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Overboard? The Complexity of Traditional TMDL Calculations Under the Clean Water Act

by Matthew DeGioia

Matthew DeGioia is a 2020 J.D. candidate at the George Washington University Law School and Senior Managing Editor of the George Washington University *Journal of Energy and Environmental Law*.

Summary

The Clean Water Act (CWA) requires states to calculate total maximum daily loads (TMDLs) of individual pollutants that impair their waters. But the means by which TMDLs are calculated are imprecise, because (1) it is difficult to geographically isolate the effects of a single pollutant; (2) it is difficult to account for the effect of numerous catalysts that alter the calculation; (3) it is difficult to isolate the effects of a single pollutant source on an individual water body; (4) it can be difficult to categorize a source either as point or nonpoint; (5) extant methods fail to fully account for catalytic variables and/or assume current regulatory programs are working more efficiently than they actually are; and (6) the federal government has not allocated sufficient funds to allow state agencies to perform proper analyses. To mitigate these effects, Congress should amend the CWA to permit states to calculate TMDLs by proxy in areas in which proxies are found to be strongly correlative with water quality. This would bring clarity to interpretation of the Act and flexibility in its execution.

American farmers live in a perpetual catch-22. On the one hand, the U.S. agricultural industry has been hailed by many as a model of efficiency and innovation, as new techniques of growing and harvesting crops have been implemented to maximize production to feed more than 327 million citizens and foreign buyers while mitigating local environmental impacts.[1] On the other hand, the continued release of macronutrients, which are necessary for crop and animal growth, into surrounding water bodies has continued to adversely affect local water bodies to the point where increased regulatory action has been considered by the U.S. Congress, including passing a substantial portion of nutrient removal costs to farmers.[2] A common effect of excess nutrient release into local water bodies is eutrophication, a process in which enrichment of water causes algal growth that leads to oxygen depletion, the blocking of sunlight to other organisms, and the contamination of the water supply by toxins.[3]

While research and technological innovation has led to the development of improved best management practices (BMPs) to ensure that excess nutrients are not deposited into local waterways,[4] the costs of implementing such practices are steep.[5] Further, since the regulatory scheme in managing pollution from agriculture is not binding, in that it is mainly built around "research, education, outreach, and voluntary technical and financial incentives" from the federal government, it is unlikely that farmers would be willing to take upon themselves additional costs that can be prohibitive, depending on the financial stability of the farm.

However, it is important to address whether implementing such practices across the board is even necessary. Are current pollutant loads being calculated in the most accurate way possible? If not, are water pollutant loads being overstated to the detriment of local farmers? This issue is most apparent in the calculation of total maximum daily loads (TMDLs), which the Clean Water Act (CWA or the Act)[6] requires states to perform if certain water bodies fail to meet water quality standards.[7] TMDLs are to be calculated for each individual pollutant preventing the water body from meeting water quality

1. Megan Stubbs, Congressional Research Service, R43919, Nutrients in Agricultural Production: A Water Quality Overview 1 (2016).
2. *Id*. at 23.
3. *Id*. at Summary.
4. *Id*.
5. *Id*. at 23. For example, the cost of removing nitrates from drinking water supplies is more than $4.8 billion per year. While the bulk of this cost is borne by large water utilities, it is estimated that if the agricultural industry were required to pay based on its contribution to nitrate loading, its share would be about $1.7 billion per year.
6. 33 U.S.C. §§1251-1387, ELR Stat. FWPCA §§101-607.
7. 33 U.S.C. §1313(d)(1)(A); *see also* Pronsolino v. Nastri, 291 F.3d 1123, 1139, 32 ELR 20689 (9th Cir. 2002).

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standards.[8] Further research into the manner in which they are calculated reveals that the method of performing such calculations is cumbersome and the data received and implemented are often imprecise. To make up for these discrepancies, agencies often estimate their calculations according to the most conservative, and therefore the most stringent, standards possible,[9] translating to increased pressure by states on farmers to absorb compliance costs to meet TMDL standards.

To mitigate the effects of statistical discrepancies between the calculation and implementation of TMDLs, this Article proposes that Congress amend 33 U.S.C. §1313(d)(1)(C) of the CWA to explicitly permit states to calculate TMDLs by proxy in situations in which there is a strong correlation between the proxy and source of impairment, in order to allow agencies enough flexibility to address the complexities of nonpoint source pollution and to allow TMDLs to be implemented with greater ease. This proposal does not aim to rid the Act of calculating TMDLs by individual pollutant. Instead, it aims to allow for the calculation of TMDL proxies in watersheds in which such a calculation would be most efficient and appropriate.

Part I introduces the reader to a brief history of the CWA, including its regulatory scheme of different pollutant sources, as well as its efficacy. Part II identifies the difficulties of calculating TMDLs for individual pollutants, including insufficient data implemented in traditional TMDL calculations, existing faulty calculation methods, and insufficient federal funding to allow for accurate data collection. Part III examines the costs and effects of implementing traditional TMDLs on the local level, and Part IV canvasses the current legal grey area that TMDL proxies occupy between different federal judicial circuits. Part V identifies the benefits of calculating TMDLs by pollutant proxies, as well as certain scenarios in which such a calculation is preferable to the traditional method, and will also answer common objections to broadening §1313(d)(1)(C) to include the calculation of proxy loads. Part VI concludes.

8. 33 U.S.C. §1313(d)(1)(C).
9. *See*, *e.g.*, Kathy Rose, Santa Ana Regional Water Quality Control Board, Total Maximum Daily Loads for Organochlorine Compounds, San Diego Creek: Total DDT and Toxaphene, Upper and Lower Newport Bay: Total DDT, Chlordane, Total PCBS, Orange County, California 77 (2006) ("In addition, a conservative approach was taken in developing these TMDLs, which should provide an added degree of protection to aquatic life, predator organisms, and human health."); *see also* Anacostia Riverkeeper, Inc. v. Jackson, 798 F. Supp. 2d 210, 252, 41 ELR 20251 (D.D.C. 2011) ("Thus, the load limits—which are developed to reduce pollution from predicted levels to amounts necessary to satisfy water quality standards—call for total reductions that are far greater than necessary to move from actual conditions to safe levels.").

I. CWA Legal Background

Prior to passage of the CWA, the public did not have to look far to witness the harm caused by water pollution. Waterways connected to urban and industrial sites were left heavily contaminated by sewage and waste,[10] causing record losses to marine life, fisheries to close, and wetlands to be destroyed.[11] Many waterways were even, inconceivably, set on fire.[12] One such fire, the Cuyahoga River Fire of 1969, effectively served as the straw that broke the camel's back.[13] After 24 years of experiencing largely ineffective federal water pollution controls, which were largely state-led and provided close to no accountability structure, the public had enough: Congress was compelled to come up with a new solution to improving the quality of the nation's waters.[14]

The CWA was passed to achieve national goals through the creation of technology-based effluent limitation standards. The driving force behind passing the legislation was "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters,"[15] through the research and development of necessary technologies to "eliminate the discharge of pollutants into the navigable waters."[16] A "pollutant" is defined as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water."[17] The Act also sets forth an interim goal to "provide water quality which protects the propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water."[18]

The CWA implements an innovative hybrid approach of mandating use of the most up-to-date technological water control standards, while also requiring states to establish and meet water quality standards for all waters within their borders.[19] It distinguishes between two types of pollution sources in its regulatory scheme: "point" sources and "nonpoint" sources. Point sources are defined under

10. Shana C. Jones, *Making Regional and Local TMDLs Work: The Chesapeake Bay TMDL and Lessons From the Lynnhaven River*, 38 Wm. & Mary Envtl. L. & Pol'y Rev. 277, 278-79 (2014).
11. Jon Devine, *Clean Water Act at 45: Despite Success, It's Under Attack*, NRDC (Oct. 18, 2017), https://www.nrdc.org/experts/jon-devine/clean-water-act-45-despite-success-its-under-attack.
12. Jones, *supra* note 10, at 278.
13. Jonathan H. Adler, *Fables of the Cuyahoga: Reconstructing a History of Environmental Protection*, 14 Fordham Envtl. L.J. 89, 91 (2002).
14. Cathleen Day, *Down by the Chesapeake Bay: Cooperative Federalism, Judicial Intervention, and the Boundary Between State Land Use and Federal Environmental Law*, 38 Energy L.J. 253, 254 (2017).
15. 33 U.S.C. §1251(a).
16. *Id*. §1251(a)(6).
17. *Id*. §1362(6).
18. *Id*. §1251(a)(2).
19. Day, *supra* note 14.

