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No Virtue Like Necessity: Dealing with Nonpoint Source Pollution and Environmental Flows in the Face of Climate Change

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NO VIRTUE LIKE NECESSITY: DEALING WITH NONPOINT SOURCE POLLUTION AND ENVIRONMENTAL FLOWS IN THE FACE OF CLIMATE CHANGE

*William L. Andreen**

In many ways, the Clean Water Act has been a tremendous success. Discharges of water pollutants from both industrial and municipal point sources have plummeted, the loss of wetlands has been decisively cut, and water quality has improved broadly across the nation. Despite all of this progress, the quality of many of our waters remains impaired. A significant proportion of our rivers, lakes, and smaller streams are simply not clean enough to fully support their designated uses, such as fishing or recreation. The primary reason for this lies in the failure of the Act to effectively tackle two significant sources of water pollution: nonpoint source pollution—diffuse runoff from fields and logging operations, for example—and hydrologic modifications, such as water withdrawals, impoundments, and diversions for off-stream uses. In both cases, Congress bowed to old concepts of federal and state responsibility, leaving control of both kinds of pollution primarily in state hands. While some states have responded well to the challenge, most have not proven equal to the task. New approaches are thus needed to deal more effectively and more comprehensively with these two problems, the magnitude of each of which is staggering: over 40,000 nonpoint source impaired water bodies and thousands of flow-impaired waters.

Both problems, moreover, will continue to worsen as climate change exacerbates each problem. Climate change has already brought greater precipitation in its wake, and this national trend toward heavier precipitation events will intensify in the future, producing even more runoff and nonpoint source pollution. Additionally, hotter and drier conditions, especially in the West, will place greater strains upon stream flows, wreaking increasing damage on aquatic ecosystems as well as shortfalls in the water available for human use.

Creating a more effective federal-state partnership to combat both problems has proven impossible for over forty years. Many states and their allies in Congress have resisted such efforts, citing traditional state interests over land use and water allocations. The problems, however, are growing more severe and it is ever more imperative that action be taken. This article, therefore, concludes with an exploration of a number

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of administrative and legislative approaches for creating more dynamic and integrated strategies for dealing with both of these national problems.

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I. INTRODUCTION

Although the Clean Water Act ("CWA")[1] has been widely recognized as a successful regulatory scheme, its story is more complex.[2] The CWA's two permit programs have indeed produced substantial progress. The section 402 point source control program has significantly reduced wastewater discharges from both industrial and municipal facilities and, in the process, has enhanced water quality throughout the nation.[3] The section 404 dredge and fill program has drastically slowed

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1 33 U.S.C. §§ 1251–1387 (2012).

2 *See, e.g.*, OLIVER A. HOUCK, THE CLEAN WATER ACT TMDL PROGRAM: LAW, POLICY, AND IMPLEMENTATION 3 (2d ed. 2002); Robert W. Adler, *Resilience, Restoration, and Sustainability: Revisiting the Fundamental Principles of the Clean Water Ac*t, 32 WASH. U. J.L. & POL'Y, 139, 172 (2010); William L. Andreen, *Water Quality Today—Has the Clean Water Act Been a Success*?, 55 ALA. L. REV. 537 (2004).

3 *See* William L. Andreen, *Success and Backlash: The Remarkable (Continuing) Story of the Clean Water Act*, 4 GEO. WASH. J. ENERGY & ENVTL. L. 25, 28–30 (2013). This improvement has been deemed one of the greatest achievements of government during the second half of the

the rate of wetlands loss.[4] The CWA, however, has not been an absolute success; in fact, it is still very much a work in progress. As Professor (now Dean) Robert Adler wrote, the high aspiration that Congress had for the Act remains largely unfulfilled.[5] We have not yet succeeded in meeting Congress' overarching objective, "restor[ing] and maintain[ing] the chemical, physical, and biological integrity of the Nation's waters."[6] While many tasks and challenges remain,[7] two primary problems stand as impediments to achieving the CWA's principal objective: the lack of adequate controls over nonpoint source pollution and the lack of any assurance that adequate stream flows will be maintained in order to sustain and maintain healthy aquatic systems.

Unlike point source discharges, nonpoint source pollution is diffuse in origin and transported into surface water by rainfall, irrigation water, or snowmelt.[8] It is generally produced by land use activities such as farming or livestock operations, silvicultural activities, mining, and urban runoff.[9] The water quality problems that nonpoint source pollution can create can be severe, as such discharges often contain nutrients and pesticides, bacteria, and organic materials, as well as sediment and mine acid.[10]

Water quality can also be degraded by water management activities such as water withdrawals, dams, and diversions for off stream uses. These kinds of hydrologic modifications can radically alter the natural flow patterns of rivers and the natural level of lakes. In the West, such "activities routinely dry up rivers—including some of the major ones in the region—or reduce them to a relative trickle."[11] Excessively low flows not only cause harm to the aquatic ecosystem and the availability of water for swimming and fishing, but they can also increase the

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twentieth century. *See* Paul C. Light, *Government's Greatest Achievements of the Past Half Century*, 2 REFORM WATCH 1, 4 (Nov. 2000).

