OPINION

The proposed change to the definition of "waters of the United States" flouts sound science

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The U.S. Environmental Protection Agency (EPA) and Army Corps of Engineers (hereafter, "the agencies") have issued a proposed rule (1) that would remove Clean Water Act (CWA) protections from more than half of wetlands and one-fifth of streams in the United States (2). This move sharply contrasts with reports indicating that US waters remain threatened by storms, droughts, contaminants, algal blooms, and other stressors. Even the EPA's National Water Quality Inventory detected poor conditions in 46% of stream and river miles and 32% of wetlands (3). In short, the proposed rule does not reflect the best-available science and, if enacted, will damage our nation's water resources.

Despite the CWA's mandate "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (4), controversy persists over jurisdiction. For decades, the protected "waters of the United States" (WOTUS) included traditionally navigable waters (TNWs), such as large rivers, lakes, and territorial seas, as well as waters meaningfully connected to or affecting the integrity of TNWs. Operationalizing this connection has become a flashpoint for the science and politics of water protection.

A proposed rule under consideration by the US federal government does not reflect the best-available science and, if enacted, will damage the nation's water resources. Image credit: Shutterstock/Martha Marks.

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Connectivity among waterbodies was the cornerstone of the Obama administration's Clean Water Rule (CWR), which reflected a state-of-the-science synthesis of more than 1,200 scientific publications [known as the "Connectivity Report" (5)], input from 49 experts, and a rigorous review by a 25-member panel of the EPA's Scientific Advisory Board (SAB) (6). Since then, scientific evidence supporting the 2015 CWR, and hence contradicting the new proposal, has only accumulated, especially as related intermittent (i.e., flow seasonally) and ephemeral (i.e., flow periodically, after precipitation events) streams, riparian and floodplain zones, and non-floodplain wetlands (i.e., geographically isolated with no direct surface water connection to a navigable water) (Fig. 1) (7–9).

The Trump administration's proposed rule largely ignores or misrepresents several conclusions of the Connectivity Report and SAB review. In relying more upon case law than science, the proposed rule would remove protection for millions of stream miles and acres of wetlands that keep waters and watersheds healthy. Some of our most vulnerable waters will lose protection, including ephemeral streams, non-floodplain wetlands, and some floodplain wetlands. The proposed rule is inconsistent with the best-available science regarding scale, structural and functional connectivity, and consideration of multiple dimensions of connectivity.

Delicate Balance

Clean water depends on complex and highly variable interactions among climate, geology, topography, land use–land cover, human perturbations, and ecosystem processes operating across multiple spatial and temporal scales. As such, the SAB cautioned that connectivity of any single waterbody must be evaluated from systems-level perspectives, such as watersheds and riverscapes, groundwater basins, and fluvial hydrosystems. Although the contribution of a single wetland or stream to water health may be small, the cumulative effects are striking. For example, ephemeral and intermittent streams constitute more than two-thirds of all streams in the conterminous United States (10), more than half of which feed public water systems supporting about a third of Americans (11). The proposed rule fails to consider watersheds from such a broad perspective, instead excluding the ephemeral streams and non-floodplain wetlands that maintain watershed integrity.

The proposed rule further deviates from science by improperly recognizing structural connectivity (i.e., how waterbodies are physically connected to one another) and functional connectivity (i.e., interactions among elements, such as the movement of sediments along river networks). Both mediate the movement of mass, energy, and biota among waterbodies (6, 10). Although streams are structurally connected to downstream waters through networks of continuous beds and banks, the proposed rule ignores the typical physical evidence (e.g., use of bed, banks, and an ordinary high-water mark) and suggests potentially using blue-line streams on U.S. Geological Survey topographic or National Hydrology Dataset maps as a way to indicate a jurisdictional stream. Although the agencies indicate that combining this information with other measures (for example, with fieldwork and the relative size of a stream, also known as "stream order") will be important to avoid overestimating flow and erroneously concluding the presence of a jurisdictional tributary, they fail to recognize the opposite problem. In fact, the poor resolution of currently mapped drainage networks can miss one-third of stream lengths relative to higher-resolution data (e.g., Light Detection and Ranging [LIDAR]) and thus lead to a gross underestimation of presence of streams.