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the Act as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged."[20] More dispersed sources of pollution, such as agricultural and urban runoff, which do not fall under the definition of a point source, are deemed nonpoint sources of pollution.[21]

The CWA prohibits the discharge of any pollutant into the nation's waters unless the discharge complies with the requirements of the Act.[22] It is particularly stringent in its regulation of point source pollution, requiring that polluters comply with a national permit program (national pollutant discharge elimination system or NPDES) identifying effluent limitations "necessary to meet water quality standards" set by states.[23] The issued permits must meet both "(1) effluent limitations that reflect the pollution reduction achievable by using technologically practicable controls and (2) any more stringent pollutant release limitations necessary for the waterway receiving the pollutant to meet 'water quality standards.'"[24] Failure to comply with the point source regulatory scheme can result in civil or criminal liability.[25]

If certain water bodies fail to meet water quality standards under the regulatory scheme, states are then required to identify such water bodies within their respective jurisdictions, regardless of whether the impairment of the water body was caused by point source or nonpoint source pollution.[26] For each of these water bodies, states must establish a TMDL for each individual pollutant preventing the water body from meeting water quality standards.[27] A TMDL comprises the sum of individual wasteload allocations (WLAs) for point sources, including industrial or urban sewer outfalls, and load allocations (LAs) for nonpoint sources, such as farmland.[28] Upon approval by the U.S. Environmental Protection Agency (EPA), the states are to encourage and incentivize the implementation of best practices to limit nonpoint source pollution in order to meet the requirements of the TMDL.

A. *Historical Efficacy of the CWA*

Since the passage of the CWA in 1972, the quality of the nation's waters has improved considerably.[29] In particular, the regulatory scheme implemented for point sources has been largely successful.[30] For example, in 2014, the U.S. Government Accountability Office (GAO) performed a review of TMDLs that were approved over five years prior to assess their efficacy in achieving water quality standards. The results of its survey of state officials knowledgeable about TMDLs revealed that 83% of TMDLs "have achieved their targets for point source pollution . . . through permits."[31]

The same cannot be said for nonpoint source pollution, however. In the same survey, GAO found that only 20% of TMDLs reached their goals for nonpoint source pollution.[32] The failure of states to abate nonpoint source pollution has thrown off much of the gains made by the CWA's regulatory scheme for point sources. According to a 2013 report issued by EPA, 55% of the nation's waters remain uninhabitable, mainly due to phosphorus and nitrogen pollution, as well as poor habitat.[33] Nutrients such as phosphorus and nitrogen come from a variety of sources, such as agriculture, developed lands, wastewater treatment plants, forested lands, and the atmosphere.[34] Introducing such nutrients into waterways can cause eutrophication and algal blooms, which decrease the amount of dissolvable oxygen in waterways. Large multijurisdictional watersheds, such as the Chesapeake Bay and the Gulf of Mexico, have particularly struggled to deal with hypoxic waters.[35]

Apart from being difficult to identify, nonpoint sources often require steep changes in land use in order to abate their effects, making it economically difficult to implement nonpoint source controls. As described in the GAO report, many regulators found that they did not have the legal authority to compel polluters or landowners to implement controls necessary to meet TMDL requirements.[36] In fact, the scheme set forth in regulating nonpoint source pollution is largely voluntary, relying on a "combination of voluntary source activities, state rules, and active watershed organizations that promote community action" to reach TMDL goals.[37] GAO also found that EPA's existing regulations do not explicitly require TMDLs to include

20. 33 U.S.C. §1362(14).
21. *See id.*; *see also* Lara B. Fowler et al., *Addressing Death by a Thousand Cuts: Legal and Policy Innovations to Address Nonpoint Source Runoff*, Choices, 3d Quarter 2013, at 1.
22. 33 U.S.C. §1311(a).
23. *Id.* §1311(b)(1)(C). *See also* 40 C.F.R. §131.2 (2015).
24. Piney Run Pres. Ass'n v. Cty. Comm'rs of Carroll Cty., 268 F.3d 255, 265 32 ELR 20208 (4th Cir. 2001); *see also* Paul Smail, *A Work in Progress: The Regulation of Stormwater Discharges From Municipal Separate Storm Sewer Systems in Maryland*, 48 Md. B.J. 12, 15 (2015).
25. *See* 33 U.S.C. §§1319, 1321.
26. *Id.* §1313(d)(1)(A); *see also* Pronsolino v. Nastri, 291 F.3d 1123, 1139, 32 ELR 20689 (9th Cir. 2002).
27. 33 U.S.C. §1313(d)(1)(C).
28. 40 C.F.R. §130.2 (2019). *See also* Smail, *supra* note 24, at 17.
29. Day, *supra* note 14.
30. Kyle Robisch, *The Future of Proxy Total Maximum Daily Loads After* Virginia Department of Transportation v. EPA, 67 Vand. L. Rev. En Banc 171, 171 (2014).
31. GAO, GAO 14-80, Clean Water Act: Changes Needed if Key EPA Program Is to Help Fulfill the Nation's Water Quality Goals 1 (2013). *See also* Claudia Copeland, Congressional Research Service, R42752, Clean Water Act and Pollutant Total Maximum Daily Loads (TMDLs) 17 (2014).
32. GAO, *supra* note 31.
33. Jones, *supra* note 10, at 278.
34. *Id.* at 278-79.
35. *Id.*
36. GAO, *supra* note 31, at 62 app. IV.
37. Robisch, *supra* note 30, at 175-76.

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how and by whom TMDLs will be implemented as well as whether periodic plan revisions would be needed.[38]

II. The Deficiencies of Traditional TMDL Calculations

Since Congress has historically been hesitant to restrict land use for political reasons,[39] it is unlikely that Congress would amend the CWA to require landowners to implement more stringent nonpoint source controls. Therefore, the next best thing would be to modify the means by which TMDLs are calculated, while still allowing for effective abatement of nonpoint source pollution. The difficulty in calculating a TMDL for an individual pollutant lies in the fact that it is difficult to isolate the harm caused by a single pollutant vis-à-vis the harm caused by a synergistic interaction of multiple pollutants in a single water body.[40]

Not only is the calculation of load limits for individual pollutants time-consuming, but the implementation of such limits by municipalities is difficult because engineers and city planners do not directly work with pollutant loads; rather, they often work with pollutant proxies, such as percent-connected impervious cover or gallons of stormwater runoff.[41] Congress should therefore amend 33 U.S.C. §1313(d)(1)(C) of the CWA to explicitly permit states to calculate TMDLs by proxy in situations in which there is a strong correlation between the proxy and source of impairment, to allow agencies enough flexibility to address the complexities of nonpoint source pollution, and to allow TMDLs to be implemented with greater ease.

A. What Is Involved in a TMDL Calculation?

A TMDL comprises the sum of individual WLAs for point sources, LAs for nonpoint sources, and a margin of safety (see Figure 1).[42]

Figure 1. TMDL Calculation

$$TMDL = \sum WLA + \sum LA + MOS$$

WLAs are defined under federal regulations as the "portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution," which constitute "a type of water quality-based effluent limitation."[43] LAs are defined under federal regulations as the "portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources," and are deemed "best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading."[44] States are also required to include in TMDL calculations a margin of safety, "which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."[45]

Notably, neither the CWA nor the *Code of Federal Regulations* identifies a specific formula to be implemented in calculating WLAs and LAs, allowing great latitude to states to implement their own calculation methods.[46] For example, Ohio's Administrative Code specifically identifies a mass balance equation to be implemented in the calculation of WLAs for discharges of toxic and carcinogenic pollutants to flowing receiving waters, the sum of which is a function of varied arithmetic calculations of water quality criterion, effluent flow, percent of stream design flow, and background water quality (see Figure 2).[47]

Figure 2. Ohio Calculation of WLAs for Discharges of Toxics and Carcinogenic Pollutants

$$[WQC\ (Qeff + Qup\ ) - (WQup)]/Qeff$$

Where:

WQC = water quality criterion
Qeff = effluent flow
Qup = percent of the stream design flow
WQup = background water quality