[4] *See* Andreen, *supra* note 3, at 30.

[5] *See* Robert W. Adler, *The Decline and (Possible) Renewal of Aspiration in the Clean Water Act*, 88 WASH. L. REV. 759, 761–62 (2013).

[6] CWA § 101(a), 33 U.S.C. § 1251(a) (2012).

[7] *See, e.g.*, WILLIAM L. ANDREEN & SHANA CAMPBELL JONES, THE CLEAN WATER ACT: A BLUEPRINT FOR REFORM (2008), *available at* http://ssrn.com/abstract=1236162. The CWA has not been amended in comprehensive fashion since 1987. *See* Water Quality Act of 1987, Pub. L No. 100-4, 101 Stat. 7 (1987). It, consequently, stands in need of more than a little fine-tuning.

[8] U.S. GEN. ACCOUNTING OFFICE, GAO/RCED-99-45, WATER QUALITY: FEDERAL ROLE IN ADDRESSING—AND CONTRIBUTING TO—NONPOINT SOURCE POLLUTION 2 (1999).

[9] Peter Rodgers & Alon Rosenthal, *The Imperatives of Nonpoint Source Pollution Policies*, *in* POLITICAL, INSTITUTIONAL AND FISCAL ALTERNATIVES FOR NONPOINT POLLUTION ABATEMENT PROGRAMS 3, 5 (Vladimir Novotny ed., 1988).

[10] Andreen, *supra* note 2, at 562–63.

[11] Reed D. Benson, *Pollution Without Solution: Flow Impairment Problems Under Clean Water Act Section 303*, 24 STAN. ENVTL. L.J. 199, 202 (2005).

concentration of pollutants in water bodies.[12] Even less dramatic alterations in streamflow (including alterations to both minimum and maximum flows) can "have profound effects on ecosystem structure and function" because the timing and magnitude of flows "dictate the evolutionary adaptations of many river biota and control many physical and chemical processes."[13]

The effects of hydrologic modifications are not just limited to the West; in fact, the association between altered flows and impaired aquatic systems extends across the entire nation.[14] Hydroelectric dams, for instance, often produce excessively high and low flows in rapid succession if they are used to generate peaking power, producing wide-ranging adverse impacts upon the aquatic system.[15] In such an altered environment, fish can be trapped in off-channel areas or stranded on gravel bars; their spawning and rearing activities may be impaired; and bottom-dwelling aquatic species can suffer high mortality when exposed to the atmosphere.[16] In short, "these artificially fluctuating environments" often wreak havoc on fish populations and the diversity of species.[17] Water quality and flow magnitudes are thus intimately related; we cannot have good water quality without some semblance of a natural environmental flow.[18]

Unlike the CWA's approach to point source pollution and wetlands loss, the role of the federal government has been minimal in dealing with both nonpoint source pollution and the provision of adequate stream flows. Rather than directly regulating nonpoint source pollution, Congress originally relied upon a state-implemented planning process to deal with the problem.[19] When that program proved ineffective,[20] a new provision, section 319, was enacted in 1987 that called upon states to identify waters impaired by nonpoint source pollution and develop management plans to address the pollution.[21] If the U.S. Environmental Protection Agency ("EPA") approves the plan, relatively modest federal

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[12] *Id.* at 203.

[13] Daren M. Carlisle et al., *Alteration of Streamflow Magnitudes and Potential Ecological Consequences: A Multiregional Assessment*, 9 FRONTIERS ECOLOGY & ENV'T. 264, 264 (2011).

[14] *Id.* at 267.

[15] ANGELA H. ARTHINGTON, ENVIRONMENTAL FLOWS: SAVING RIVERS IN THE THIRD MILLENNIUM 116–17 (2012) ("[H]ydroelectric dams cause extreme daily variations in water level that have no natural analogue in freshwater systems and represent an extremely harsh environment of frequent, unpredictable flow disturbance.").

[16] *Id.*

[17] *Id.* at 117.

[18] *Id.* at 10.

[19] *See* CWA § 208, 33 U.S.C. § 1288 (2012).

[20] *See* ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 794 (2013).

