant 1996). I can appreciate the political difficulty of extending CWA jurisdiction to these waters, and the economic hardship that such extension of jurisdiction could place on the regulated public. However, I would be remiss if I didn't point out that any decision to not cover these types of ditches is wholly a policy decision and completely unsupported by scientific evidence.

The proposal that groundwaters be non-waters by rule, though consistent with past interpretations, remains troubling. Globally, the total volume of groundwater exceeds the total volume of surface water by nearly two orders of magnitude (Fetter 2001). Groundwater contributes approximately half of the annual streamflow, though precise contributions vary widely and range from 14% to 90% (Winter et al. 1998). Furthermore, groundwater comprises ~20% of the total annual withdrawals nationwide, and upwards towards 100% in many specific regions (Kenny et al. 2009). Therefore, it is incomprehensible that the chemical, physical, and biological integrity of the nation's waters could be protected and the national goal that all waters of the US could be fishable and swimmable could be achieved without also extending CWA protections to groundwaters. Again, I can appreciate the political difficulty of extending CWA jurisdiction to these waters, and the economic hardship that such extension of jurisdiction could place on the regulated public. I also appreciate that groundwaters are protected under other federal statutes, such as the Safe Water Drinking Act and the Superfund Act. However, again, I would be remiss if I didn't point out that any decision to not cover groundwaters is wholly a policy decision and completely unsupported by scientific evidence. I also nevertheless strongly recommend that they continue to be used to extend connectivity to certain surface-water isolated features. Such connections are the rule rather than the exception, and play critical roles in facilitating the exchange of water and dissolved constituents between different waters (Rains et al. 2006).

References

Dunne, T, Black, RD. (1970) Partial area contributions to storm runoff in a small New England watershed. Water Resources Research 6:1296-1311.

Fetter CW (2001) Applied Hydrogeology, 3d ed. Prentice Hall, Upper Saddle River, New Jersey.

Helley EJ, Harwood DS. 1985. Geologic Map of Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California. U.S. Geological Survey, Miscellaneous Field Studies Map MF-1790. U.S. Government Printing Office, Washington, DC.

Izbicki JA (2007) Physical and temporal isolation of headwater streams in the Western Mojave Desert, Southern California. Journal of the American Water Resources Association 43:26-40.

Jones JA, Grant GE (1996) Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resources Research 32:959-974.

Kenny JF, Barber NL, Hutson SS, Linsey KS, Lovelace JK, Maupin MA (2009) Estimated Use of Water in the United States in 2005. US Geological Survey Circular 1344.

Rains MC, Mount JF, Larsen EW (2004) Simulated changes in shallow groundwater and vegetation distributions under different reservoir operations scenarios. Ecological Applications 14:192-207.

Rains MC, Fogg GE, Harter T, Dahlgren RA, Williamson RJ (2006) The role of perched aquifers in hydrological connectivity and biogeochemical processes in vernal pool landscapes, Central Valley, California. Hydrological Processes 20:1157-1175.

Rains MC, Dahlgren RA, Williamson RJ, Fogg GE, Harter T (2008) Geological control of physical and chemical hydrology in vernal pools, Central Valley, California. Wetlands 28:347-362.

Raymond HL (1979) Effects of dams and impoundments on migrations of juvenile chinook salmon and steelhead from the Snake River, 1966 to 1975. Transactions of the American Fisheries Society 108:505-529.

Smith DW, Verrill, WL. 1998. Vernal pool-soil-landform relationships in the Central Valley, California. Pages 15-23 in: Witham CW, Bauder ET, Belk D, Ferren Jr. WR, Ornduff R (eds), Ecology, Conservation, and Management of Vernal Pool Ecosystems – Proceedings from a 1996 Conference, California Native Plant Society, Sacramento, California.

Stanford JA, Ward JV (2001) Revisiting the serial discontinuity concept. Regulated Rivers: Research & Management 17:303-310.

Ward JV, Stanford JA (1995) The serial discontinuity concept: extending the model to floodplain rivers. Regulated Rivers: Research & Management 10:159-168.

Winter TC, Harvey JW, Franke OL, Alley WM (1998) Ground Water and Surface Water: A Single Resource. US Geological Survey Circular 1139.

Dr. Amanda Rodewald

Comments on scientific basis for rule – A. Rodewald

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The scientific literature does support the idea that tributaries greatly impact the physical, chemical, and biological integrity of downstream waters through a wide variety of processes, including supplying water to rivers & other waters, transport of sediment and organic matter, provide habitat, and nutrient spiraling. In addition, most jurisdictional waters are fed by tributaries, many of which are intermittent in certain regions. In a report currently undergoing quality review by the Chartered SAB, the Connectivity Panel agreed that the scientific literature provided strong support that ephemeral, intermittent, and perennial streams have important downstream effects, and that connectivity occurs along a gradient determined by the frequency, duration, magnitude, predictability, and consequences of stream, watershed, and landscape processes. Although connectivity can vary among streams, the consequences of connectivity for the physical, chemical, and biological integrity of downstream waters are sufficiently strong that streams can be justifiable viewed as a category. For example, even short duration and highly episodic flow connections and/or long periods of dry conditions could be important to downstream waters. Based on the Panel's recent deliberations, the ruling that tributaries remain jurisdictional even with natural or human-caused interruptions seems consistent with the science even though interrupted streams also can show high variability in the degree of connectivity.

One concern that I have relates to what seems to be different definitions of tributary used in the scientific review and the rule. The scientific review focused on perennial, ephemeral, and intermittent streams, whereas the rule seems to include a wide range of waters, including lakes, ponds, ditches, and impoundments. In the below text excerpted from the proposed rule, I have underlined two sentences that seem to expand what is commonly thought of as a tributary to any type of water. This definition confused me because the extent to which non-stream waters are jurisdictional seems to be addressed under adjacent waters.

"Tributary: a water physically characterized by the presence of a bed and banks and ordinary high water mark, which contributes flow, either directly or through another water, to a water identified in paragraphs a1-a4. <u>In addition, wetlands, lakes, and ponds are tributaries (even if they lack a bed and banks or ordinary high water mark) if they contribute flow, either directly or through another water to a water identified in paragraphs a1-a3.</u> A water that otherwise qualifies as a tributary under this definition does not lose its status as a tributary if, for any length, there are one of more man-made breaks (e.g., culverts, dams, pipes, bridges) or one or more natural breaks (e.g., wetlands, debris piles, boulder fields) so long as a bed and banks and an ordinary high water mark can be identified upstream of the break. <u>A tributary, including wetlands, can be a natural, man-altered, or man-made water and includes waters such as rivers, streams, lakes, ponds, impoundments, canals, and ditches not otherwise excluded</u>."

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a

significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The Connectivity Panel supported the conclusion in the EPA's report that floodplain wetlands and waters have strong impacts on the physical, chemical, and biological integrity of downstream waters. Wetlands and waters in floodplain settings are important buffers to pollution and nutrients, provide habitat, and retain sediments and nutrients and contaminants. This warrants the consideration of waters and wetlands in floodplain settings as a class falling under CWA jurisdiction.

As noted above, there was a mismatch between the definition of adjacent waters used in the rule and the floodplain settings in the review document. I assume that floodplain waters and wetlands are one type of adjacent water (i.e., neighboring and floodplain definitions), but not all of them.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition.

The Connectivity Panel disagreed with the EPA Report's conclusion that the literature did not provide sufficient information to evaluate or generalize about the degree of connectivity or its downstream consequences. As such, the Panel requested better acknowledgement that the science does show that non-floodplain waters and wetlands can have strong and important impacts on the physical, chemical, and biological integrity of downstream waters.

The Connectivity Panel agreed that downstream consequences of waters and wetlands in non-floodplain settings will likely require a case-by-case evaluation that considers the magnitude, duration, frequency, predictability, and consequences of water, material, and biotic fluxes to downstream waters, and their impact on the integrity of downstream waters. An additional recommendation was to establish relevant guidelines identifying baseline temporal intervals that are likely to meaningfully connect non-floodplain wetlands and waters to downstream waters.

I'm unclear about the jurisdiction of wetlands that have a surface or subsurface water connection (italicized text from draft rule below). If a wetland in a non-floodplain setting has a connection to the river network, then is it a tributary or an "other water"? Or is seeing the connection effectively the "case-specific analysis" needed to make it jurisdictional?