The Ohio Administrative Code also identifies a different equation to be implemented in the calculation of WLAs for direct discharges to lakes, the sum of which is a function of water quality criterion and background water quality calculations (see Figure 3).[48]

Figure 3. Ohio Calculation of WLAs for Direct Discharges to Lakes

$$11(WQC) - 10(BACK)$$

Where:

WQC = water quality criterion
BACK = background water quality

38. GAO, *supra* note 31, at 1.
39. Jones, *supra* note 10, at 279.
40. Dave Owen, *Urbanization, Water Quality, and the Regulated Landscape*, 82 U. Colo. L. Rev. 431, 461 (2011).
41. *Id.* at 461-62.
42. 40 C.F.R. §130.2 (2019). *See also* Smail, *supra* note 24, at 17.
43. 40 C.F.R. §130.2(h) (2019).
44. *Id.* §130.2(g).
45. 33 U.S.C. §1313(d)(1)(C).
46. *See* Ohio Admin. Code §3745-2-05 (2018); *but see* Minn. Stat. Ann. §114D.26 (2013).
47. Ohio Admin. Code §3745-2-05 (2018).
48. *Id.*

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By contrast, Minnesota, while calling for the calculation of WLAs and LAs for TMDLs, does not identify in its water pollution control statute any models or equations by which such allocations are to be calculated[49]:

> **Minn. Stat. Ann. §114D.26. Watershed Restoration and Protection Strategies:**
>
> The Pollution Control Agency shall develop watershed restoration and protection strategies [WRAPS]. To ensure effectiveness and accountability in meeting the goals of this chapter, each WRAPS shall:
>
> (1) identify impaired waters and waters in need of protection;
> (2) identify biotic stressors causing impairments or threats to water quality;
> (3) summarize watershed modeling outputs and resulting pollution load allocations, wasteload allocations, and priority areas for targeting actions to improve water quality;
> (4) identify point sources of pollution for which a national pollutant discharge elimination system permit is required under section 115.03;
> (5) identify nonpoint sources of pollution for which a national pollutant discharge elimination system permit is not required under section 115.03, with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions;
> (6) describe the current pollution loading and load reduction needed for each source or source category to meet water quality standards and goals, including wasteload and load allocations from TMDLs;
> (7) contain a plan for ongoing water quality monitoring to fill data gaps, determine changing conditions, and gauge implementation effectiveness; and
> (8) contain an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources, including:
>
> (i) water quality parameters of concern;
> (ii) current water quality conditions;
> (iii) water quality goals and targets by parameter of concern;
> (iv) strategies and actions by parameter of concern and the scale of adoptions needed for each;
> (v) a timeline for achievement of water quality targets;
> (vi) the governmental units with primary responsibility for implementing each watershed restoration or protection strategy; and
> (vii) a timeline and interim milestones for achievement of watershed restoration or protection implementation actions within ten years of strategy adoption.

It is important to note the effects of the variability of both the LA calculation and the margin-of-safety calculation. While WLAs tend to be more accurately calculated because they are connected to the well-defined regulatory scheme for point source pollution, LAs are merely calculated as "best estimates" from the more dispersed nonpoint sources of pollution.[50] With respect to margin-of-safety calculations, neither the CWA nor the *Code of Federal Regulations* identifies how such a calculation is to be performed.[51] Historically, states have either opted to incorporate a margin of safety implicitly "through the use of conservative assumptions to develop the TMDLs," or explicitly by deferring to a commonly implemented federal standard.[52] In implementing either option, states tend to adopt the CWA's bent toward the complete elimination of pollutant discharges into navigable waters,[53] and therefore lean toward calculations that would lead to the implementation of stricter water pollution control standards on the local level than may be necessary.[54]

As illustrated in Part III, local farmers bear significant costs in the implementation of stricter water pollution control standards. The greater the variability in the calculation of pollutant loads, or in the calculation of a margin of safety, the greater the financial strain placed on polluters seeking to comply with federal and state-mandated water controls. Such variability comes from the difficulties that arise in calculating TMDLs by individual pollutant.

B. Why Is It Difficult to Calculate TMDLs by Individual Pollutant?

There are many factors in play in traditional TMDL calculations that cause state agencies to issue inaccurate TMDL calculations. Primarily, it is difficult to calculate TMDLs by individual pollutant because it is difficult to isolate the effects of a single pollutant in a single geographic area. Here, agencies must ask where the pollutant came from, how much of it came from that source, and how the pollutant is specifically contributing to water degradation (as opposed to other pollutants that may exist and interact in the same water body).

Second, the calculation of pollutant loads is compromised to a certain extent because many models have not considered the effects of environmental catalysts, such as climate change and ocean acidification, in determining

49. *See* Minn. Stat. Ann. §114D.26 (2013).

50. 40 C.F.R. §130.2(g) (2019).
51. Anacostia Riverkeeper, Inc. v. Jackson, 798 F. Supp. 2d 210, 252 (D.D.C. 2011) ("The CWA mandates only the existence of a margin of safety—it does not dictate any particular manner in which that margin is to be incorporated into the TMDL, nor does it require a margin of safety that is 'quantifiable,' as plaintiffs insist.").
52. Rose, *supra* note 9.
53. 33 U.S.C. §1251(a)(6).
54. Rose, *supra* note 9 ("In addition, a conservative approach was taken in developing these TMDLs, which should provide an added degree of protection to aquatic life, predator organisms, and human health."). *See also Anacostia Riverkeeper, Inc.*, 798 F. Supp. 2d at 252 ("Thus, the load limits—which are developed to reduce pollution from predicted levels to amounts necessary to satisfy water quality standards—call for total reductions that are far greater than necessary to move from actual conditions to safe levels.").

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how much of a pollutant is being contributed to a particular water body and therefore how much of the pollutant is interacting with other pollutants in the water body. Third, there are pollutants that are contributed by unanticipated sources that are not accounted for in current calculations. Finally, it can be difficult to determine how much of a pollutant is to be attributed from a point source or a nonpoint source when the line differentiating the two categories is blurry. Each of these factors can cause significant variability of the LA calculation, which can lead to the calculation and adoption of unnecessarily overbearing TMDLs.

1. Difficulty of Isolating the Effects of a Single Pollutant

One major source of the variability of the LA calculation lies in the difficulty of isolating the effects of a single pollutant in a single geographic area. This is especially the case with respect to the contribution of pollutants from nonpoint sources. For example, agricultural stormwater runoff is one of the fastest-growing sources of water pollution, contributing millions of pounds of sediment, nitrogen, and phosphorous into local watersheds that, in some areas, have even equaled the amount of pollution contributed by point sources and urban runoff combined.[55] Notwithstanding the substantial effect agricultural stormwater runoff has had on pollution of local water bodies, urban runoff tends to exceed agricultural runoff by volume,[56] and is responsible for its own share of water impairment in the United States.[57] When the contributions of agricultural and urban runoff to water impairment are considered collectively, much of the harm to water quality in the United States lies outside the reach of the NPDES permit program for point sources. Therefore, collecting data from runoff in order to implement a traditional TMDL calculation remains difficult.

It is particularly difficult to isolate the effect of individual pollutants in runoff because the runoff itself is a mixture of a wide variety of elements that "synergistically interact to degrade water quality."[58] In being forced to isolate the effects of individual pollutants when performing TMDL calculations in impaired watersheds, federal and state agencies are effectively required to "untangle a Gordian Knot of causes and effects" that are difficult to chronologize.[59] Moreover, focusing on the effects of particular individualized pollutants may cause a federal or state agency to ignore the effects of other pollutants that may be just as potent as those that are purported to be doing damage to the water body.

For example, in the Chesapeake Bay, cleanup efforts have focused primarily on nitrogen, phosphorus, and sediment loads, with the former two nutrients largely responsible for causing eutrophication and algal blooms, which decrease the amount of dissolvable oxygen in waterways.[60] However, federal and state agencies have not considered measuring the effects of other substances, such as chemicals found in counterfeit pesticides, on water quality.[61] The effects of counterfeit pesticide use on crops and local watersheds can be irreparable.[62] Despite beginning to report statistics regarding seized commodities impacting the safety and security of consumers in 2008, the Chesapeake Bay Program, to date, has not specifically identified which chemicals have been seized and counterfeit pesticides "have not been specifically listed as a commodity seized by [the Chesapeake Bay Program]."[63]

2. Catalysts Alter the Calculation of Pollutant Loads

In addition, it is difficult to isolate the effect of a single pollutant in an impaired water body because of numerous catalysts that alter the calculation of pollutant loads. For example, climate change is known to increase the temperature of water and air, which increases the frequency of large storms, thereby increasing runoff volume in local catchments.[64] Varying runoff flow rates impact the manner in which different pollutants interact, making the calculation

55. For example, in 2009, the Chesapeake Bay Program reported that approximately 226 million pounds of nitrogen and 9.1 million pounds of phosphorus drained into the bay. Agricultural runoff is the largest contributor to pollution in the bay, representing 44% of nitrogen and phosphorus loads. Combined, point source pollution and urban runoff almost equal the amount contributed by agriculture. Jones, *supra* note 10, at 282.