[21] *See* CWA § 319, 33 U.S.C. § 1329.

funds are provided to help a state implement the plan, develop demonstration projects, and conduct some limited restoration of impaired waters.[22] Unfortunately, most states have forgone concrete regulatory action in favor of voluntary management,[23] and thus the section 319 program has produced scant progress. In fact, at the current pace of remediation, it will take 700 years to achieve full restoration of currently-impaired waters.[24] Even the Act's special program for addressing water quality impaired waters[25] has failed to control nonpoint sources of impairment in any comprehensive fashion.[26] For while load allocations are required to be set for any nonpoint source contribution to the impairment,[27] there is no regulatory or statutory provision requiring that a state actually implement the nonpoint source total maximum daily load allocation.[28]

Additionally, the CWA does not contain any program that deals explicitly with environmental flows.[29] Streamflow alterations, however, can fall within the Act's definition of "pollution"—namely, "the man-made or man-induced alteration of the chemical, physical, [and] biological . . . integrity of water."[30] In fact, the Act specifically acknowledges that "changes in the movement, flow, or circulation" of our rivers and streams can result in "pollution."[31] While EPA has

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[22] *See id*. § 319(h), 33 U.S.C. § 1329(h); OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, A NATIONAL EVALUATION OF THE CLEAN WATER ACT SECTION 319 PROGRAM 11–12 (2011).

[23] Only a handful of states regulate nonpoint source pollution to some extent. *See* U.S. GOV'T ACCOUNTABILITY OFFICE, CLEAN WATER ACT: CHANGES NEEDED IF KEY EPA PROGRAM IS TO HELP FULFILL THE NATION'S WATER QUALITY GOALS 26 (2013) (listing California, Florida, Hawaii, Oregon, Pennsylvania, Washington, and Wisconsin).

[24] OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 13.

[25] *See* CWA § 303(d), 33 U.S.C. §1313(d) (requiring states to establish a total maximum daily load ("TMDL") for water quality impaired waters).

[26] State TMDL coordinators report that only 20 percent of load allocations in long established TMDLs have been met. U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 35.

[27] *See* 40 C.F.R. §§ 130.2 (g), 130.7 (2015).

[28] *See* Robert W. Adler, *Agriculture and Water Quality: A Climate-Integrated Perspective*, 37 VT. L. REV. 847, 868 (2013).

[29] The Act's permit programs do sometimes require, directly or indirectly, certain flow conditions. For example, a minimum flow of 750 cubic feet per second was established at Peachtree Creek along the Chattahoochee River in order to provide adequate flow to assimilate the wastewater discharged by Atlanta's R. M. Clayton wastewater treatment plant. *See* U.S. ARMY CORPS OF ENG'RS, DRAFT ENVIRONMENTAL IMPACT STATEMENT, WATER ALLOCATION FOR THE APALACHICOLA-CHATTAHOOCHEE-FLINT (ACF) RIVER BASIN—MAIN REPORT 4-111, 4-116 (1998). The section 404 Guidelines, promulgated by EPA, direct the Army Corps of Engineers to consider impacts on downstream flows and normal water fluctuation when making permit determinations on proposed dredge and fill operations. 40 C.F.R. 230.11(b).

[30] CWA § 502(19), 33 U.S.C. § 1362(19).

[31] *Id.* § 304(f), 33 U.S.C. § 1314(f).

disseminated information on flows[32] and urged states to include flow considerations in their water quality standards,[33] the decision on whether to provide for adequate flows has been left almost entirely in state hands; this in spite of the fact that the CWA calls upon EPA and other federal agencies to work with state and local authorities "to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources."[34] Left to their own devices, most states have chosen not to set stream flows that reasonably reflect the natural hydrograph in terms of flow, timing, duration, and rate of change.[35]

The CWA's approach to nonpoint source pollution and environmental flows has had dire consequences. Today, nonpoint source pollution is the leading source of water quality impairment in the nation,[36] responsible for over seventy-five percent of the rivers and lakes that fail to meet water quality standards.[37] It is also a leading cause of the degradation of some of our most significant coastal resources such as the Chesapeake Bay and the waters of the Gulf of Mexico that lie at the mouth of the Mississippi River.[38] Agriculture is by far the leading source of water quality impairment, while flow problems produced by hydrologic modifications and habitat alterations take second place.[39] In fact, natural flow regimes have been altered on eighty-six percent of our rivers and streams in the contiguous United States, and those anthropogenic changes have produced extensive ecological damage.[40] Our growing population and expanding economic activity would likely amplify these problems in the future, even on their own.[41] However, climate change promises to make reform of the way in which we deal with nonpoint source pollution and environmental flows an imperative.

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[32] *See, e.g.*, N. KANNAN & J. JEONG, EPA & AGRILIFE RESEARCH & EXTENSION, TEXAS A&M SYSTEM, AN APPROACH FOR ESTIMATING STREAM HEALTH USING FLOW DURATION CURVES AND INDICES OF HYDROLOGIC ALTERATION 1, 5–11 (2011); *Hydrology Assessments*, EPA, http://water.epa.gov/polwaste/nps/watershed/hydrologic.cfm (last visited Mar. 7, 2016).

[33] *See, e.g.*, Letter from Joanne Benante, Chief, Water Quality Plan. Branch, EPA, Region 4, to James McIndoe, Chief, Water Division, Ala. Dep't of Envtl. Mgmt. 5 (Aug. 20, 2010) (on file with author).