Regarding wetlands and open waters located outside of floodplains and riparian areas, the Report finds that they provide many benefits to rivers, lakes, and other downstream waters. <u>If the wetland or open water has a surface or shallow subsurface water connection to the river network, it affects the condition of downstream waters. Where the wetland or open water is not connected to the river network through surface or shallow subsurface water</u>, the type and degree of connectivity varies geographically, topographically, and ecologically, such that the significance of the connection is difficult to generalize across the entire group of waters.

There was strong agreement among Panel members that connectivity assessments should explicitly consider aggregate and cumulative effects of wetland complexes. I was pleased to see that the rule provided guidance about how and when to aggregate with the phrase "similarly situated".

"*Other waters'' will be evaluated either individually, or as a group of waters where they are determined to be similarly situated in the region. Waters are similarly situated where they perform similar functions and are located sufficiently close together or when they are sufficiently close to a jurisdictional water. How these ''other waters'' are aggregated for a case-specific significant nexus analysis depends on the functions they perform and their spatial arrangement within the ''region'' or watershed. For other waters that perform similar functions, their landscape position within the watershed (i.e., the ''region'') relative to each other or to a jurisdictional water is generally the determinative factor for aggregating waters in a significant nexus analysis, which will focus on the degree to which the functions provided by those ''other waters'' affect the chemical, physical, or biological integrity of (a)(1) through (a)(3) waters and whether such effects are significant."*

The similarly-situated case for aggregation requires similar functions, but what if there is a wetland complex where some wetlands are connected and others are important for storage due to lack of connection?

"*A hydrologic connection is not necessary to establish a significant nexus, because, as Justice Kennedy stated, in some cases the lack of a hydrologic connection would be a sign of the water's function in relationship to the traditional navigable water, interstate water or the territorial seas. These functional relationships include retention of flood waters or pollutants that would otherwise flow downstream to the traditional navigable water, interstate water or the territorial seas."*

I support the Agency's consideration of using subcategories that identify groups for which there is evidence of strong connections and thus should be jurisdictional.

I appreciate that they are trying to provide guidance on how to evaluate different kinds of connectivity, but these are largely describing how to identify the presence or absence of different "types" of connections, rather than the degree of those connections. (below)

p. 22214:

Evidence of chemical connectivity and the effect on waters can be found by identifying: Whether the properties of the water in question are similar or dissimilar to an identified (a)(1) through (a)(3) water; signs of retention, release, or transformation of nutrients or pollutants; and the effect of landscape position on the strength of the connection to the nearest ''water of the United States,'' and through it to an (a)(1) through (a)(3) water. In addition, relevant factors influencing chemical connectivity include hydrologic connectivity (see physical factors, below), surrounding land use and land cover, the landscape setting, and deposition of chemical constituents (e.g. acidic deposition).

Evidence of physical connectivity and the effect on (a)(1) through (a)(3) waters can be found by identifying evidence of physical connections, such as flood water or sediment retention (flood prevention). Presence of indicators of hydrologic connections between the other water and jurisdictional water are also indictors of a physical connection. Factors influencing physical connectivity include rain intensity, duration of rain events or wet season, soil permeability, and distance of hydrologic connection between the ''other water'' and the (a)(1) through (a)(3) water, depth from surface to water table, and any preferential flowpaths.

Evidence of biological connectivity and the effect on waters can be found by identifying: resident aquatic or semi-aquatic species present in the ''other water'' and the tributary system (e.g., amphibians, aquatic and semi-aquatic reptiles, aquatic birds); whether those species show life-cycle dependency on the identified aquatic resources (foraging, feeding, nesting, breeding, spawning, use as a nursery area, etc.); and whether there is reason to expect presence or dispersal around the ''other water,'' and if so whether such dispersal extends to the tributary system or beyond or from the tributary system to the ''other water.'' Factors influencing biological connectivity include species' life history traits, species' behavioral traits, dispersal range, population size, timing of dispersal, distance between ''other water'' and an (a)(1) through (a)(3) water, the *presence of habitat corridors or barriers, and the number, area, and spatial distribution of habitats. Non-aquatic species or species such as non-resident migratory birds that are not demonstrating a life cycle dependency on the identified aquatic resources are not evidence of biological connectivity for purposes of this rule"*

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions.

Tributary – it seems that the definition for tributary includes most types of water, by way of adding the two sentences underlined above in the response to question 1. Also on p 22197, the text talks about tributary streams, which were the focus of the scientific review, but then the rule adopts the broader definition.

How would the categorical exclusion of ditches that do not contribute flow, directly or indirectly, to a traditional navigable water affect the outcome of a request to establish a connection? Wouldn't that be important and jurisdictional under tributary definition? However, at the time of impact / construction/ alteration, the ditch would be excluded. (p.22194, bottom of 2nd column and top of 3rd column recognizes that the significance of certain adjacent waters is to prevent or delay a hydrological connection with downstream waters and store water or pollutants)

p. 22204: I am unclear about the following text. I thought that swales were one of the exclusions? If not, does that mean it is a case-specific other water?

" *Non-jurisdictional geographic features (e.g., non-wetland swales, ephemeral upland ditches) may still serve as a confined surface hydrologic connection between an adjacent wetland or water and a traditional navigable water, interstate water or the territorial sea, provided there is an actual exchange of water between those waters, and the water is not lost to deep groundwater through infiltration (i.e., transmission losse*s)."

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

p. 22195-22196: It is really important that they articulate that (1) "significance" is not a scientific term but rather a determination of the agencies in light of the law and science and (2) the relative strength of downstream effects informs the agencies' conclusions about the significance of those effects for purposes of interpreting the CWA.

p. 22199 footnote: is it appropriate to use "in the region" and "watershed" interchangeably? In general, regions seem to include many watersheds.

p. 22208: Does the following text mean that connections via groundwater cannot establish connectivity?

"*Shallow subsurface connections are distinct from <u>deeper groundwater connections, which do not satisfy the requirement for adjacency</u>, in that the former exhibit a direct connection to the water found on the surface in wetlands and open waters*"

p. 22209: Here again, I'm confused b/c it sounds like nothing farther than an adjacent wetland or water will be jurisdictional; is that so? "*Waters located near an adjacent water but which are not themselves (independently) adjacent to an (a)(1) through (a)(5) water would, under the proposed rule, <u>not be regulated under (a)(6).</u> However, waters, including wetlands that are adjacent to a wetland that meets the definition of a tributary would be considered adjacent waters*."

Dr. Emma Rosi-Marshall

Aug 26, 2014

To Dr. Amanda Rodewald, Chair, Science Advisory Board (SAB) Panel for the Review of the EPA Water Body Connectivity Report

Below are my revised comments on the US EPA proposed rule entitled "Definition of 'Waters of the United States' Under the Clean Water Act". As requested in your memorandum dated July 16, 2014, I have revised these comments in response to the SAB conference calls in August and now provide final comments on "the adequacy of the scientific and technical basis of the proposed rule cited above."

Thank you for considering these preliminary comments on the EPA Proposed Rule.

Specific Charge Questions
1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank*)

Response: The proposal includes tributaries in the definition of waters of the United States is based on a strong foundation of scientific research. There is ample scientific evidence that tributary streams are connected to downstream waters and that these connections can fundamentally influence the biological integrity of downstream waters. To reiterate, there is ample scientific evidence that headwater streams are not simply connected to downstream waters, but the scientific literature reviewed in the EPA Connectivity Report and the follow up comments by the SAB demonstrate that these connections strongly influence the physical, chemical and biological integrity of downstream waters. For example, the nutrient cycling and removal of nitrogen that occurs in headwater streams reduces the downstream inputs of nitrogen to downstream waters (e.g. Mulholland et al. 2008, and others as reviewed in the Connectivity Report). Nitrogen pollution is known to be a major contribution to impairment of waterbodies due to eutrophication. This is one example, of many, provided in the Connectivity Report and the SAB comments on the report, of how headwater streams are not simply connected to downstream waters, but that these connections fundamentally influence the integrity of downstream waters. The significant nexus determination that tributaries influence the integrity of waters as a policy decision is well justified by the best available science. Inclusion of tributary streams in the definition of waters the US is based on a large body of scientific knowledge. In addition, effective maintenance and/or restoration of the integrity of downstream waters will require protection of these tributary systems which feed into downstream waters.