56. *See* Liang Wei et al., *Variable Streamflow Contributions in Nested Subwatersheds of a US Midwestern Urban Watershed*, 32 Water Resource Mgmt. 213, 213 (2018). This study looked at streamflow data from five nested hydrological stations with varying impervious areas (from 0.5% to 26.6%). The study found that the "two most urbanized subwatersheds contributed > 365 [millimeter] mm streamflow in 2012 with 657 mm precipitation, which was more than fourfold greater than the two least urbanized subwatersheds. Runoff occurred almost exclusively over the most urbanized subwatersheds during the dry period." Historically, it was found that "frequent floods occurred and the same amount of precipitation produced about 100 mm more streamflow in 2008-2014 than 1967-1980 in the urbanizing watershed; such phenomena did not occur in surrounding rural watersheds."

57. *See, e.g.*, National Research Council, Urban Stormwater Management in the United States (2008). The report states:

> Of the waterbodies that have been assessed in the United States, impairments from urban runoff are responsible for about 38,114 miles of impaired rivers and streams, 948,420 acres of impaired lakes, 2,742 square miles of impaired bays and estuaries, and 79,582 acres of impaired wetlands. These numbers must be considered an underestimate, since the urban runoff category does not include stormwater discharges from municipal separate storm sewer systems (MS4s) and permitted industries, including construction. Urban stormwater is listed as the "primary" source of impairment for 13 percent of all rivers, 18 percent of all lakes, and 32 percent of all estuaries.

Id. at 21.

58. Owen, *Urbanization*, *supra* note 40.

59. *Id.*

60. Jones, *supra* note 10, at 278-79.

61. Kirsten M. Koepsel, *Counterfeit Pesticides: Silent Spring of the Chesapeake Bay*, 48 Md. B.J. 29, 34 (2015).

62. *Id.*:

> When counterfeit pesticides are used on crops, the results can be devastating and may include total loss or destruction of the crop, chemicals leaking into the watershed or the food chain, a decrease in the market value of the crops, and a loss in confidence or income from Maryland agricultural products or Bay seafood.

63. *Id.* at 33-34.

64. *See, e.g.*, Michael Williams et al., *Stream Restoration Performance and Its Contribution to the Chesapeake Bay TMDL: Challenges Posed by Climate Change in Urban Areas*, 40 Estuaries & Coasts 1227, 1244 (2017):

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of individual pollutant loads in watersheds with varying runoff flow rates complex.[65]

To make matters more difficult, however, EPA has reported that it is "probable that most existing TMDLs do not take climate change considerations into account" and due to the vast number of TMDLs in existence, it would be infeasible to have states recalculate each TMDL to consider the effects of climate change on local waterways.[66] Such inaction by EPA arises despite EPA acknowledging that the unaccounted-for effect of climate change in TMDLs may "alter the attainability of some designated uses and parameters related to water quality standards."[67] While it has been found that the impact of climate change has not undermined the positive effects of the CWA's regulatory scheme, there is evidence that the failure to account for the effects of climate change may prevent future controls from being as effective as they historically have been.[68]

Another catalyst that can impact the calculation of individual pollutant loads is ocean acidification caused by the absorption of atmospheric carbon dioxide. In 2010, the National Research Council of the National Academies of Sciences concluded that the acidity of the ocean is increasing at an "unprecedented rate" due to man-made carbon dioxide emissions, and that "there is a risk of ecosystem changes that threaten coral reefs, fisheries, protected species, and other natural resources of value to society."[69] However, EPA has admitted that it has insufficient data to define standards for marine acidity, and therefore "listing for [ocean acidification] may be absent or limited in many states."[70] In not being able to update marine pH standards, states are limited in their ability to account for the effects of increased oceanic acidity in their pollutant load calculations.

3. Unanticipated Sources of Pollution

Not only is it difficult to account for the effect of a single pollutant on an individual water body, but it is also difficult to account for the effect of a single pollutant *source* on an individual water body. Returning to runoff as an example, not only does the complexity of runoff composition cause variability in an LA calculation, but runoff is also typically not the only source of pollution in a water body. It is difficult to isolate the effect of runoff itself, let alone the pollutants it contributes, on water quality when nonpoint sources are widely varied.[71] For example, while one purpose of local dams is to limit the amount of nutrient sediment loads that cross into major water bodies, the deterioration of sediment storage capacity of the dams over time can lead to hundreds of thousands, if not millions, of pounds of loads that are unaccounted for in a TMDL calculation.[72] Similarly, sediments contributed by bay feeder streams and boat wakes significantly impact water quality, especially during seasons of high recreational activity,[73] and are often unaccounted for in TMDL calculations in part because of the difficulty in creating a predictive model.[74]

4. Grey Area Between Point Sources and Nonpoint Sources

In addition, in some cases it can be difficult to adequately categorize a source either as a point source or a nonpoint source. *Alt v. U.S. Environmental Protection Agency*, decided in 2013 by the U.S. District Court for the Northern District of West Virginia, highlights this difficulty.[75] Under the

> Regarding climate change, projections indicate that a higher frequency of larger-sized storm events will result in a 10 to 20% increase in runoff from developed catchments in the Chesapeake Bay watershed this century. One likely possibility . . . is that higher air and water temperatures and rates . . . produce a proportionally larger amount of stormflow runoff from urban catchments due to the increased frequency of larger-sized storms, resulting in a net increase in total runoff.

65. Notably, "[s]ome of the stressors associated with urban stormwater runoff also do not meet the CWA's definition of pollutant. Excess flow . . . is an excellent proxy for pollutant levels and also is a major stressor for many urban waterways. But, flow is not itself a pollutant." Dave Owen, *After the TMDLs*, 17 Vt. J. Envtl. L. 845, 861-62 (2016).
66. Copeland, *supra* note 31, at 9.
67. *See id.*; *see also* Williams et al., *supra* note 64.
68. Isaac D. Irby et al., *The Competing Impacts of Climate Change and Nutrient Reductions on Dissolved Oxygen in Chesapeake Bay*, 15 Biogeosciences 2649, 2662 (2018).
69. Copeland, *supra* note 31, at 8.
70. *Id.* at 8-9. In 2009, the Center for Biological Diversity sued EPA challenging the Agency's approval of Washington's impaired waters list, which did not include waters impaired by carbon dioxide acidification. The Center requested that EPA adopt more stringent marine pH criteria in adopting water quality standards. As part of settling the case, EPA issued a memorandum advising coastal states to list waters impaired by marine pH when data are available. However, the memorandum did not explain when such data would be available and admitted "that information is absent or limited for [ocean acidification] parameters and impacts at this point in time and, therefore, listing for [ocean acidification] may be absent or limited in many states."
71. *Id.* at 7. *See also* Maine Department of Environmental Protection, Maine Impervious Cover Total Maximum Daily Load Assessment (TMDL) for Impaired Streams 2 (2012).
72. *See*, *e.g.*, Chesapeake Bay Commission, Policy for the Bay 8 (2017). For example, Chesapeake Bay calculations have historically failed to consider the effect of the nutrient and sediment loads crossing the Safe Harbor, Holtwood, and Conowingo Dams: "Advanced modeling estimates the annual addition in nutrient loads bypassing the three dams and entering the Bay at six million pounds of nitrogen and 260,000 pounds of phosphorus. Sediment loads are also higher." "Unfortunately, pollution sources upstream of the dam are almost entirely nonpoint, making them hard to identify and difficult to control." *See also* Leanna Richardson, *Strong-Arm Tactics of the Best Chance of Saving the Chesapeake Bay: How Maryland Should Use Section 401 of the Clean Water Act*, 4 Earth Juris. & Envtl. Just. J. 72, 75-79 (2014) ("Current estimates state that approximately two million pounds of sediment enter the Chesapeake Bay from the Susquehanna River. An additional million pounds is stopped by the [Conowingo] Dam, but these figures assume that the dam can maintain its current sediment storage capacity." The additional sediment that is not impeded by local dams "has not been taken into account by the plans to meet the sediment reduction goals of the TMDL.").
73. *See*, *e.g.*, Chesapeake Bay Commission, *supra* note 72, at 9.
74. *See id.*:

> [A] significant portion of the sediment contributing to the health challenges of the Bay could well be coming from the bay feeder streams themselves, and not just from urban, suburban or agricultural runoff. That is, sediment eroding from the banks of the waterway or resuspension of it from the riverbed was traveling through the system to the Bay.