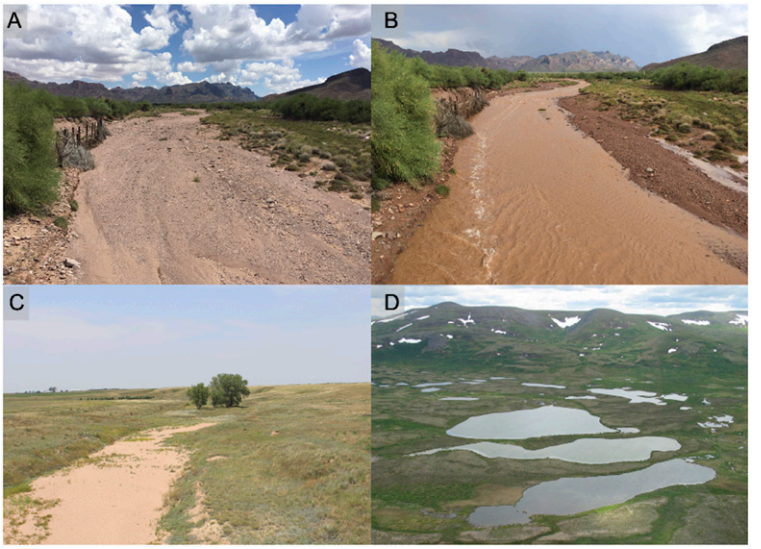

Fig. 1. The proposed WOTUS rule would remove protections for ephemeral streams, such as those seen here—dry and wet phases of a stream in Arizona (*A* and *B*), dry phase of a stream in Colorado (*C*)—as well as non-floodplain wetlands (*D*, in Alaska). Nonperennial streams comprise millions of stream miles, and non-floodplain wetlands encompass millions of acres in the United States. Image credits: *A* and *B*, Michael T. Bogan (University of Arizona, Tucson, AZ); *C*, Daniel C. Allen (University of Oklahoma, Norman, OK); and *D*, Mark Rains.

To the extent that the proposed rule improperly quantifies structural connectivity, it ignores functional connectivity entirely. Functional connectivity varies widely over time, partly as related to floodplain and river size and the propensity for overbank flooding. Indeed, the functional connectivity of a water to downstream waters may persist even without direct hydrologic surface connection "in a typical year," a criterion used by the proposed rule to establish jurisdiction of wetlands. Consistent with new science, the SAB recommended that functional gradients of connectivity are not binary in nature and, rather, should be viewed as a gradient of frequency, duration, magnitude, and predictability of connections (6). Yet the proposed rule uses that binary lens to eliminate protection from all ephemeral streams and non-floodplain wetlands, irrespective of connectivity and the consequences for downstream waters.

The near-exclusive emphasis of the proposed rule on hydrologic connectivity contradicts the CWA's mandate to protect chemical and biological connectivity as well.

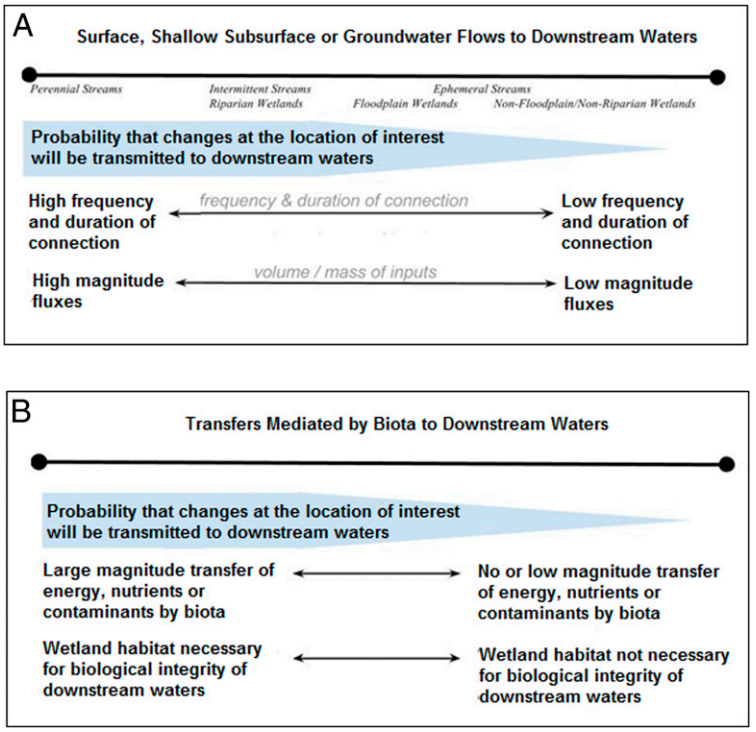

Fig. 2. The agencies improperly used the above figure from the SAB review to support removing federal protection for ephemeral streams and non-floodplain wetlands. The conceptual figure is meant to convey that connectivity between streams and wetlands and downstream waters is more appropriately represented by a connectivity gradient (*A* and *B*); this is not a binary property. Aggregate effects and low levels of connectivity can be important. Reprinted from ref. 6.