The scientific and technical basis for the inclusion of tributaries is based on the well established evidence that the flux of water, nutrients, materials such as organic matter and contaminants, and the movement of biota, from tributaries to larger water bodies influences the biological integrity of downstream waters. The movement of multiple materials, beyond simply water, is essential for the maintenance of the chemical and biological integrity of downstream waters. The connections that exist between tributary streams and their downstream receiving waters are well described in the draft report by the EPA, in the comments by the SAB, and are well documented in the peer reviewed scientific literature. The wealth of information on these connections provides a very strong basis for this rulemaking and the proposed rule is defensible.

The definition of a tributary: "a water physically characterized by the presence of a bed and banks and ordinary high water mark as defined at 33 CFR, 328.3(e), which contributes flow either directly or through another water, to a water defined in paragraphs (a)(1) through (4)" is scientifically defensible. However, the EPA may reconsider their reliance on the ordinary high water mark because of the lack of an OHWM in some systems. Much of the water and materials that enter downstream waters originate in small headwater streams high up in watersheds. In some locations in the US, small headwater streams are intermittent, but intermittency does not negate the influence of these tributaries on downstream waters. Indeed, scientific research has shown that flows that occur intermittently, e.g. during a flood or spring snowmelt, can exert a strong influence on downstream systems. A definition of tributary that includes these small but extremely important systems, which are inherently connected to downstream waters via water and material flow, is necessary. Headwater streams, even when they only flow intermittently, exert a strong influence on the chemical and biological integrity of downstream waters. This assertion is based on a wealth of scientific evidence (reviewed in the EPA draft report on Connectivity, further elaborated on in the SAB's comments on the draft report, and found in the peer-reviewed scientific literature).

Including wetlands, lakes and ponds in the definition of a tributary although defensible may lead to confusion as these systems are not often thought of as tributaries. Although there is substantial evidence that maintaining these systems will allow for maintaining the integrity of downstream, it may clarify the definition of tributaries to include these systems under the "adjacent" waterbodies. In the course of water flowing through a river network, the landscape can change and a small stream may flow into and then out of a pond, lake or wetland. These chains of aquatic habitats can be thought of as beads on a string that can act in concert to influence the biological integrity of downstream waters. In addition, pollution that enters into an aquatic system anywhere along a river network will be transported downstream and potentially impair the integrity of downstream waters. Whether the discharge occurs in a wetland, pond or headwater stream does not reduce its eventual downstream transport to larger waters and does not eliminate its impact and I concur that there is scientific evidence to demonstrate that these systems contribute to the integrity of downstream waters, but it may be more clear to include them in the definition of "adjacent".

In addition, I agree with the proposed definition that the "upper limit of a tributary is established where the channel begins". A great deal of scientific research demonstrates that these very small streams that begin high up in a watershed have high biological activity and can exert a strong influence of the downstream flow of water and materials, including nutrients, organic matter and animals. The flow of these materials has a large influence on the biological integrity of downstream waters as defined in in paragraphs (a)(1) through (4) of the proposed rule. In addition, pollutants that are discharged into a very small tributary stream will not remain in place, but will be transported downstream and have the potential to affect downstream waters. I concur that there is sufficient scientific evidence to include tributaries in the definition of waters of the US to maintain the biological and chemical integrity of downstream waters.

The additional need to consider the effects of small waterbodies in aggregate (see page 22196 of the proposed rule) were highlighted as an important conclusion of the EPA Report on Connectivity and the subsequent comments from the SAB Panel on Connectivity. This is an extremely important finding and there is scientific evidence that small waterbodies that are distributed throughout a river landscape can have effects in the aggregate. At times, the effects of one small system on a much larger downstream waterbody may be challenging to ascertain, but many small systems in aggregate can have a large effect on the biological and chemical integrity of the larger downstream water bodies. This aggregation effect should be explicitly considered in the rulemaking process.

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan*)

Response: The inclusion of adjacent waters, including floodplain aquatic habitats and wetlands, in the definition of waters of the United States is also based on sound science. The biological integrity of river ecosystems is strongly linked to maintaining the connections between water bodies and their adjacent aquatic habitats. River ecologists have known for a long time that it is more appropriate to think of rivers as part of a larger landscape or "riverscape" comprised of a river's mainstem and adjacent floodplain or wetland habitats. The connections between the river and adjacent habitats, e.g. floodplain wetlands and marginal aquatic habitats, include the flux of materials (water, nutrients and contaminants) and the flux of organisms. The flux of these materials (e.g. the connectivity of these systems) is essential for maintaining the chemical and biological integrity of downstream waters. There are numerous examples of these connections provided in the EPA Draft Report on Connectivity, the SAB comments on the report and in the published peer reviewed literature.

The inclusion of adjacent waters, including wetlands, in the definition of waters of the United States is also based on a large body of scientific evidence that demonstrates that these systems are connected to larger water bodies and that these connections are crucial for maintaining the chemical and biological integrity of surface waters. Indeed, when these connections are severed, due to dikes, levees or wetland draining, research demonstrates that there are negative consequences for the integrity of downstream waters. The inclusion of these habitats in the definition of waters of the US is well grounded in scientific and technical understanding of how rivers are connected to adjacent aquatic habitats and how these connections influence the chemical and biological integrity of waters.

As mentioned above in response to question 1, the need to consider the effects of small waterbodies such as adjacent aquatic habitats in aggregate (see page 22196 of the proposed rule) is very important. There is strong scientific evidence that small waterbodies that are distributed throughout a river landscape have effects in the aggregate. The effects of one small adjacent system on a larger adjacent waterbody may be difficult to determine, but many small adjacent systems in aggregate will influence the biological and chemical integrity of waters.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (*lead discussants are: Drs. Emily Bernhardt and Michael Gooseff*)

Response: The justification for “other waters” being evaluated on a “case by case” basis or as a group to determine the extent to which they have a significant nexus with downstream waters is well described in the proposed rule. I agree that considering groups of “similarly situated” waters and the extent to which they affect downstream waters in aggregate is justified and would alleviate the need for extensive “case by case” analysis. The approach to consider “similarly situated” systems and evaluate their connectivity as a group makes sense based on our ecological understanding of these systems, i.e. that similar systems in a region may act in similar ways and that not every water is unique. In addition, these systems should be considered in aggregate, as the degree to which they influence downstream waters will be more apparent when considered in aggregate.

The SAB Report provides additional information on how “other waters” should be defined and how they may be connected to downstream waters even when an apparent hydrologic surface flow is lacking. It is very important that the ideas put forward by the SAB in response to this section of the Connectivity Report be considered when making the final rule about “other waters”. Although these systems may not be adjacent to downstream waters and therefore may lack an explicit surface water hydrologic connection, they may function, especially in aggregate, in ways that influence the biological and chemical integrity of downstream waters. These ideas are well developed in the SAB report and these ideas should be explicitly considered during the final rulemaking in regards to these “other waters”.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (*lead discussants are: Drs. David Allan and Mark Rains)*

No comment.

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

Appendix A, in the CFR document (starting on page 22222) appears to be a draft or a synopsis of the Connectivity Report. I assume that because the Connectivity report is still in draft form that this Appendix will be revised in the future. As such, I did not provide detailed comments or additional suggested references on Appendix A, as that is the content of the SAB’s report. I hope that these suggestions will be incorporated into the draft report and that Appendix A will be revised accordingly.

References: Mulholland, Patrick J., et al. "Stream denitrification across biomes and its response to anthropogenic nitrate loading." *Nature* 452.7184 (2008): 202-205.

Dr. Mazeika Sullivan

Revised Preliminary Comments on "Waters of the United States Proposed Rule"
Mazeika Sullivan, 08.25.2014

Introductory Comments:

The scientific evidence supports a broad, systemic view of the goal of maintaining and improving water quality, as presented in the proposed rule. Consistent with the recommendations of the EPA SAB Panel, the collective scientific evidence indicates that there exists a gradient of connectivity between tributaries, adjacent waters, "other waters" and downstream waters. Although this gradient of connectivity is recognized at multiple locations in the proposed rule (e.g., 22193, 22198, 22223, 22226, 22248), this concept should figure as the conceptual backbone of the preamble in order to clearly establish the rationale for those cases where important connectivity exists and for those cases where it may not. This gradient framework would then provide the basis on which subsequent discussion of various types of water bodies and whether or not a "significant nexus" exists with traditional navigable water, interstate water, or the territorial seas.