Predictive models to quantify the relative sediment contributions of boat wakes have not been developed yet, and therefore such contributions have not been incorporated into the TMDL calculation.

75. 979 F. Supp. 2d 701, 715, 43 ELR 20236 (N.D. W. Va. 2013).

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CWA, concentrated animal feeding operations (CAFOs) are considered point sources, but agricultural runoff is considered a nonpoint source pollutant.[76] The court found that the precipitation-caused runoff of litter and manure from the farmyard was agricultural stormwater discharge exempt from the CWA's permit requirement.[77] This finding came even though point sources such as CAFOs are generally regulated by the NPDES permit system.[78] The holding in the *Alt* case complicates the calculation of TMDLs for individual pollutants because it is close to impossible in this case to distinguish whether a pollutant originated from a point source or nonpoint source.[79]

C. *Faulty Calculation Methods Raise Further Questions of Traditional TMDLs*

Not only does the complexity of the inquiry of isolating the effects of individual pollutants complicate the calculation of traditional TMDLs, but many extant calculation methods have been found to be faulty. For example, in 2002, GAO issued a report that revealed inconsistencies in states' approaches to identifying impaired waters.[80] In one sense, this finding is unsurprising, given the deference that the CWA gives to states in calculating pollutant loads.[81] However, the GAO report also found that some of the approaches used by states to identify impaired waters have no appropriate scientific basis, and that information in EPA's database of impaired waters is of questionable reliability.[82]

As alluded to in Section II.B.2., some federal and state agencies are implementing faulty calculation methods because such methods do not fully account for the effects of catalytic variables such as climate change. For example, in February 2018, the Scientific and Technical Advisory Committee of the Chesapeake Bay Program performed a review of their framework for incorporating climate change into their water quality standard determinations. The Committee found that their conventional approach is "not fully capable of analyzing future changes in variability and extreme events."[83] Also, many of the plans to incorporate climate change into extant calculation methods have used insufficient quantitative data, requiring the development of new research techniques to consider the full effect of climate change on local water pollution.[84]

Such techniques would need to be continually refined to account for changes in rates of precipitation and runoff volume that will occur to allow local agencies to be most up-to-date on the costs required to implement controls to maintain pollutant loads at TMDL levels.[85] However, scientists are also finding it necessary to adopt controls that consider the effects of geographic variability, such as urban sprawl, in conjunction with the effects of increased runoff volume caused by climate change.[86] It is evident that as models are continually refined, so too will projected changes in the magnitude of pollutant loads need to be constantly modified.[87]

In addition, some calculation methods are inaccurate because they assume that certain regulatory programs are working more efficiently than they actually are. As an example, it has been found that most mercury TMDL calculations have been performed without consideration of regulatory controls outside of the CWA, including the Clean Air Act's regulation of mercury emissions from coal-fired power plants and other sources.[88] This omission has made it difficult for agencies to confidently estimate the effectiveness of mercury controls and has led to perpetual revision of water quality standards in at least seven states.[89]

Insufficient calculation methods that arise from the unpredictability of catalytic factors, as well as improper estimations of present-day implementation rates, make the traditional TMDL calculation more of an arbitrary standard than one rooted in fact. If such calculation methods are not modified, local farmers and manufacturers will continue to bear unnecessary compliance costs through the implementation of such standards.

D. *Insufficient Federal Funding Leads to Insufficient Data*

Another difficulty in performing accurate TMDL calculations simply lies in the fact that the federal government has not allocated sufficient funds to allow state agencies to perform proper TMDL analyses. For 2019, EPA has allocated no money, down from $169,771,600 from the prior fiscal year, to address nonpoint source pollution.[90] In lieu of such an allocation, EPA advises that it "will continue to coordinate with the United States Department of Agriculture to target funding where appropriate to address nonpoint sources."[91] As it stands, many states lack sufficient funding to perform proper TMDL analyses by individual pollutant, as water quality monitoring data have been limited and EPA has been reluctant to intervene.[92] There cannot be much expectation for TMDL calculations to improve in accuracy if the federal government will not allocate suffi-

76. *Id.*
77. *Id.*
78. *Id.*
79. *Id.*
80. Copeland, *supra* note 31, at 16.
81. *See* Robisch, *supra* note 30, at 175-76.
82. Copeland, *supra* note 31, at 16.
83. Maria Herrmann et al., Scientific and Technical Advisory Committee Review of the Chesapeake Bay Program Partnership's Climate Change Assessment Framework and Programmatic Integration and Response Efforts 5, 15 (Pub. No. 18-001, 2018) ("To a large degree, the magnitude of the future precipitation events is being dictated by the 1991-2000 baseline period used as the template for daily variability." The approach has an "unacceptably high bias against recent historical observations," which makes its projections "unlikely.").
84. *Id.* at 6.
85. Williams et al., *supra* note 64.
86. *Id.*
87. *Id.*
88. Copeland, *supra* note 31, at 7-8.
89. *Id.*
90. U.S. EPA, FY 2019 EPA Budget in Brief 55 (2018) (EPA-190-R-18-002).
91. *Id.* at 77.
92. Owen, *After the TMDLs*, *supra* note 65, at 852-54.

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cient funds to allow states to perform accurate calculations in the first place.

III. Difficulties in TMDL Implementation: A Case Study

The aforementioned problems with traditional TMDL calculation methods translate to difficulties in local implementation of BMPs. The agricultural industry incurs significant costs to comply with TMDL requirements; the less accurate TMDL calculations are, the more prohibitive implementation costs will be to farmers. The insufficient allocation of federal funds compounds the impact on the livelihood of local farmers because there is insufficient technical assistance to help farmers implement best practices, which makes it even more difficult for farmers to comply with traditional TMDLs.[93] One example of the difficulty of best practice implementation lies in the Chesapeake Bay TMDL, the introduction of which caused significant outcry and even a lawsuit.

The Chesapeake Bay TMDL was established by EPA in December 2010 to reduce the concentration of nitrogen, phosphorus, and sediment in bay waters.[94] The Chesapeake Bay TMDL is the largest load ever developed by EPA, requiring collaboration between six states and the District of Columbia to meet water quality standards.[95] Not only is the TMDL innovative, but it is also ambitious as it aims for full restoration of the bay and its tidal rivers by 2025.[96]

Agriculture plays a significant role in bay pollution, with data indicating that it is "the largest economic source of nutrients and sediments to the Bay."[97] As expected, the cost imputed to agriculture to implement BMPs in the bay area is substantial; professors of the Environment and Natural Resources Institute at Penn State University estimate that compliance costs incurred for the period between 2011 and 2025 would total about $3.6 billion (in 2010 dollars).[98] Moreover, while the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture has implemented a cost-share program to allow for up to 75% of best management implementation costs to be covered by the federal government with the remainder to be incurred by farmers, in many situations, the implementation of BMPs can decrease the profitability of a farm regardless of the extent to which the federal government subsidizes BMP implementation.[99]

Further, even with the implementation of the cost-share program, the NRCS' funding efforts have proven insufficient. The Chesapeake Bay Commission, in a 2017 assessment, found that in order to meet their 2025 TMDL goals for the Chesapeake Bay, the number of acres of farmland implementing pollution controls needs to increase by 28% to 135%, depending on the state.[100] In order to meet this target, the Commission found that farmers need more readily available access to conservation professionals to provide them assistance with managing their finances and complying with local controls.[101] The insufficient allocation of federal funds, coupled with the mismanagement of such funds, is a significant factor that impedes local farmers from having access to conservation professionals to help them comply with existing TMDLs.[102]