[34] CWA § 101(g), 33 U.S.C. § 1251(g).

[35] *See* Benson, *supra* note 11, at 214 (stating that it is "extremely uncommon" among the states to regulate water quantity in pursuit of water quality).

[36] OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 4.

[37] *See* Robert L. Glicksman & Matthew R. Bezel, *Science, Politics, Law, and the Arc of the Clean Water Act: The Role of Assumptions in the Adoption of a Pollution Control Landmark*, 32 WASH. U. J.L. & POL'Y 99, 132 (2010).

[38] OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 6.

[39] *Id.* at 5.

[40] *See* Carlisle et al., *supra* note 13, at 264.

[41] *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 4.

Heavier rainfall events have been increasingly common all across the nation, and this trend is expected to intensify in the future.[42] In places like the Northeast, Midwest, and Mountain West, where this effect is expected to be most pronounced, the effect on water quality will be profound. More intense storms will produce greater erosion and stormwater runoff, resulting in more nonpoint source pollution in the form of excess nutrients, organic material, and sediment.[43] In the Southwest, drought and increased warming will likely produce more wildfires,[44] which will in turn lead to increased soil erosion and heightened levels of nonpoint source degradation.[45] Warmer temperatures and drier summers will also produce more wildfires in the Northwest.[46] In fact, the amount of land burned by wildfire in parts of western North America is expected to grow by a factor of two to four for each degree Celsius of global warming,[47] thus significantly increasing nonpoint source pollution in many of the rivers and streams in the western part of the country.[48]

The Southwest is our hottest region, and it will get even hotter under the impact of climate change. In addition, many areas in the Southwest have also experienced unusually dry weather, and this is expected only to worsen in the southern half of the region.[49] Between increasing evaporative loss due to higher temperatures, less snowpack due to later winters and earlier spring melts, and less rainfall across broad swaths of the region, the Southwest faces a real threat to the adequacy of its water resources, and its streams face the prospect of longer low flow

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42 U.S. GLOBAL CHANGE RES. PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT 71 (2014).

43 *Id.* at 198.

44 *Id.* at 468.

45 *See* MICHAEL R. OVERCASH & JAMES M. DAVIDSON, ENVIRONMENTAL IMPACT OF NONPOINT SOURCE POLLUTION 313 (1981) (stating that when the natural forest environment is disturbed by fires, soil loss increases and becomes "a major source of nonpoint source pollution").

46 U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 42, at 489.

47 NAT'L RES. COUNCIL, CLIMATE STABILIZATION TARGETS: EMISSIONS, CONCENTRATIONS, AND IMPACTS OVER DECADES TO MILLENNIA 7 (2011); *see also* FOREST SERVICE, U.S. DEP'T OF AGRIC., FUTURE OF AMERICA'S FORESTS AND RANGELANDS: FOREST SERVICE 2010 RESOURCE PLANNING ACT ASSESSMENT 51 (2012) (projecting more fire in the western forests and rangelands even in places where rainfall remains the same or increases due to higher temperatures and increased drought stress).

48 *See* OVERCASH & DAVIDSON, *supra* note 45, at 313. While increased amounts of erosion and runoff are most pronounced in areas immediately adjacent to a wildfire, areas within a 100 mile radius often experience higher erosional impacts. Annual runoff can rise as much as thirty percent in the year after a fire, but in steep terrain, peak runoff may exceed average peak flows by 10 to 100 times. Ginger Paige & Jennifer Zygmunt, *The Science Behind Wildfire Effects on Water Quality, Erosion*, *in* LIVING WITH WILDFIRES IN WYOMING 31 (Jennifer Thompson & Steve L. Miller eds., 2013).

49 U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 42, at 463.

conditions and the severe stresses to their aquatic life that follow in the wake of low flows amid higher temperatures.[50]

Other areas, however, are not immune from the problems associated with lengthy dry periods. All regions, but especially the Northwest and the South, will likely experience longer dry spells. Short-term droughts are projected to grow worse in most places, but especially in large areas of the Southeast and the southern Great Plains.[51] And everywhere in the country, the temperature is expected to increase, although more in some areas than others,[52] along with earlier and smaller snowmelts in the West.[53]

Climate change is also expected to increase water use considerably. Withdrawals are projected to rise twenty-three percent over 2005 levels by the year 2060 due to climate change.[54] Seventy-six percent of that increase will be due to greater demands from irrigated agriculture, because higher temperatures increase evapotranspiration thereby requiring more water to grow the same crops.[55] Although a portion of most water withdrawals are eventually returned to the stream, irrigated agriculture and the livestock sector actually consume prodigious amounts of water.[56] All of this indicates that the U.S. water supply will become much more vulnerable to shortages in the future.[57] Most of this rise in vulnerability will occur in arid and semi-arid areas, such as California, the Southwest, the Great Basin, and the central and southern Great Plains.[58] In addition, projected increases in the acreage devoted to agricultural irrigation in the East[59] may well cause serious problems for instream flow levels in many Eastern streams, particularly in the Southeast.[60] This increasing vulnerability to water shortages will exacerbate conflicts over water in the future as well as increase pressures to mine groundwater and deplete streamflows.[61]

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[50] *Id.* at 86, 463–65.