Within this context, variation in the strength of connectivity as measured through frequency, duration, magnitude, predictability (and other metrics) supports the conclusions that streams and wetlands (and other waters) in riparian and floodplain settings are unambiguously connected to and have impacts on downstream traditional navigable waters, interstate waters, and the territorial seas (or they are connected via tributaries). For "other waters", a gradient of connectivity can be used to interpret the magnitude of impacts on downstream waters and whether this magnitude justifies jurisdictional status under the CWA. Establishing a gradient of connectivity as the scientific framework would also clarify that there may not exist cases wherein there is no connectivity (in contrast to the statement on 22192: "Waters in a watershed in which there is no connection to a traditional navigable water, interstate water, or the territorial seas … "), although the degree of connectivity may not be sufficient to effect meaningful downstream impacts and, therefore, warrant classification as "waters of the United States".

The proposed rule addresses aggregate effects of streams, wetlands, and other waters on downstream waters (e.g., 22196, 22215, 22217, 22222, 22226) and mentions temporal variability in that "connectivity varies within a watershed and over time" (22197). The science supports this explicit recognition of the spatial and temporal scales at which streams, groundwater systems, and wetlands are functionally aggregated. Understanding the interactions of cumulative and temporal effects on downstream waters will also be critical to properly assess connectivity both over space and time.

It is my understanding that the agencies will review the SAB Report and make adjustments to the final rule that are deemed appropriate. Given that my comments and contributions relative to the synthesis of the supporting scientific literature are incorporated within the SAB Report, I have not provided extensive comments on this section (starting on 22222) at this time. I will briefly comment, however, that the synthesis of scientific evidence presented in the proposed rule is overall technically accurate and relatively thorough and provides support for the conclusions that streams and adjacent wetlands are physically, chemically, and/or biologically connected to downstream navigable waters; however, these connections should be considered in terms of a connectivity gradient that includes frequency, magnitude, predictability, and consequences of connectivity pathways. On the other hand, the scientific literature supports more definitive statements that reflect how numerous functions of "other waters" sustain the physical, chemical, and/or biological integrity of downstream waters, although the amount of connectivity can vary widely. Additionally, as noted below, the role of biological connectivity, while recognized in the synthesis of scientific information, is not sufficiently represented as a mechanism of connectivity in the determinations of a significant nexus. For example, the science and rule related to adjacency could be clarified by including biological (and chemical) connections in addition to hydrological linkages.

1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank)

In keeping with the SAB Panel's conclusions, there is strong scientific support that streams exert strong impacts on downstream waters and that all tributary streams are physically, chemically, and biologically connected to downstream waters. In particular, the proposal that all waters that meet the definition of a tributary are "waters of the United States" by rule is technically sounds and supported by the available science, as perennial, ephemeral, and intermittent streams all influence the physical, chemical, and biological nature of downstream aquatic systems.

The science clearly supports protection of tributaries, including headwater streams and man-made or man-altered tributaries, under the CWA given the critical functions they perform relative to the larger drainage network (e.g., 22227, 22230, 222235). Relative to the proposed definition of "tributary", a broad definition that includes, in addition to streams and rivers, fluvial impoundments, canals, ditches (otherwise not excluded), and wetlands that connect tributary segments (i.e., wetland tributaries – which could also would be jurisdictional as "adjacent" waters") that are part of the tributary network is reasonable. However, including other features as tributaries that do not have a bed and bank and OHWM (e.g., 22202: "A tributary is a longitudinal surface feature that results from directional surface water movement and sediment dynamics demonstrated by the presence of bed and banks, bottom and lateral boundaries, or other indicators of OHWM.") seems to extend the classification beyond the scope of the definition provided and is unnecessary as these water bodies are jurisdictional as "adjacent" waters. Additionally, adding a descriptor along the lines of "or other evidence of flow" to the current definition would more adequately capture variability in tributary characteristics in different geographic settings, particularly those in low-gradient, semi-arid and arid systems that may not have, for example, a OHWM.

In determining tributaries, map scale will be an important consideration as differences in map resolution can lead to appreciable differences in estimating the extent of the watershed (e.g., Meyer and Wallace 2001, Heine et al. 2004). The following language (22201), "When considering whether the tributary being evaluated eventually flows to an (a)(1) through (a)(4) water, the tributary connection may be traced using direct observation or U.S. Geological Survey maps, aerial photography or other reliable remote sensing information, or other appropriate information.", may be insufficiently specific to ensure adequate estimation of the tributary network across different geographic regions that vary in land cover, geology, etc. Additional consideration of the aggregate impacts of tributaries to downstream waters is needed.

For further comment on aspects of the proposed definition related to non-jurisdictional features, see response to Question #4, below.

2. *The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan)*

There is clear scientific evidence to support strong connectivity between adjacent wetlands and waters, including those waters separated from other "waters of the United States" by man-made barriers, natural river berms, dunes, etc., and traditional navigable water, interstate water, and the territorial seas, impoundments, or tributaries. In particular, the proposal to include adjacent waters, not only adjacent wetlands, as "waters of the United States" (e.g., 22199, 22272) is supported by the available science and is a technically sound recommendation (i.e., 22207: "The proposed rule proposes to change "adjacent wetlands" to "adjacent waters" so that water bodies such as ponds and oxbow lakes, as well as wetlands, adjacent to jurisdictional waters are "waters of the United States" by rule."). Consistent with the SAB Panel's assessment, the scientific literature unequivocally supports the finding that floodplains and waters and wetlands in floodplain and riparian settings support the physical, chemical and biological integrity of downstream waters. Indeed, river-floodplain systems are integrated ecological units (i.e., riverine landscapes and riverscapes, e.g., Thorp et al. 2006) and as such, adjacent wetlands and waters are intimately linked to downstream systems. The literature review on this subject (starting 22236) clearly supports strongly connectivity of adjacent waters, although a broader riverine landscape perspective would help provide a foundational underpinning for the literature synthesis.

The definition of the term riparian area (22207, 22263, 22272) as "an area bordering a water where surface or subsurface hydrology directly influence the ecological processes and plant and animal community structure in that area" is somewhat narrow in scope given the importance of riparian zones to stream function and water quality. Both the EPA Connectivity Report and SAB Panel Report provide ample documentation of the science supporting the myriad functions of riparian zones and connections that extend beyond hydrologic pathways. Some riparian zones in high-relief headwater catchments, for example, may have limited hydrological connections relative to downstream riparian zones but are still critical for maintaining stream function via controls on temperature, inputs of organic material, etc.

Relative to the proposed definitions of "adjacent" and "neighboring" (e.g., 22272), additional consideration should be given to the distance between the water body and the tributary in determining whether or not the water body is adjacent (in situations where a water body lies outside of the floodplain and riparian area of a tributary). In determining a significant nexus, functional adjacency is key, not simply distance. Although distance can be one measure to help ascertain the degree of hydrological connectivity, biological and chemical connectivity should also be considered. Biological connectivity, in particular, can integrate spatially disparate water bodies through movement of organisms. This point is well articulated in the SAB Panel Report and could be used as guidance in refining how best to assess connectivity of water bodies outside of the floodplain and riparian zone and the question of "reasonable proximity" (e.g., 22208). Using hydrological connectivity here as the only linkage measure also seems inconsistent with other parts of the proposed rule. For example, relative to "other waters": (22213) "A hydrological connection is not necessary to establish a significant nexus, because, as Justice Kennedy stated, in some cases the lack of a hydrological connection would be a sign of the water's function in relationship to the traditional navigable water, interstate water or the territorial seas". Furthermore, the role of chemical and biological connectivity is clearly recognized elsewhere in Section G. For instance, the proposed rule states: (22210) "The agencies proposal to determine "adjacent waters" to be jurisdictional by rule is supported by the substantial chemical, physical, and biological relationships between adjacent waters, alone or in combination with similarly situated waters and (a)(1) through (a)(5) waters."

The temporal component is of particular importance in floodplain systems and requires additional discussion. The SAB Panel Report suggests using the science of flood frequency-floodplain inundation to estimate connectivity, which may help in in ascertaining the appropriate flood interval to use. Nonetheless, regional/climatic differences in stream-floodplain dynamics, variable human impacts, and other sources of variability may suggest that the determination of the appropriate flood interval is best left to the professional judgment of the agency (22209).