Not only are Chesapeake Bay farmers often unequipped to meet TMDL standards, but the stringency of the standards has led to public outcry by farmers, local representatives, and agricultural interest groups. Former Rep. Tim Holden (D-Pa.) has expressed concern that the implementation of the Chesapeake Bay TMDL places farmers "at a financial and competitive disadvantage," and that such costs would put many farms out of business.[103] Representative Holden and agricultural interest groups have particularly targeted EPA's role in establishing the TMDL. They argue that data used by EPA in calculating the TMDL was questionable, and that the adoption of a TMDL by EPA for the entire Chesapeake Bay was an overreach of power.[104]

Former Pennsylvania Farm Bureau President Carl Shaffer also argues that EPA has failed to acknowledge local farmers' voluntary pollution reduction measures, such as using fewer cows to produce milk in order to curtail manure, increasing efficiency of nitrogen use, and using no-till farming to reduce carbon in soil.[105] These concerns by agricultural groups led the Agricultural Nutrient Policy Council (ANPC) to analyze data implemented by EPA to calculate Chesapeake Bay TMDLs. In completing its study, the ANPC concluded that EPA incorrectly documented local uses of farmland and implemented inconsistent cropland models in performing its TMDL calculations.[106]

93. Chesapeake Bay Commission, *supra* note 72, at 7.
94. James Shortle et al., Pennsylvania State University, The Costs to Agriculture of the Chesapeake Bay TMDL 6 (2014).
95. *Id.*
96. *Id.*
97. *Id.* ("Agricultural activities are estimated to contribute approximately 44% . . . of nitrogen and phosphorus loads, and 65% of the sediment loads delivered to the Bay. . . .)".
98. *Id.* at 9.
99. *Id.* at 15-16:

> For example, installing a riparian buffer reduces crop or pasture land and takes away the income that would have been earned from that land. In these cases, the farmer's cost is the out-of-pocket expense plus any opportunity costs resulting from changes in the farm operation. If installation is purely voluntary, profit-maximizing farmers will not be willing to adopt unless their costs are fully covered by NRCS payments. In these cases, NRCS payment schedules can be viewed as an upper bound on the cost to the farmer, not 75% of the cost.

100. Chesapeake Bay Commission, *supra* note 72, at 7.
101. *Id.*
102. The Commission identified four existing problem areas that impede effective implementation of local controls: (1) conservation professionals who provide the assistance are both public and private, and therefore each have differing responsibilities and authorities that they are accountable to; (2) funding for the training and salaries of public-sector providers were inconsistent and insufficient; (3) administrative work overburdens many conservation professionals; and (4) the insufficiency of available technical assistance can result in available federal financial assistance left unspent. *Id.*
103. Annabelle Klopman, *An Undercurrent of Discontent: The Chesapeake Bay Total Maximum Daily Load and Its Impact on Bay Industries*, 24 Vill. Envtl. L.J. 97, 112 (2013).
104. *Id.*
105. *Id.*
106. *Id.*

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A. *The Costs of Compliance as Reflected in* American Farm Bureau Federation v. U.S. Environmental Protection Agency

The effect of the ANPC study, coupled with local outcry, motivated the American Farm Bureau Federation, along with other agricultural trade associations, to file suit against EPA in 2011.[107] The Federation alleged that in setting a TMDL for the entire Chesapeake Bay, EPA overreached its authority under the CWA and encroached on the states' regulatory authority.[108] The Federation argued that a TMDL refers only to a numerical limit for pollutant loads, and that EPA's requirement to also include source allocations, target dates, and the requirement of reasonable assurances from the Chesapeake Bay states exceeded EPA's statutory authority and interfered with state and local land use decisions.[109]

The Federation also alleged that EPA did not adequately include the public in its decision to establish the TMDL, and that the scientific models EPA used to set TMDL allocations were flawed.[110] In requesting that the court vacate the Chesapeake Bay TMDL, the Federation projected that the compliance costs that would be incurred between 2011 and 2017 would include approximately $10 billion for the state of Maryland, between $3 and $6 billion for New York, and $7 billion for Virginia.[111] Overall, the plaintiffs claimed that cleanup of the Chesapeake Bay through implementation of the current TMDL would cost $28 billion, with an additional $2.7 billion reinvested annually, and that both states and private parties would be required to shoulder these costs.[112]

Notwithstanding the Federation's defeat both in the federal district court and on appeal before the U.S. Court of Appeals for the Third Circuit,[113] the case highlights the financial difficulties that local farmers face under the CWA's implementation of TMDLs. One should wonder whether these difficulties can be mitigated through implementing more accurate and efficient TMDL calculation methods.

IV. The Legality of Calculating TMDLs by Proxy

An amendment to the CWA is necessary to facilitate alternate TMDL calculation methods, because it is questionable whether TMDLs by proxy are legally permissible to begin with. The Act requires states to establish a TMDL for each individual pollutant preventing the impaired water bodies from meeting water quality standards.[114] A "pollutant" is defined as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal and agricultural waste discharged into water."[115]

Notably, the definition does not explicitly include pollutant proxies as determinable TMDLs, which has led at least one court to prohibit the implementation of proxy TMDLs.[116] In *Virginia Department of Transportation v. U.S. Environmental Protection Agency*, the U.S. District Court for the Eastern District of Virginia ruled that EPA's calculation of a TMDL by volume of stormwater runoff for the Accotink Creek was not permitted under the CWA because a plain reading of the Act limits TMDLs to be calculated per individual pollutant.[117] EPA did not appeal the decision, likely because it did not want to risk creating law that would affect the entire U.S. Court of Appeals for the Fourth Circuit.[118]

While at this time there are no other cases that directly address the legality of implementing proxy TMDLs, some circuits have appealed to the breadth of the CWA to enable federal and local agencies to effectively regulate pollutant loads in local waterways.[119] The mechanism of *Chevron* deference has also been effective in allowing EPA leeway in its interpretation of the Act.[120] In *Pronsolino v. Marcus*, the U.S. District Court for the Northern District of California ruled that the CWA permitted EPA to calculate a TMDL only for water segments that were polluted by sediment from timber harvesting, agricultural runoff, and other nonpoint sources, even though (1) sediment is not listed as a pollutant under the Act, and (2) the Act explicitly states that a TMDL is to be established if a water body is impaired by both point sources and nonpoint sources.[121]

107. Karli A. McConnell, *Limits of* American Farm Bureau Federation v. EPA *and the Clean Water Act's TMDL Provision in the Mississippi River Basin*, 44 Ecology L.Q. 469, 482 (2017).
108. Am. Farm Bureau Fed'n v. U.S. Envtl. Prot. Agency, 984 F. Supp. 2d 289, 324, 43 ELR 20213 (M.D. Pa. 2013).
109. *Id.* at 333.
110. *Id.* at 340.
111. Klopman, *supra* note 103, at 117.
112. *Id.*
113. *Am. Farm Bureau Fed'n*, 984 F. Supp. 2d at 316, *aff'd*, 792 F.3d 281, 45 ELR 20129 (3d Cir. 2015), *cert. denied*, 136 S. Ct. 1246 (2016).
114. 33 U.S.C. §1313(d)(1)(C).
115. *Id.* §1362(6).
116. Virginia Dep't of Transp. v. U.S. Envtl. Prot. Agency, No. 1:12-CV-775, 2013 U.S. Dist. LEXIS 981, at **6-12, 43 ELR 20002 (E.D. Va. Jan. 3, 2013).
117. *Id.*
118. Robisch, *supra* note 30, at 181.
119. *See, e.g.*, Pronsolino v. Nastri, 291 F.3d 1123, 1137, 32 ELR 20689 (9th Cir. 2002).
120. This doctrine arises out of the holding of *Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837, 14 ELR 20507 (1984), which directs courts to defer to an agency's interpretation of its enabling statute if "Congress delegated authority to the agency generally to make rules carrying the force of law, and . . . the agency interpretation claiming deference was promulgated in the exercise of that authority." *Pronsolino*, 291 F.3d at 1131 (citing United States v. Mead, 533 U.S. 218, 226-27 (2001)).
121. 91 F. Supp. 2d 1337, 1351, 30 ELR 20460 (N.D. Cal. 2000). The court noted that case law from the Ninth Circuit, and other circuits, as well as the legislative history, referred to sediment as a pollutant. *See, e.g.*, Rybachek v. Envtl. Prot. Agency, 904 F.2d 1276, 1285-86, 20 ELR 20973 (9th Cir. 1990); Idaho Conservation League v. Thomas, 91 F.3d 1345, 1347, 26 ELR 21650 (9th Cir. 1996); Driscoll v. Adams, 181 F.3d 1285, 1291, 29 ELR 21387 (11th Cir. 1999); *see also* United States v. M.C.C. of Fla., Inc., 772 F.2d 1501, 1505-06, 15 ELR 21091 (11th Cir. 1985); Hudson River Fishermen's Ass'n v. Arcuri, 862 F. Supp. 73, 76, 25 ELR 20460 (S.D.N.Y. 1994). *See also* 33 U.S.C. §1313(d)(1)(A).