[51] *Id.* at 71, 75.

[52] FOREST SERVICE, U.S. DEP'T OF AGRIC., *supra* note 47, at 115.

[53] U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 42, at 72.

[54] FOREST SERVICE, U.S. DEP'T OF AGRIC., *supra* note 47, at 115. Total withdrawals will likely grow by 26 percent; in other words, water withdrawals would grow by only 3 percent in the absence of climate change. *See id.*

[55] *See id.*

[56] *Id.* at 113.

[57] *Id.* at 175.

[58] *Id.* at 118.

[59] Irrigated acreage in the East is projected to grow from 15 million acres in 2005 to 20 million acres in 2060. *Id.* at 113.

[60] Increases in consumptive use in the East may exceed 50 percent in places due to the expected increase in irrigated acreage. *Id.* at 116.

[61] *See id.* at 121, 175.

There is still time to adapt the CWA and our state and federal water management policies to meet these challenges before the problems reach crisis proportions. But it will take political courage as well as an increased level of civic wisdom at all levels of our system. The political obstacles are obvious. Nonpoint source pollution control often generates opposition from a number of powerful interests, such as the farm lobby.[62] In addition, state officials and their supporters frequently assert that nonpoint source controls are a form of land use planning that ought to remain exclusively in state and local hands.[63] Similarly, state agencies and traditional water users are likely to object to any federal involvement with water matters, including stream flows, that is perceived to encroach upon the "primary" role of state governments over water management and water allocation.[64] The federal government, however, has strong interests and historic involvement with both water management and pollution control, and the national perspective must be represented as we address problems that are truly national in scope. It is time to set aside parochial concerns. The problems are stark and will grow worse, much worse, unless we summon the will to act in collaborative fashion, drawing upon the technology and resources of the federal government as well as the specialized knowledge of state and local governments. We desperately need the synergy that a collective approach would produce.

This article will begin by surveying in more detail the evolution of our current approach to the control of nonpoint source pollution. Then, after taking a closer look at the relationship of flows to water quality and the historic roles played by the federal and state governments with respect to water management, the article will proceed to analyze the CWA's treatment of flow issues. Finally, after reviewing the inadequacies of our current approaches to both nonpoint source pollution control and environmental flows, the article will conclude by

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62 *See* Rodgers & Rosenthal, *supra* note 9, at 12.

63 *See id.* at 11. The notion that land use is an exclusive matter for state and local government flies in the face of the fact "that the national government has been involved in land use planning since the early days of the republic." BRUCE BABBITT, CITIES IN THE WILDERNESS: A NEW VISION OF LAND USE IN AMERICA 5 (2005). Not only does the federal government manage federal lands comprising one-third of the nation's land area, but federal policies and activities exert tremendous influence over land use patterns and many private land use decisions. *See* PERCIVAL ET AL., *supra* note 20, at 805–13.

64 Reed D. Benson, *The Greenback, The Humpback, and the Silverback: How a Third Wave of Federal Water Policy Could Benefit the West*, 93 OR. L. REV. 685, 687–88 (2015). In the western United States, "traditional water users" generally refers to those interests which have long held water rights in the region—usually senior with large allocations. In the East, the term generally refers to large-scale water users that have historically enjoyed free reign in their consumption—electric utilities, for example.

exploring a number of ways in which a more dynamic and expansive approach could help fill the voids that lie at the heart of the CWA.

II. THE CLEAN WATER ACT'S APPROACH TO NONPOINT SOURCE POLLUTION

A. Section 319

Although Congress certainly understood that nonpoint source pollution was a significant problem in 1972, it chose to prioritize the control of point source pollution.[65] That choice is not difficult to understand. The regulation of approximately 60,000 point sources—many of which were fairly notorious and easily targeted—was a much more manageable task in the short-term than dealing with the hundreds of thousands of persons and businesses responsible for various kinds of nonpoint source pollution.[66] Plus, there was a perception that nonpoint source pollution was difficult to control.[67] That, of course, was a myth. As Professor Oliver Houck has written: "[T]he control technologies for nonpoint pollution (e.g., shelter-belts, nutrient caps, retention ponds) are anything but unknown, complex, technologically difficult, or even very costly."[68] But, of course, that perception was sufficient excuse for largely side-stepping a politically sensitive issue.[69]

Rather than regulate nonpoint pollution, Congress relegated control to an area-wide planning program. Under the section 208 program, states received grants in order to identify nonpoint sources of pollution and develop procedures and methods to control them.[70] The Act,