Inasmuch as I understand that the agencies are seeking to reduce the burden of many case-specific situations, caution is warranted in some cases when the science may not be available to adequately determine where jurisdiction should or should not be asserted. Of the alternative options presented (22208), I do not believe that current scientific evidence supports asserting jurisdiction over adjacent waters only if they are located in the floodplain or riparian zone. However, other proposed options likely would need additional investigation at this point. Along a connectivity gradient, there may exist threshold levels of connectivity above which downstream influences are impactful to water quality and below which they are not. See responses to Question #5 for additional discussion of thresholds.

22208: "While they may provide the connection establishing jurisdiction, these shallow subsurface flows are not "waters of the United States". Similar to my comment below (Question #4), if the pathway of connectivity is not protected, then ultimately neither are downstream water bodies. Ensuring the mechanism of connectivity (i.e., that defines the "significant nexus") is critical.

3. *The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (lead discussants are: Drs. Emily Bernhardt and Michael Gooseff)*

Recognizing the myriad connections between non-floodplain and non-riparian waters and wetlands and downstream waters (via surface water, shallow subsurface flowpaths, shallow or deep ground water flowpaths, or through chemical and biological connections) with specific attention paid to the magnitude, duration, frequency, predictability, and consequences of these connections is critical to understanding that all water bodies are likely connected to some extent to downstream waters, although the degree of connectivity can vary widely. The proposed rule draws heavily on hydrological connections, and should weight other connections equally. For instance, there is growing scientific evidence regarding biological connections between non-floodplain wetlands and other water bodies and downstream waters, including the bulk exchange of materials via biota, biota as disease vectors, and the movement of nutrients by biota. Other water bodies can also provide critical habitat, which can be essential for the life-cycle requirements of downstream species. There is some discussion of these points (e.g., 22214, 22222), but the full scope of biological connectivity is not fully established in the proposed rule (particularly relative to the role of biota as vectors of nutrients, contaminants, and other materials). For example, the proposed rule recognizes that even when hydrological connections are visibly absent, many waters still can influence downstream waters, yet states that, "However, such circumstances would be uncommon" (22249). To the contrary, birds and other organisms can be key movers of nutrients, plants (seeds), and invertebrates between wetlands and downstream waters across ranges of spatial scales (e.g., Figuerola et al. 2003, Green et al. 2008).

I believe that the science is currently available (partially summarized starting 22250) to demonstrate that sufficient connectivity exists without a case-specific analysis for certain subcategories of "other waters" (22216) (e.g., prairie potholes, Carolina and Delmarva bays, pocosins, Texas coastal prairie wetlands, western vernal pools). However, further subcategories of these may be appropriate that incorporates a combination of water-body type and regional context. I do not believe that the science is sufficiently developed to support a determination to exclude any groups of "other waters" (or subcategories thereof, e.g., Great Plains playa lakes) from jurisdictional status at this time in spite of the resource-intensive nature of a case-specific analytical approach. Before such determinations are made, additional research is required to establish degree of connectivity, analysis of spatial and temporal variability, and threshold levels of connectivity. This research will be a requisite step in further refining rules relative to the jurisdictional status of "additional other waters of the US" and in particular, if "categories of 'other waters' are similarly situated and have a significant nexus and are jurisdictional by rule, or that as a class they do not have such a significant nexus and might not be jurisdictional" (22216-22217).

Determining if waters are "similarly situated" is a reasonable approach with scientific support (22247). Biotic community assemblage and presence/absence of species might be other metrics used to assess similarity, along with the factors currently provided as examples in the proposed rule (22213: habitat, water storage, sediment retention, pollution sequestration). Whereas analyzing the chemical, physical, and/or biological effects of "other waters" in concert with other similarly situated water bodies is technically sound, supported by the science, and provides a basis for decision-making, water bodies that are disparate relative to their characteristics and function may also contribute to the cumulative effects of the water bodies in a region, and thus there may be cases wherein it is appropriate to analyze "other waters" in the aggregate (in contrast to a whole-scale statement indicating that it would be "inappropriate … to consider 'other waters' as 'similarly situated' if these 'other waters' are located in different landforms, have different elevation profiles, or have differ soil and vegetation characteristics …" (22213). Determining by rule that "other waters" are similarly situated in certain areas of the country is an intriguing idea, although my initial reaction is that Level 3 Ecoregions may be too broad of a classification. Additionally, human alteration of watersheds can alter the types of connections to downstream waters as well as the magnitude, frequency, duration, predictability, and consequences of these connections. How would variability stemming from the role of humans on the watershed landscape be captured within a regional approach?

Relative to a case-specific basis for other waters, the proposed rule correctly recognizes the role of aggregate and temporal effects. This is a key point in relation to assessing whether a water body has a "significant nexus". Determining when (temporally) surveys will be conducted, what map scale will be used (although this point is somewhat addressed on 22212, 22226), and how aggregate effects will be determined is critical to appropriate assessment of these case-by-case situations. For example, many current databases do not represent the full extent and/or size of the drainage network. For additional comments on this point, see responses to Question #1. This topic is also addressed in the SAB Panel Report.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (lead discussants are: Drs. David Allan and Mark Rains)

Discriminating between shorter-term erosional features (e.g., rills and gullies) and longer-term headwater channels represents a challenge relative to mapping (e.g., James et al. 2007) as well as to the nature of ecological transitions between, for example, gullies and ephemeral streams. However, to exclude these and other variable source areas (e.g., swales) from jurisdiction is not fully supported by the available science as they can be important components of integrated aquatic systems with measurable impacts to downstream systems. For instance, Hansen and Law (2006) found that small gullies in South Carolina contributed runoff and sediment during tropical storm episodes of a magnitude of 48 tonnes from a 0.1-ha discontinuous valley side gully over 9.5 years. Thus, consideration of these features in the aggregate and over variable temporal scales is important relative to downstream impacts. The SAB Panel Report provides further suggestions and guidance relative to these erosional features, and emphasizes that the important role of these source areas to downstream connectivity. Thus, the agencies should maintain the right to classify specific gullies, rills, and swales (either separately or in the aggregate) as jurisdictional when warranted. The agencies are proposing to not retain authority to determine in a particular case that these waters are a "water of the United States" (22218), and I remain unconvinced that this determination is fully in keeping with the available science.

In general, the rationale for excluded waters focuses on physical features (channel morphology, flow permanence, etc.). There is an alarming lack of evidence provided relative to making the case for a lack of biological and/or chemical connectivity. While I agree that some of these waters should not be jurisdictional, consideration of other measures of connectivity may aid in making appropriate determinations as to which should be considered on a case-specific basis (or potentially as a class). To determine regulatory practices only on one dimension of connectivity is problematic and may indicate it is premature to move fully away from a case-specific basis for all the waters listed on 22218, 22263, 22274. For example, drainage ditches have been shown to exhibit a range of ecological functions (see Herzon and Helenius 2008) and while hydrological connectivity is clearly important, other types of connectivity should also be considered.

In general, I do not agree that there is sufficient scientific evidence to support the exclusion of ditches, and it may be appropriate to move some categories of ditches into "other waters". In the Midwest, for example, ditches dominate headwaters in many watersheds. Excluding by rule certain ditches from these systems could be highly problematic and further fragment these watersheds. Currently, the definition of "uplands" is unclear in the proposed rule and I do not agree that perennial flow should be a requirement for jurisdiction.

How is connectivity that may not be initially present but would be expected to develop over time viewed? For instance, does an artificial lake or pond created by excavating and/or diking dry land and used exclusively for stock watering, irrigation, settling basins, etc. that is likely to develop a strong connection with a traditional navigable water body in the future remain non-jurisdictional?

There are other points that warrant attention. For example, 22219: "It is important to note, however, that even when not jurisdictional waters, these non-wetland swales, gullies, rills and specific types of ditches may still be a surface hydrologic connection for purposes of the proposed definition of adjacent under paragraph (a)(6) or for purposes of a significant nexus analysis under paragraph (a)(7). For example, a wetland may be a ''water of the United States,'' meeting the proposed definition of 'neighboring' because it is connected to such a tributary by a non-jurisdictional ditch that does not meet the definition of a 'tributary'." The entire concept of water body connectivity is that integrated ecological units composed of aquatic systems distributed across the landscape are intimately linked through a suite of pathways. How is it consistent with this notion or in the spirit of the CWA that the ditch that connects two "waters of the US" is not jurisdictional?