Multiple lines of evidence point to the importance of chemical and biological connectivity. For instance, non-floodplain wetlands can be important chemical sources (e.g., nutrients, dissolved organic compounds, salts) and sinks (via a suite of physicochemical processes including denitrification, sedimentation, long-term storage in plant detritus, and ammonia volatilization) to downstream waters (8). Likewise, animals transport nutrients, energy, and other organisms between disparate locations at both local and landscape scales. Through these movements, biota also prevent inbreeding, escape stressors, locate mates, find food resources, and recolonize habitats, thus contributing to biodiversity and exchanging nutrients and carbon among waterbodies and serving as critical agents of connectivity and resiliency among streams, wetlands, and downstream waters (7).

The proposed rule also misinterprets and contradicts previous recommendations from the EPA's own scientists and SAB. The rule is not only inconsistent with the science of the Connectivity Report and the SAB review, but its exclusions are justified with information from the SAB review that has been misinterpreted or taken out of context. For instance, the proposed rule justifies the removal of federal protection for ephemeral streams and non-floodplain wetlands by improperly referencing a conceptual model developed by the SAB. The model in question illustrates how connectivity gradients can facilitate the evaluation of the downstream impacts of changes to streams and wetlands (Fig. 2). Although the connectivity gradient does suggest that certain ephemeral streams and non-floodplain wetlands may be comparably less connected to downstream waters than perennial streams and floodplain wetlands, the SAB affirmed that even low levels of connectivity can be important relative to impacts on the chemical, physical, and biological integrity of downstream waters.

Indeed, the relative lack of connectivity between some wetlands and downstream waters is inversely related to their contribution to water quality (12). For instance, when non-floodplain wetlands capture water, materials, and nutrients from stormwater or agricultural runoff, pollution to downstream waters is prevented or reduced. Scientific advances since the development of this figure bolster the notion of a connectivity gradient, indicating that having no connectivity is unlikely, and that even habitat in non-floodplain wetlands is important for downstream waters.

Another shortcoming of the proposed rule is its departure from a critical recommendation from the SAB, which was that connectivity gradients must be contextualized within broader watershed processes, including the aggregate, collective effects of waterbodies. The cumulative effects of waterbodies are a particularly important consideration for non-floodplain wetlands, where the relative distance (compared with floodplain wetlands, for example) from a jurisdictional water may be greater and, thus, the impacts to downstream waters relatively lower. However, the cumulative effects of aggregated wetlands can strongly influence fluxes or transport of water, materials, and biota to downstream waters (8). Because of variability in the degree of connectivity between non-floodplain wetlands and downstream waters, the SAB recommended a case-by-case analysis to determine the degree of connection, which was adopted by the current CWR.

In addition to improperly using the science to justify summarily removing protections for all non-floodplain wetlands, the agencies go one step further by claiming that removing case-by-case evaluations of non-floodplain wetlands will help improve the clarity of the rule and ease of implementation. However, they propose case-by-case judgments in multiple other instances. For instance, the agencies suggest using a combination of methods to distinguish perennial and intermittent from ephemeral flows as defined by the proposed rule, including field visits and remote and field-based tools. Similarly, under the proposed rule, ditches that may have been constructed in a tributary would have to be evaluated on a case-by-case basis. Thus, the proposed rule selectively applies case-by-case consideration to waterbodies, for which such examination is likely to result in exclusion from CWA protections, and removes such consideration from waterbodies (i.e., non-floodplain wetlands) where a case-by-case examination may be more likely to afford protection.

Dire Implications

If enacted, the proposed rule will erode protections for millions of miles of ephemeral and headwater streams (10, 13) and more than 16 million acres of wetlands in the conterminous United States, including many playa lakes, prairie potholes, Carolina and Delmarva Bays, pocosins, and vernal pools (14). As such, the rule increases the vulnerability of already sensitive waters that provide critical ecosystem services, such as protecting water quality, recharging aquifers, transporting organic material, safeguarding habitats for endangered species, and supporting recreational and commercial endeavors. Severe losses of wetland functions are likely under the proposed rule, with impacts to wetlands in arid and semi-arid regions particularly high. For instance, the Cimarron River Watershed in northeastern New Mexico is projected to lose between 18 and 69% of wetland acres under the proposed rule (15).

Particularly worrisome is that the proposed rule is likely to facilitate the removal of waters from protection in the future, given anticipated trends in human activities and climate change. In some areas of the country, perennial streams are shifting to intermittent and ephemeral streams, presumably as a result of groundwater pumping accentuated by a changing climate (16). Under the proposed rule, these newly ephemeral streams will lose protection, setting a dangerous precedent by opening the door for further losses of protection.

Every nation's citizens need clean water to be healthy and productive—today and into the future. When carefully considered and integrated, science provides an evidence-based strategy to ensure clean water—as with the Obama administration's CWR. However, the current administration's proposed rule at once contradicts both the rich body of science about water connectivity and the clearly articulated mandate of CWA. Furthermore, it lacks the alleged clarity touted by the agencies. The apparent opposition to enacting science-based policies undermines decades of efforts—and investments by tax-paying Americans—to clean and protect our nation's waters.

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