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[65] *See* Helen M. Ingram & Dean E. Mann, *Preserving the Clean Water Act: The Appearance of Environmental Victory*, *in* ENVIRONMENTAL POLICY IN THE 1980S: REAGAN'S NEW AGENDA 251, 257 (Norman J. Vig & Michael E. Kraft eds., 1984). The gravity of nonpoint source problems, as well as flow problems, had been understood for many years. In a book published in 1968, for example, two engineering professors at the University of Washington wrote: "In many instances, the effect on water quality caused by irrigation return flows, erosion, and diversion far transcend the effects of municipal and industrial waste water." Robert O. Sylvester & Carl A. Rambow, *Methodology in Establishing Water-Quality Standards*, *in* WATER RESOURCES MANAGEMENT AND PUBLIC POLICY 111 (Thomas H. Campbell & Robert O. Sylvester eds., 1968). Also in 1968, the Water Resources Council noted that sediment from "croplands, unprotected forest soils, overgrazed pastures, [and] the bulldozed 'developments' of urban areas" was a "major" source of water pollution, as were the nutrients that were "adsorbed on sediment particles." U.S. WATER RES. COUNCIL, THE NATION'S WATER RESOURCES: THE FIRST NAT'L ASSESSMENT OF THE WATER RESOURCES COUNCIL 5-3-2 (1968).

[66] Andreen, *supra* note 2, at 562.

[67] *See* S. REP. NO. 92-414, at 39 (1972) (stating that "many nonpoint sources of pollution are beyond present technology of control").

[68] HOUCK, *supra* note 2, at 87.

[69] *See* PERCIVAL ET AL., *supra* note 20, at 793–94.

[70] CWA § 208(b), 33 U.S.C. § 1288(b) (2012).

however, neither required nor funded implementation of any resulting nonpoint source control plans.[71]

The concept behind the planning process was logical. It was based on the idea that construction grants for municipal wastewater treatment facilities, industrial pretreatment requirements, permit decisions, stormwater collection systems, and nonpoint source controls should all be based upon an integrated area-wide plan.[72] The time limit of two years, within which such ambitious plans were to be developed, however, was not entirely consistent with the complexity and scope of the task.[73] Undoubtedly, the reason for the limit was to quickly provide a strategic planning foundation for the issuance of both construction grants and permits.[74] Unfortunately, the Nixon administration impounded most of the funds that Congress had appropriated for this task in 1973-1975, thus throwing the planning process badly off-schedule.[75]

Although over 200 grants had been made by 1978, no plans were completed by the fall of 1978.[76] By that time few state agencies were even developing controls for nonpoint source pollution, due in part to the two year time limit.[77] Moreover, the passage of time made significant portions of the planning process moot. For example, many funding and location decisions for new and upgraded sewage treatment plants had already been made without the benefit of a comprehensive plan.[78] By 1980, the 208 planning process was slowly dying,[79] and, with respect to nonpoint source pollution, only "negligible" progress at best had been achieved.[80]

The need to deal with nonpoint source pollution never completely receded from view. The Council on Environmental Quality wrote in 1980, for example, that "[f]or the nation to have clean waters, it must

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71 *See* PERCIVAL ET AL., *supra* note 20, at 794 (referring to what was a fatal absence of a link between planning and implementation under section 208).

72 *See* FREDERICK R. ANDERSON, DANIEL R. MANDELKER & A. DAN TARLOCK, ENVIRONMENTAL PROTECTION: LAW AND POLICY 384 (3rd ed. 1990).

73 CWA § 208(b)(1)(A), 33 U.S.C. § 1288(b)(1)(A).

74 *See* NAT'L COMM'N ON WATER QUALITY, STAFF REPORT I-64 (1976).

75 *See* U.S. GEN. ACCOUNTING OFFICE, CED-78-167, WATER QUALITY MANAGEMENT PLANNING IS NOT COMPREHENSIVE AND MAY NOT BE EFFECTIVE FOR MANY YEARS 5–6 (1978).

76 *See id.* at 6–7.

77 *See id.* at 12.

78 *See* NAT'L COMM'N ON WATER QUALITY, STAFF REPORT I-65 (1976); ANDERSON, MANDELKER & TARLOCK, *supra* note 72, at 385.

79 *See* Ingram & Mann, *supra* note 65, at 258. After 225 plans were developed, funding for the section 208 program ceased in 1981. *See* S. REP. NO. 103-257, at 46 (1994).

80 *See* COUNCIL ON ENVTL. QUALITY, ENVIRONMENTAL QUALITY: THE ELEVENTH ANNUAL REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY 133 (1980).

become a high national priority to ensure that [Best Management Practices] are properly installed, maintained, and operated. Strong regulatory measures must be applied nationwide to ensure that Best Management Practices are implemented successfully to achieve water quality goals."[81] Furthermore, with point sources coming under control and the tide of nonpoint source pollution rising, the Senate Committee on Environment and Public Works reported in 1985 that fifty percent of all water pollution now came from nonpoint sources.[82] The problem could no longer be ignored.