In summary, the current science supports that some "other waters" are unlikely to be sufficiently connected to warrant jurisdiction (e.g., artificial reflecting pools, swimming pools, artificially irrigated areas, depressions with water following construction) but I am not convinced that the science currently exists to summarily exclude certain groups other waters including gullies, swales, artificial lakes and ponds, and ditches that do not contribute flow to a jurisdictional water body. These waters should be assessed along a gradient of connectivity on a case-specific basis until the science is available to make an appropriate determination for the respective class as a whole.

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

Significance: The Proposed Rule points out that "significance" is not a scientific term (e.g., 22195). However, it is a statistical term, often used in scientific contexts to indicate when observations are "real" versus those observed by chance. Other terms that do not carry such meaning may be more appropriate: e.g., important, substantial, impactful.

Ecological thresholds: Ecosystems may not respond to gradual changes in smooth and/or linear ways, but rather with sudden, discontinuous shifts to an alternative stable state as the ecosystem exceeds a tipping point in one or more of its principal processes (Ludwig et al. 1997). Such thresholds – conditions beyond which an abrupt change in a quality, property, or function of an ecosystem are precipitated – are tightly linked to ecosystem condition (see Turner 2002). Understanding and targeting potential threshold levels of connectivity between water bodies and downstream waters could substantially contribute to our current understanding if and where threshold levels of connectivity occur along the connectivity gradient that includes frequency, magnitude, predictability, and consequences of connectivity pathways. There is a growing body of literature on environmental and ecological thresholds (e.g., Friedel 1991, Bledsoe and Watson 2001, Church 2002, Richardson et al. 2007, Evans-White et al. 2009, King et al. 2011, Chambers et al. 2012, Goss et al. 2014) as well as suite of analytical methods (e.g., Clements et al. 2007, Gido et al. 2007, King and Richardson 2003, Richardson and Qian 2007, Richardson et al. 2007, Sonderegger et al. 2009, King et al. 2011, Daily et al. 2012). This could be an area of importance for future research.

Literature Cited

Bledsoe, B.P. and C.C. Watson. 2001. Logistic analysis of channel pattern thresholds: meandering, braiding, and incising. Geomorphology **38**:281-300.

Chambers, P.A., J.M. Culp, E. S. Roberts, and M. Bowerman. 2012. Development of environmental thresholds for streams in agricultural watersheds. Journal of Environmental Quality **41**:1-6.

Church, M. 2002. Geomorphic thresholds in riverine landscapes. Freshwater Biology **47**:541-557.

Clements, W., B. Noon, and H. Wang. 2007. Ecological thresholds and responses of stream benthic communities to heavy metals. Ecological Thresholds in Aquatic Ecosystems: The Role of Climate Change, Anthropogenic Disturbance, and Invasive Species Progress Review Workshop. US EPA, Washington, DC, USA, http://www.scgcorp.com/eco-thresholds07/docs/13-Clements.pdf.

Daily, J.P., N.P. Hitt, D.R. Smith, and D.R. Snyder. 2012. Experimental and environmental factors affect spurious detection of ecological thresholds. Ecology **93**:17-23.

Evans-White, M.A., W.K. Dodds, D.G. Huggins, and D.S. Baker. 2009. Thresholds in macroinvertebrate biodiversity and stoichiometry across water-quality gradients in Central Plains (USA) streams. Journal of the North American Benthological Society **28**:855-868.

Friedel, M.H. 1991. Range condition assessment and the concept of thresholds: a viewpoint. Journal of range management **44**:422-426.

James, L.A., Watson, D.G., and W.F. Hansen. 2007. Using LiDAR to map gullies and headwater streams under forest canopy: South Carolina, USA. Catena **71**:132-144.

Figuerola, J., A. J. Green, and L. Santamaria. 2003. Passive internal transport of aquatic organisms by waterfowl in Doñana, south-west Spain. Global Ecology and Biogeography **12**:427-436.

Gido, K., W. Dodds, J. Koelliker, K. With, D. Walks, D. Chandler, and J. Aguilar. 2007. Ecosystem thresholds and alternate states in Great Plains rivers and streams: cascading effects of anthropogenic hydrologic disturbance. Ecological Thresholds in Aquatic Ecosystems: The Role of Climate Change, Anthropogenic Disturbance, and Invasive Species Progress Review Workshop. US EPA, Washington, DC, USA, http://www.scgcorp.com/eco-thresholds07/docs/05-GIDO-DODDS.pdf

Goss, C.W., P.C. Goebel, and S.M.P. Sullivan. 2014. Shifts in attributes along agricultural-forest transitions of two streams in central Ohio, USA. Agriculture, Ecosystems & Environment **197**: 106-117.

Green, A. J., K. M. Jenkins, D. Bell, P. J. Morris, and R. T. Kingsford. 2008. The potential role of waterbirds in dispersing invertebrates and plants in arid Australia. Freshwater Biology **53**:380-392.

Hansen, W.F., and D.L. Law, 2006. Sediment from a small ephemeral gully in South Carolina. *In*: Proc. Soc. American Foresters National Convention, Fort Worth, Texas, 2005.

Heine, R.A., Lant, C.L., and R.R. Sengupta. 2004. Development and comparison of approaches for automated mapping of stream channel networks. Annals of the Association of American Geographers **94**: 477–490.

Herzon, I. and J. Helenius. 2008. Agricultural drainage ditches, their biological importance and functioning. Biological Conservation **141**: 1171-1183.

King, R.S. and C.J. Richardson. 2003. Integrating bioassessment and ecological risk assessment: An approach to developing numerical water-quality criteria. Environmental Management **31**:795-809.

King, R.S., M.E. Baker, P.F. Kazyak, and D.E. Weller. 2011. How novel is too novel? Stream community thresholds at exceptionally low levels of catchment urbanization. Ecological Applications **21**:1659-1678.

Ludwig, D., B. Walker, and C.S. Holling. 1997. Sustainability, stability and resilience. Conservation Ecology **1**:7.

Meyer, J.L., and L.B. Wallace. 2001. Lost linkages and lotic ecology: rediscovering small streams. *In*: Press, M.C., Huntly, N.J., and S. Levin (Eds.), Chapter 14. Ecology: Achievement and Challenge. Blackwell Science, Oxford, UK.

Richardson, C.J., R.S. King, S.S. Qian, P. Vaithiyanathan, R.G. Qualls, and C.A. Stow. 2007. Estimating ecological thresholds for phosphorus in the Everglades. Environmental Science and Technology **41**:8084-8091.

Richardson, C.J. and S.S. Qian. 2007. A statistical methodology for the detection, quantification, and prediction of ecological thresholds. Ecological Thresholds in Aquatic Ecosystems: The Role of Climate Change, Anthropogenic Disturbance, and Invasive Species Progress Review Workshop. US EPA, Washington, DC, USA http://www.scgcorp.com/eco-thresholds07/docs/03-RICHARDSON.ppt.pdf.

Sonderegger, D.L., H.N. Wang, W.H. Clements, and B.R. Noon. 2009. Using SiZer to detect thresholds in ecological data. Frontiers in Ecology and the Environment **7**:190-195.

Thorp, J.H., M.C. Thoms, and M.D. DeLong. 2006. The riverine ecosystem synthesis: biocomplexity in river networks across space and time. River Research and Applications **22**:123-157.

Turner, M. 2002. Landscape pattern, ecological processes and critical thresholds. *In*: Workshop on Ecological Thresholds. USEPA, Office of Research and Development, Washington, DC, http://www.environmentalfutures.org/agenda.htm.

Dr. Jennifer Tank

Comments to the chartered EPA-SAB on the adequacy of the scientific and technical basis of the proposed rule titled *Definition of Waters of the United States Under the Clean Water Act*.

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Questions
1. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all tributaries of a traditional navigable water, interstate water, the territorial seas, or impoundment. This definition is based on the conclusion that a significant nexus exists between tributaries (as defined in the proposed rule) and the traditional navigable waters, interstate waters, and the territorial seas into which they flow. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (lead discussants are: Drs. Emma Rosi-Marshall and Jennifer Tank)

General Comment:
Given my expertise and familiarity with the science associated with the Connectivity Report, informing the proposed rule, I found the proposed definition of "tributaries" to be accurate and clearly written.

Specific Comments:
P22203, C1, P2, L16 AND P22206, C2, P2: I am also supportive of the alternate interpretation that wetlands that connect tributary segments would be considered "adjacent wetlands", and as such would be jurisdictional waters of the United States under (a)(6). As such, wetlands would not be considered tributaries, but would remain jurisdictional as adjacent waters.