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On appeal, the U.S. Court of Appeals for the Ninth Circuit primarily dealt with the question of whether EPA was permitted to establish a TMDL solely for waters affected by nonpoint source pollution. In upholding the lower court's decision, the court applied *Chevron* deference and agreed with EPA's interpretation of the Act in "requiring TMDLs where existing pollution controls will not lead to attainment of water standards," which would include waters only impaired by nonpoint sources.[122] Despite the Ninth Circuit's expansive view of EPA's implementation authority under the CWA, other circuits have not been consistent in deferring to EPA's interpretation of the Act, instead limiting the effect of the Act to a plain reading.[123] As noted by the Ninth Circuit, however, ambiguities arise given that the Act "is replete with multiple listing and planning requirements applicable to the same waterways (quite confusingly so, indeed)," which call into question the extent to which Congress intended to limit EPA in executing the broad scope of the Act.[124]

Moreover, despite potential legal challenges, many state agencies continue to implement TMDLs by proxy because the *Code of Federal Regulations* permits establishment of TMDLs by using a "pollutant-by-pollutant or biomonitoring approach,"[125] as well as "in terms of either mass per time, toxicity, *or other appropriate measure*."[126] These regulations give municipalities a hook to hang their hats on in establishing TMDLs for proxies that may not be the direct cause of water impairment, but that may be strong indicators for impairment.[127] However, an amendment to extend calculation of TMDLs to pollutant proxies, at least in situations in which there is a strong correlation between the proxy and source of impairment, would help resolve inconsistencies between federal regulations, the language of the CWA, and interpretations of the Act that differ between circuits.

V. Implementing Proxy TMDLs

Before proceeding to introduce the benefits of implementing TMDLs by proxy, it is important to reiterate that this Article does not seek to completely undo the traditional calculation of TMDLs by individual pollutant. Rather, this proposal aims to amend the CWA to allow latitude to implement TMDLs by proxy in limited circumstances (i.e., in the event where there is a strong correlation between the calculation of a proxy and the concentration of a particular pollutant in a particular geographic area). It may also be beneficial to implement proxy TMDLs in cases where the calculated margin of safety in a traditional TMDL calculation exceeds a certain amount in order to mitigate compliance costs incurred by farmers

A. The Benefits of Implementing Proxy TMDLs

To begin, proxies simplify the calculation of TMDLs. Instead of isolating the effects of individual pollutants on water segments, agencies can begin by identifying strong correlations between proxies and pollutants, which can be easily assessed.[128] For example, percent-connected impervious cover tends to strongly correlate with nitrogen loads in local water segments.[129] Impervious cover increases the volume of stormwater runoff entering nearby waters, which increases the rate at which pollutants are being disposed into those waters.[130]

The effects of the wide variety of pollutants[131] that are transported by stormwater into local water bodies are difficult to isolate. While the implementation of BMPs can assist in mitigating the effects of pollution, some researchers have found that there is a point of no return created by increased imperviousness.[132] For waterways that have yet to reach such a threshold, an effective and time-efficient remedy to improve water quality is to limit percent-connected impervious cover, which can be easily assessed by land cover data made readily available by satellite photos and geographic information system technology.[133]

Proxies may also be more effective indicators of pollutant loads in certain watersheds. For example, traditional

122. *Pronsolino*, 291 F.3d at 1137 (citing Dioxin/Organochlorine Ctr. v. Clarke, 57 F.3d 1517, 1527, 25 ELR 21258 (9th Cir. 1995)). *See also* 40 C.F.R. §130.7(b).
123. *See* Nat. Res. Def. Council, Inc. v. Muszynski, 268 F.3d 91, 103, 32 ELR 20203 (2d Cir. 2001) (holding that an expression of the TMDL in terms of an annual phosphorus load is not precluded by the CWA); *but see* Friends of the Earth, Inc. v. Envtl. Prot. Agency, 446 F.3d 140, 146, 36 ELR 20077 (D.C. Cir. 2006) ("[W]e see no way to conclude that 'as a matter of logic and statutory structure, [Congress] almost surely could not have meant' to require daily loads.").
124. *Pronsolino*, 291 F.3d at 1138.
125. 40 C.F.R. §130.7(c)(1)(i) (2019).
126. *Id.* §130.2(i) (emphasis added).
127. *See*, *e.g.*, Amey Marrella & Betsey Winfield, Connecticut Department of Environmental Protection, A Total Maximum Daily Load Analysis for Eagleville Brook, Mansfield, CT 6 (2007). Eagleville Brook is significantly impaired by stormwater runoff. Despite acknowledging that impervious cover may not be the direct cause of the impairment of the brook, the Connecticut Department of Environmental Protection implemented a percent-connected impervious cover TMDL on the basis that pollutant loads strongly correlate to percent-connected impervious cover in water segments impaired by stormwater runoff. The Department cited to 40 C.F.R. §130.7(c)(1)(i) and 40 C.F.R. §130.2(i) as giving it legal authority to do so.
128. *See*, *e.g.*, Oklahoma Department of Environmental Quality, Final Bacterial and Turbidity Total Maximum Daily Loads for the Arkansas-Verdigris River Study Area 4-7 (2012). For example, there is often a strong relationship between total suspended solids concentration and turbidity. Also, bacterial TMDLs are often implemented as proxies for sulfate loads, and is consistent with EPA's Protocol for Developing Pathogen TMDLs.
129. Owen, *Urbanization, supra* note 40, at 462. *See also* Marrella & Winfield, *supra* note 127.
130. Marc A. Yaggi, *Impervious Surfaces in the New York City Watershed*, 12 Fordham Envtl. L.J. 489 (2001).
131. Such pollutants include "motor oil, engine coolant, brake linings, rust, nutrients, litter, animal waste, sand, salt, and other materials found on roads, parking lots, and sidewalks. Moreover, impervious surfaces generate pollutants by attracting traffic, pesticides, fertilizers, and other land uses." *Id.* at 496-97.
132. Thomas Schueler of the Center for Watershed Protection has found that water degradation not only occurs at levels of impervious cover as low as 10%, but that such degradation is irreversible. *Id.* at 499.
133. Owen, *Urbanization, supra* note 40, at 462.

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TMDL calculations in urban watersheds tend to ignore stressors, such as excessive or insufficient flows or loss of riparian habitat, that are important to water quality.[134] Impervious cover proxies would be more effective as a TMDL because historically such TMDLs take these stressors into account.[135] Impervious cover TMDLs are especially useful in water segments impacted by stormwater runoff because the ideal cover "load" would not vary over time, whereas ideal pollutant loads can vary over time.[136]

Further, there is a practical benefit to implementing proxy TMDLs. Proxies such as impervious cover and stormwater volume are not only understood by city planners and civil engineers, but they are already being implemented by these professionals to assess environmental impact.[137] Municipal workers think in terms of space, not in terms of pollution.[138] They work more with the metrics of pavement area and zoning limits than in terms of individual pollutant discharges.[139] Therefore, to such workers, an impervious cover TMDL, as an example, is comprehensible because they are already using that yardstick when assessing environmental impacts.[140] In turn, proxy TMDLs tend to produce more friendly budgets for local municipalities because they do not over-allocate as much funding as would occur in the implementation of a traditional TMDL through the overestimation of LAs and margin of safety.[141]

B. *Concerns With Implementing Proxy TMDLs*

Despite the benefits to implementing proxy TMDLs, there are legitimate concerns regarding their efficacy. The predominant concern that is raised by environmental groups and lawmakers against the implementation of proxy TMDLs is whether the implementation of a less precise standard than a TMDL by individual pollutant would allow for water quality standards to be met.[142] Even if a proxy has a reasonable scientific basis, data on the effectiveness of its controls are still generally inconclusive.[143] So even if regulators are able to assess a strong correlation between the impairment of a water body and impervious cover, "they cannot be sure that the targeted level of retrofits will fix that impairment,"[144] nor do such TMDLs "specify who exactly will go about retrofitting their properties, to what standards, and with what methods."[145]