In response, Congress added a new provision dealing with nonpoint source pollution in 1987, section 319.[83] It was introduced with great fanfare, with Congress declaring that "it is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of [the Act] to be met . . . ."[84] Unfortunately, while the new section did focus exclusively on nonpoint source pollution, it did not differ substantially from the approach of the old section 208.[85]

The new section 319 program directed the states to submit an assessment report listing those waters that cannot meet water quality standards due to nonpoint source pollution and identifying the significant sources of nonpoint pollution responsible for those conditions.[86] The states were then called upon to develop management plans containing "best management practices" to reduce pollutant loadings[87] "to the maximum extent practicable".[88] Although these plans are subject to EPA review,[89] Congress permitted states to use non-regulatory approaches such as technical assistance, education, training, and demonstration projects as alternatives to regulation.[90] The only sanction EPA has at its disposal, in the event a state plan is found deficient, is to withhold funding for the state nonpoint source program—rather than establishing an adequate program in its stead.[91] Since withholding funds would deprive a state of resources needed to

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81 *Id.* at 135.
82 S. REP. NO. 99-50, at 7–8 (1985).
83 CWA § 319, 33 U.S.C. § 1329 (2012).
84 CWA § 101(a)(7), 33 U.S.C. § 1251(a)(7).
85 Adler, *supra* note 28, at 861.
86 CWA § 319(a)(1)(A), (B), 33 U.S.C. § 1329(a)(1)(A), (B).
87 *Id.* § 319(b)(1), (2)(A), 33 U.S.C. § 1229(b)(1), (2)(A).
88 *Id.* § 319(a)(1)(C), 33 U.S.C. § 1229(a)(1)(C).
89 *Id.* § 319(d), 33 U.S.C. § 1229(d).
90 *Id.* § 319(b)(2)(B), 33 U.S.C. § 1229(b)(2)(B).
91 *Id.* § 319(d)(2), 33 U.S.C. § 1229(d)(2).

make at least some progress toward abating serious nonpoint source pollution, EPA has been unwilling to take that step.[92]

During Congress' consideration of section 319, a number of members of Congress indicated that the provision was not necessarily the final step in the nation's attempt to control nonpoint source pollution. Senator Robert Stafford, the chairman of the Senate Committee on Environment and Public Works[93] presented the Conference Report on the floor of the Senate.[94] At that time, he declared that section 319 was just "a first step in tackling the problem—a trial run, to see if allowing the States the option to develop a control program will indeed abate nonpoint source pollution across the Nation."[95] Eventually, a decision would have to be made as to whether a "voluntary program" could work, in the words of Congressman James Oberstar, or whether "Congress should consider a regulatory and enforceable approach in the next phase of the program."[96] Of course, there were a number of members who appeared to be resolutely opposed to considering a regulatory course of action at any point in time.[97]

Despite the grandiloquent statement of congressional policy, Congress failed to provide the program with adequate resources. While section 319 authorized $400 million for state programs for the four-year period from 1987 to 1991,[98] no appropriation was made for this purpose until 1990, and between 1990 and 1994, a total of only $270 million was appropriated.[99] Citing the lack of progress due both to inadequate

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92 *See* Fran Dubrowski, *Crossing the Finish Line*, 14 ENVTL. F. 28, 32–33 (1997).

93 *See* CONGRESSIONAL DIRECTORY: 99TH CONG. 193 (1985).

94 132 CONG. REC. 32,380 (1986).

95 *Id.* at 32,382.

96 130 CONG. REC. 18,811 (1984) (statement of Rep. James Oberstar of Minnesota during House debate on the initial House bill, which he co-sponsored). Minnesota Senator David Durenberger, a minority member of the Senate Committee on Environment and Public Works, also indicated during the Senate debate on the conference report that Congress would have to revisit the question of how much flexibility states should have during the next legislative cycle if real improvement in water quality was not produced. 132 CONG. REC. 32,399 (1986).

97 *See* 132 CONG. REC. 32,385 (1986) (statement of Sen. Lloyd Bentsen of Texas, asserting that nonpoint source pollution "is not easily subjected to a harsh regulatory solution"); 130 CONG. REC. 18,813 (1984) (statement of Rep. Harold Daub of Nebraska, declaring that "action of a regulatory nature could have dire consequences on those in agriculture").