P22203, C2, P2. L50: In response to the query, I suggest that the flow regime in identified ditches should be less than intermittent flow, rather than less than perennial flow as proposed, based on my familiarity with the science associated with the Connectivity Report. This would apply only to those ditches not excluded by the proposed regulation and that meet the proposed definition of tributary as ''waters of the United States.''

2. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean all waters, including wetlands, adjacent to a traditional navigable water, interstate water, the territorial seas, impoundment, or tributary. This definition is based on the conclusion that a significant nexus exists between adjacent water bodies (as defined in the proposed rule) and traditional navigable waters, interstate waters, and the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (lead discussants are: Drs. Siobhan Fennessy and Mazeika Sullivan)

General Comment:
Given my expertise and familiarity with the science associated with the Connectivity Report, informing the proposed rule, I found the proposed definition of "adjacent water bodies" to be accurate and clearly written, which includes definitions of the terms "neighboring", "riparian area" and "floodplain".

Specific Comment:

P22209, C1, P2, L38: I am supportive of keeping text as written whereas best professional judgment is used to determine which flood interval is appropriate to determine if a water is located in the floodplain of a jurisdictional water, rather than providing greater specificity.

P22209, C2, P3, L1: I am supportive of the proposed deletion of the parenthetical text from the existing ‘‘adjacent wetlands’’ regulatory provision of the phrase ‘‘other than waters that are themselves wetlands’’.

3. The proposed rule has defined Waters of the U.S. under the jurisdiction of the Clean Water Act to mean, on a case-specific basis, other waters including wetlands, provided that those waters alone, or in combination with other similarly situated waters, including wetlands, located in the same region, have a significant nexus to a traditional navigable water, interstate water, or the territorial seas. Please comment on the adequacy of the scientific and technical basis of this proposed definition. (lead discussants are: Drs. Emily Bernhardt and Michael Gooseff)

General Comment:
Given my expertise and familiarity with the science associated with the Connectivity Report, informing the proposed rule, I found the proposed definition of “other waters” to be accurate and clearly written.

Specific Comment:
Pg 22212, C1, P2, L14: In response to the request by the agencies for comments on the listing of “other waters”, I am supportive of the rule as it stands whereby the agencies “do not propose to re-promulgate this list of ‘‘other waters’’ because it is unnecessary and has led to confusion where it has been incorrectly read as an exclusive list.”

Pg22214, C3, P1, L2: In response to the request by the agencies for feedback on “the inclusion of subcategories of types of ‘‘other waters,’’ either alone or in combination with similarly situated waters, that can appropriately be identified as always lacking or always having a significant nexus”, I suggest that Comments made through the SAB review of the Connectivity Report could provide suggestions appropriate for inclusion.

4. The proposed rule defines other terms and excludes specified waters and features from the definition of Waters of the U.S. Please comment on the adequacy of the scientific and technical basis of the other definitions and exclusions. (lead discussants are: Drs. David Allan and Mark Rains)

General Comment:
Given my expertise and familiarity with the science associated with the Connectivity Report, informing the proposed rule, I found the descriptions proposed other definitions and exclusions to be accurate.

5. If you have any other comments about the adequacy of the scientific and technical basis of the proposed rule, please provide them as well.

Pg 22193,C2, P3, L8 AND Pg 22197, C3, P4, L8: Replace “is not an all or nothing situation”, with “is a gradient” as that concept is central to the Connectivity Report on which the rule is based.

Pg 22194, C3, P1, L5: Recommend inserting “and recurring” after “systematic” to better reflect the nature of the interactions occurring in a watershed.

Pg 22196, C1, P2, L34: Recommend replacing “mercury” with “contaminants” as the Connectivity Report covers contaminants more broadly than just mercury.

Pg 22196, C1, P3, and continuing in C2: Up until this point, the term tributary has been used, and here the term “stream” is introduced, presumably interchangeably. This may be confusing, and if tributary rather than stream is appropriate, then it should be used consistently throughout.

Pg 22196, C2, P1, L3: Recommend “take up and change nutrients” be replaced with “assimilate and transform nutrients”, if not deemed too technical.

Pg 22196, C2, P2, L15: Recommend that the statement “such that the significance of the connection is difficult to generalize across the entire group of waters.” be modified so as to be consistent with revision to the Connectivity Report, where the concept of “gradient of connectivity” was introduced in this context.

Pg 22197, C2, P1, L24: Recommend replacing “nitrogen” with “nutrients”, to be consistent with role of streams in transforming multiple nutrients, not just nitrogen.

Pg 22197, C2, P3 and continuing in C3: This text should be revised to be consistent with any changes made to the Connectivity Report in response to SAB review. At present, the content does not reflect the consensus that “non-adjacent waters reflect a continuum of connectivity” which is the sentiment of the SAB Review based on current scientific understanding.

Pg 22222, C1, Appendix A: The text provided in this summary of scientific evidence should be updated and consistent with any changes that are incorporated in response to the SAB Review of the Connectivity Report.

Dr. Maurice Valett

Proposed Rule for Definition of Waters of the United States Under the Clean Water Act:
Comments from HM Valett

Proposed Rule for Definition of Waters of the United States Under the Clean Water Act:

I. General Info

none

II. Background

22195: use of the term 'significant'- The text on this page indicates that 'significant is not a scientific term'. It would be better to state that 'significant' is not meant to be used in a scientific manner at this point (i.e., refer to Kennedy's intent, as employed on page 22196; …more than speculative or insubstantial). I make this point because 'significant' is indeed a scientific term with implications of the probability of quantitative relationships among statistical estimates to effectively reflect reality (i.e., P values, etc).

III. Proposed definition of Waters of the United States

22204: proposed definition of 'tributary' - OHWM and semi-arid channels - Central to the proposed definition is the notion of the existence of an 'ordinary high water mark' (OHWM) and indirect or direct linkage to jurisdictional water. Recognition of both direct and indirect (i.e., through an additional entity that connects directly to the jurisdictional water) appropriately employs a 'systems' approach as emphasized in the *Rapanos* case (547 US 1t 781-782). This is a great strength of the definition.

Reliance on the OHWM to distinguish 'streams' from gullies or rills is perfectly appropriate in environments where climatic conditions result in fluvial geomorphic features that are formed by perennial flows and effectively represent 'permanent' waters. The science behind perspectives addressing where 'streams' start and the progression of hydrologic and geomorphic character, however, is hugely biased towards perennial systems. Other work (has emphasized environments and biomes where flow is not 'ordinary' and the concept of OHWM just doesn't work well. In truth, the transition from terrestrial to aquatic is a continuum and while I recognize the need for distinction, care must be taken to incorporate channels in semi-arid environments where flows occur uncommonly but are critical to the 'aquatic system'. Accordinlgy, I am worried about how this definition will be employed (or not) in semi-arid (i.e., desert) biomes where water issues are likely to first become apparent.

On the bottom of the first column on page #22202 the text reads 'The flow in a tributary may be ephemeral, intermittent, or perennial…' but on page #22203 in the middle column, half way down the page, the text reads 'The scientific concept of perennial flow is a widely accepted and well understood hydrologic characteristic of tributaries'. Written in that manner, it would suggest that perennial flow is a 'necessary' component for a channel to qualify as a tributary. This seems inconsistent. The inconsistency continues as the text on page #22205, middle column near top, reads that 'Sediment transport is also provided by ephemeral streams', provided as part of a description of how tributaries have significant nexus with jurisdictional waters. This sort of statement suggests that 'ephemeral' systems qualify first as streams and second as tributaries. My concern is that the terminology used here (ephemeral, intermittent, perennial) must be clearly identified and quantifiable. Determining a 'sig nexus' for the headwater (i.e., intermittent) streams of semi-arid landscapes will be greatly complicated by the 'atypical' geomorphology of these systems. Without the OHWM these channels may be categorized as 'other waters' and, therefore, will require establishment of a significant nexus to be categorized as 'adjacent' or 'neighboring'.

22205: significant nexus for tributaries - Biological linkage is argued to occur among tributaries and the text here emphasizes anadromous fishes. This is accurate and appropriate, but these fishes are rare at a national scale. Benthic insects, however, are robustly common and integrate streams and tributaries through drift and upstream flight (i.e., Colonization Cycle, Muller, K. 1982. The **colonization cycle** of freshwater insects. Oecologia 52:202-207.)