These concerns are brought out in a recent study by Thomas Schueler,[146] who performed a literature review of 65 research studies that had been published since 2003, the majority of which endorsed a correlation between percent-connected impervious cover and impaired water quality.[147] While Schueler agrees that there is a relationship between impervious cover and water quality, the relationship comes with a number of caveats. Most notably, Schueler finds that the effects of impervious cover on water quality are most difficult to isolate when percent-connected impervious cover is below 10%, which is associated with "extensive predevelopment forest or natural vegetative cover present in the subwatershed."[148]

An even greater impediment to implementing an impervious cover TMDL in such areas is that percent-connected impervious cover is "unrealizable" in areas where management practices are poor. This not only includes aforementioned areas of predevelopment, but also areas in which there is active "deforestation, acid mine drainage, intensive row crops, [and] denudation of riparian cover."[149] Schueler also finds that impervious cover may not be a good indicator of water quality impairment in areas with "major point sources of pollutant discharge, or extensive impoundments or dams located within the stream network."[150] Evidently, percent-connected impervious cover should not be the only metric that is used to determine water quality in such areas.[151]

Another objection arises from the implementation of satellite-derived coastal water quality products in determining proxies that are correlative with pollutant loads.[152] There are questions as to how accurate the findings of satellite-derived water quality products are. While regulators are interested in observing how proxies are developed for pollutants, satellite-derived water quality products are best implemented for "optically significant materials," and therefore are not effective for the majority of sources of water impairment.[153] Overall, scientists find that there are numerous deficits in the implementation of satellite-

134. *Id*.
135. *Id*.
136. Susanne Meidel, Maine Department of Environmental Protection, Barberry Creek Total Maximum Daily Load 25 (2006).
137. Owen, *Urbanization, supra* note 40, at 463.
138. *Id*.
139. *Id*.
140. *Id*.; *see also* Yaggi, *supra* note 130, at 498 ("When dealing with stormwater, the primary design consideration for civil engineers is to direct the runoff from paved surfaces as quickly as possible."); *see also* Thomas R. Schueler et al., *Is Impervious Cover Still Important? Review of Recent Research*, J. Hydrologic Engineering, Apr. 2009, at 309.
141. Owen, *After the TMDLs*, *supra* note 65, at 862.
142. Owen, *Urbanization, supra* note 40, at 464 ("Simply setting a connected impervious cover target is different from setting forth a blueprint for a comprehensive, implementable, and enforceable restoration program.").
143. *Id*.
144. *Id*.
145. *Id*.
146. Notably, Schueler has found that water degradation occurs at levels of impervious cover as low as 10%. Yaggi, *supra* note 130, at 499.
147. Schueler et al., *supra* note 140.
148. *Id*. at 311 ("Other metrics, such as subwatershed forest cover, riparian forest cover, road density, or crop cover may be more useful in explaining the variability within sensitive subwatersheds.").
149. *Id*. at 313-14.
150. *Id*. at 313.
151. *Id*.
152. Guangming Zheng & Paul M. DiGiacomo, *Progress in Oceanography*, 159 Progress Oceanography 45, 45 (2017). For example, "solutions to derive suspended particulate matter concentration are much less generalizable—in one case it might be more accurate to estimate this parameter based on satellite-derived particulate backscattering coefficient, whereas in another the nonagal particulate absorption coefficient might be a better proxy."
153. *Id*. ("Currently available satellite-derived water quality products are restricted to optically significant materials, whereas many users are interested in toxins, nutrients, pollutants, and pathogens. Presently, proxies or indicators for these constituents are inconsistently (and often incorrectly) developed and applied.").

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derived water quality products, and that improvement in this area will require that

> (i) optical oceanographers and environmental scientists start collaborating more closely and making optical and environmental measurements in parallel, (ii) more efforts are devoted to identifying optical, ecological, and environmental forerunners of autochthonous water quality issues, and (iii) environmental processes associated with the source, transport, and transformation of allochthonous issues are better understood.[154]

While the aforementioned concerns are legitimate, they do not demonstrate the inefficacy of implementing impervious cover as a proxy in geographic areas in which they have proven to be indicative of water degradation. Even though Schueler finds that impervious cover is not strongly correlative with water quality impairment in streams with less than 10% connected impervious cover, it becomes increasingly correlative in watersheds with greater areas of impervious cover (i.e., areas affected by urban stormwater).[155] Schueler also finds that percent-connected impervious cover is most effective in indicating water quality for first-, second-, and third-order alluvial streams.[156]

While limited, the successes of impervious cover in determining water quality impairment in these specific circumstances should be considered in, not excluded from, the CWA's regulatory scheme. While concerns surrounding the reliability of impervious cover as a proxy for water quality are legitimate, the inefficacies of traditional TMDL calculations and their effects on local farmers should motivate lawmakers to implement proxy calculations in areas in which they work best.

Ultimately, the motivation behind implementing such an amendment is not for the sake of weakening environmental protections of national waterways, nor to enable the abuse of clean water controls by local farmers and municipalities. Rather the purpose of this proposed amendment, which is limited in scope, is to enable federal and state agencies to be more cost efficient in detecting water pollution in particular areas, while preventing the agricultural industry from incurring prohibitive compliance costs.

VI. Conclusion

Despite the considerable improvement of the quality of the nation's waters under the CWA, the regulatory scheme of the Act has yet to put a dent into controlling nonpoint source pollution. This comes to the detriment of farmers, who are required to implement steep changes in land use in order to abate the effects of nonpoint source pollution. The heightened costs incurred by farmers and municipalities in complying with such controls is largely due to the complexity of the traditional TMDL calculation by individual pollutant.

The difficulty in calculating a TMDL for an individual pollutant lies in the fact that it is difficult to isolate the effects of a single pollutant on a particular water body. It is particularly difficult to isolate the effect of a single pollutant in an impaired water body because of numerous catalysts that alter the calculation of pollutant loads, such as climate change and ocean acidification. Moreover, it is difficult to account for the effect of a single pollutant source, let alone an individual pollutant, on an individual water body. Further, in some cases, it can be difficult to adequately categorize a source either as a point source or a nonpoint source. The accuracy of the traditional TMDL calculation is further compromised by faulty extant calculation methods, which fail to fully account for the effects of catalytic variables and/or by improperly assuming that current regulatory programs are working more efficiently than they actually are. In addition, the federal government has not allocated sufficient funds to allow state agencies to perform proper TMDL analyses.

The aforementioned difficulties in the calculation of traditional TMDLs lead to difficulties in local TMDL implementation. The insufficient allocation of federal funds alone impacts local farmers because there is insufficient technical assistance to help farmers implement best practices, which makes it even more difficult for farmers to comply with traditional TMDLs.

To mitigate the effects of statistical discrepancies between the calculation and implementation of TMDLs, Congress should amend 33 U.S.C. §1313(d)(1)(C) of the CWA to explicitly permit states to calculate TMDLs by proxy in areas in which proxies are found to be strongly correlative with water quality. Proxies simplify the calculation of TMDLs and can be more effective indicators of pollutant loads in certain watersheds. Proxies are also already being implemented by municipal workers to assess environmental impacts of city projects, and therefore are easily translatable between regulatory sectors.

Amendment of the CWA would be necessary to implement TMDL proxies because the plain language of the Act limits federal and state agencies to calculating TMDLs by individual pollutant. Despite the implications of *Chevron*, the ability of EPA and local agencies to successfully implement unconventional TMDLs to effectively address the specific challenges of certain watersheds has not been consistent across the federal circuits. An amendment to extend calculation of TMDLs to pollutant proxies, at least in situations in which there is a strong correlation between the proxy and source of impairment, would bring much clarity to the interpretation of the Act and much flexibility in its execution.

154. Guangming Zheng and Paul DiGiacomo also find that there is a need "to conduct fundamental research in satellite ocean color radiometry, including development of more robust atmospheric correction methods and inverse models for coastal regions where optical properties of both aerosols and hydrosols are complex." *Id.*
155. Schueler et al., *supra* note 140, at 313.
156. *Id.*