22206: exclusion of wetlands as 'tributaries', middle column - I agree with the agencies recognition that wetlands may play critical roles linked to lotic systems, but I feel it is best not to incorporate them in the more robust definition of tributary contributed by the proposed rule. Inclusion will dilute the clarity intended and promote confusion. It is far better to rely on 'adjacent' or 'neighboring' status to link wetlands to jurisdictional waters.

22208 & 22209: clarification on waters with 'these types of connections' - This portion of the proposed rule addresses waters that are 'neighboring' or 'adjacent' and how 'waters with these types of connections' may be identified via 'reasonable options for providing clarity'.

Two responses come to mind in regard to this issue, 1) there is no simple way to address the existence of a significant nexus….the concept is the correct one and addressing the existence of the nexus will be the burden of the agencies as recognized, and 2) claiming the 'floodplain' waters as adjacent is theoretically sound but operationally problematic. In studies of larger river systems, it is clear that current climatic conditions may support flooding and inundation of a given frequency, but its occurrence may be eliminated by modifications to stream banks (e.g., levees) and flow regimes (e.g., extractions, impoundments). Flood recurrence intervals are logical for 'connected' floodplains but there will be a need to establish new flow assessment to determine how a given magnitude will translate to 'connection' and influence nexus. The ultimate issue is one of connection and distinction as 'riparian' may or may not correspond to 'floodplain' landscape position. I do believe that the agencies are correct to claim the floodplain waters as 'adjacent' but the 'riparian' definition suggests that 'surface or subsurface hydrology' influences these environments. First of all, 'hydrology' is the study of water movements and distribution. That's not really the correction term to use in the riparian definition. I will admit that the term is commonly used (in peer-re viewed literature) to mean the movement and distribution of water, but the definition fails to link 'riparian' environments to the lotic systems of concern. The floodplain definition takes care of this issue.

Regarding how to approach designation, there isn't a 'desktop' version available. Floodplains and their surrounding environments are linked over vastly differing spatial and temporal scale and I don't believe that the agencies are going to be able to 'categorize' without due diligence. Costly, but accurate.

22211: 'other waters' and case-specific assessment - I think the agencies have it right here. There is a clear need to address on a 'case-specific' basis the status of a water body designated as 'other'. In fact on page

#22211, right column, 'other waters' are specifically defined as those that require assessment of a 'case-specific significant nexus determination'. The agencies clarify that they will remove an old list of 'others' to eliminate confusion (i.e., the mistaken notion that the list was exhaustive).

The larger issue is whether 'similarly situated' water bodies need to be addressed individually or can be assessed as a 'landscape unit' (see page #22213. left column) in a cumulative context. This language appropriately embraces the cumulative effects of 'neighboring' waters, characteristic of dendritic drainages and 'watersheds' as a whole. I really like the use of 'landscape unit' as it suggests integrated function. The request to employ a 'landscape unit' approach is a tricky one, but one that seems like it can be operationalized (i.e., aggregation on a 'local' basis to establish the landscape unit).

22212-22213: 'in the region' and 'similarly situated' - The agencies have correctly engaged in addressing this issue by clarifying their position on Justice Kennedy's use of 'in the region' and 'similarly situated'. With their approach, 'region' becomes synonymous with watershed (really catchment is the correct term). Later there appears to be recognition that 'regions' are larger things. Their interpretation does, however, keep the hydrologic linkage (i.e., and evident nexus) at the core of the distinction and that is a strength of the approach. Use of the NHD and HUC-10 tools are appropriate for designation as they are based on the same notion of 'watershed' delineation.

The definition employed for 'similarly situated' waters is nicely rooted in function and appropriately employs the 'landscape unit' concept. While geographic proximity can be misleading (i.e., some things nearby may be disconnected while others afar remain fully integrated), it needs to be included in the use of the term as geographic proximity is the basis of the 'region' notion above and the notion of similarity employed here....even given the clear focus on function. Note, however, when the definition of 'similarly situated' is addressed (left column, bottom, 22213), it is rooted in characteristics of the terrestrial environment (soils, vegetation, landform). Given the emphasis that the SAB has placed on a 'flowpath' conceptual basis for the Water Body Connectivity report, I find it strange that 'hydrologic connectivity to each other or a jurisdictional water' arrives as a caveat...almost an afterthought. I would propose elevating it to the same level of importance as the terrestrial characteristics.

At the same time, the use of 'relatively homogenous soils, vegetation and landform' is a vague distinction. Soils and vegetation are notoriously heterogeneous at different scales. I'm not sure if this notion helps aggregate at all.

22214: use of the term 'report' – In the left column, top of page, the text reads 'For example, a report that reviewed the results....'. The use of the term 'report' is misleading. The citation provided indicates a peer-reviewed publication and the product should be named as such. There are no standards for reports that cross agencies and institutions.

22214: clarifying chemical nexus – Mid-point of left column the text argues that landscape position influences the strength of connection to the nearest water of the US. This may be a true statement, but it is not specific to chemical nexus and seems out of place.

22214: regional and national studies and 'desktop evaluation' – Despite the very specific definition of region and the efforts to consider 'similarly situated', the agencies now suggest that 'national' scale assessments are applicable. Moreover, they make the statement that 'desktop' assessment will be appropriate if 'sufficient' information exists. Without any protocol established a priori, this statement is arrogant and borders oninflamatory. Is it their intent to say that they dont have to do field work when it isn't necessary? Again, without established protocol to address, this statement should be seriously reconsidered.

22214: 'additional scientific research and data that might further inform decisions about other waters' – The rule to be promulgated addresses specific relationships among water bodies across multiple scales. It is clear that the agencies are concerned about 'resources' for case-specific assessment. I suggest that a series of specific RFPs address these needs in the future to focus research on just these issues. Back-fitting research originally addressing a different question will only go so far in this sense.

22215-22216: request for comment on 'these alternative approaches' – Determining by rule that 'other waters are similarly situated' in certain areas is proposed to be applicable by recognition of the idea that streams/waters within an 'ecoregion' behave similarly. The ecoregions addressed by the agencies are thought to have similar ecosystems and resources. Omernik's work comes from a geography background (Omerink, J.M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geographers. 77:118-125). This (and the list of Leve III ecoregions) compiles associations based again on terrestrial entities. What about HUC-10 or aggregation based on flow characteristics (Poff, N. L., and J. V. Ward. 1989. Implications of streamflow variability and predictability for lotic community structure: A regional analysis of streamflow patterns. Canadian Journal of Fisheries and Aquatic Sciences **46**:1805-1818.)? While the focus is on Waters of the United States, there seems to be tie to terrestrial geography here at the expense of 'water-based' categorization. Result may be similar or not but the focus should be on distribution and flow of water within 'regions' directly assessed rather than inferred from terrestrial association. A comparison of the two (terrestrial vs. aquatic) should yield insight.

Such an approach would 'group' streams as similar in the context of their flow characteristics and derive a geographic association simultaneously. The issue of whether those streams within a 'region' are 'similarly situated' remains unsolved. Position along the flow continuum and discontinuities associated with different processing domains (Montgomery, D. R. 199. Process domains and the river continuum. Journal of the American Water Resources Association **35**:397-410.) will be important in determining 'landscape position' and addressing the question of 'similarly situated'.

22217: general tendencies – Middle column half way down – I'm not sure it make any sense to telegraph the interpretation of aggregation at this point. This may raise the ire and appears to be pre-judging the issue of aggregation. How does including this help with clarity?

2217 & 2218: agriculture and the CWA – While this is not the task of the SAB, the agencies and the US as a whole need to start thinking about the logic of regulating all but the largest polluters of its waters.

IV. Related Acts of Congress, Executive Orders, and Agency Initiatives

none

Appendix A: Scientific Evidence

Part I: synthesis of peer-reviewed literature

22222: upper right column, bidirectional vs. unidirectional – These terms continue to hang around even as we have clearly deemed them confusing and inappropriate. I expect they will be eliminated from future versions?

Part II: additional scientific support

Under section ‘i. tributaries’ the outline form breaks down with the following errors:

i. tributaries	
	A. tribs have nexus
	B. tribs affect physical integrity
	C. tribs affect chemical integrity
mistake	C. tribs affect biological integrity
mistake	D. headwater tribs influence phys, chem, biol
	F. non-permanent streams via phys, chem, biol
mistake	E. Trib lake, pponds, wetlands
mistake	F. man-made tirbs