98 CWA § 319(j), 33 U.S.C. § 1229(j) (2012).

99 S. REP. NO. 103-257, at 47 (1994). Congress did, however, enact another initiative to deal with nonpoint source pollution when it passed the Coastal Zone Act Reauthorization Amendments of 1990 ("CZARA"). Pub. L. No. 101-508, 104 Stat. 1388 (codified at 16 U.S.C. § 1455b (2012)). Section 1455b requires states with approved coastal zone management plans to develop a Coastal Zone Nonpoint Source Pollution Control Project and submit it to EPA and the National Oceanic and Atmospheric Administration for approval. *Id.* The CZARA program is discussed in detail at *infra* notes 272–82 and accompanying text.

state plans and inadequate funding,[100] the Senate Committee on Environment and Public Works drafted a tough new provision in 1994 that included a requirement directing states to establish enforceable management practices.[101] In the event a state failed to do so, EPA was required to promulgate regulations establishing a management program for that state and to use the state's funding allocation to carry out the federal program.[102] Although the committee reported the bill containing this provision favorably to the full Senate, it proceeded no further.[103] It should be noted that a minority in the committee objected strenuously to this provision, complaining that it was too early to declare the voluntary approach to nonpoint source control a failure, since Congress had seriously underfunded the program.[104]

Although annual funding rose to $100 million per year by 1995,[105] the amount was far from equal to the task. Hamstrung by this modest level of support, the program was largely limited to the funding of state staff and their activities such as outreach, training, the provision of technical assistance, and the implementation of demonstration projects.[106] Nevertheless, by working with other stakeholders, some states were able to improve water quality significantly in a relatively small number of water bodies.[107]

In 1999, Congress recognized that improved levels of funding were absolutely necessary and increased section 319 funding to $200 million per year,[108] a level that was sustained through 2010.[109] EPA determined that the additional $100 million should be expended on restoring impaired waters with the remaining amount to be made available for core state functions such as staff support, education, and technical assistance.[110] Beginning in 2011, appropriations for the section 319

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100 S. REP. NO. 103-257, at 47 (1994).

101 *See* Water Pollution Prevention and Control Act of 1994, S. 2093, 103d Cong. § 319(b) (1994).

102 *See id.* § 319(b)(7).

103 *See* CLAUDIA COPELAND, CONG. RESEARCH SERV., RL33466, WATER QUALITY: IMPLEMENTING THE CLEAN WATER ACT 2–3 (2006).

104 S. REP. NO. 103-257, at 214 (1994) (minority views of Senators Smith, Faircloth, and Kempthorne).

105 *319 Grant Program for States and Territories: 319 Overview*, EPA, https://www.epa.gov/polluted-runoff-nonpoint-source-pollution/319-grant-program-states-and-territories (last visited Mar. 26, 2016).

106 *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 11, 18.

107 *See id.* at 11.

108 *See id.*

109 *See* EPA, *supra* note 105.

110 *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 11–12, 18. Between 2004 and 2010, approximately 55 percent of section 319 funding was spent on these core functions. *See* U.S. GOVT. ACCOUNTABILITY OFFICE, NONPOINT SOURCE WATER

began to decrease significantly.[111] By 2012, funding had fallen to $165 million, and EPA decided that the $100 million set aside for watershed restoration activities was no longer supportable, revising the requirement to require at least a fifty percent set aside for watershed projects.[112] At times, additional state resources and more substantial funding from one of the U.S. Department of Agriculture's Farm Bill programs such as the Conservation Reserve Program or the Wetlands Reserve Program supplement this meager level of restoration funding.[113]

By 2011, however, only 354 nonpoint source-impaired waterbodies had been remediated under the section 319 program.[114] The successful projects ranged from large multi-million projects that took years to plan and implement to relatively small, inexpensive restoration activities.[115] This progress is scant compared to the need, representing only one percent of the nonpoint source-impaired waters in the nation.[116] At this pace and without adding any more waters to the impaired list, it will take some 700 years to finish the job.[117]

Section 319, in the final analysis, has just amounted to a minor remedial program lacking teeth. Only a handful of states have somewhat comprehensive regulatory programs to control nonpoint source pollution.[118] Most rely primarily on voluntary action.[119] Thus, regulatory action is for the most part missing from the program, and funding has proven woefully inadequate. Meanwhile, nearly thirty years have passed during which nonpoint source pollution problems have festered and

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POLLUTION: GREATER OVERSIGHT AND ADDITIONAL DATA NEEDED FOR KEY EPA WATER PROGRAM 14–16 (2012).

111 *See* EPA, *supra* note 105.

112 EPA, NONPOINT SOURCE PROGRAM AND GRANTS GUIDELINES FOR STATES AND TERRITORIES 1–2 (Apr. 12, 2013).

113 *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 98, 117. Although the U.S. Department of Agriculture ("USDA") has much more funding available for conservation purposes than EPA has at its disposable under the section 319 program, a number of observers have criticized the USDA programs for not being well-targeted at priority problems, such as impaired waters, and for the lack of adequate monitoring, reporting, and enforcement. *See* Jonathan Cannon, *A Bargain for Clean Water*, 17 N.Y.U. ENVTL. L.J. 608, 627–30 (2008). Transparency is a particular problem in these USDA programs since the USDA is forbidden to disclose information provided by a farmer concerning his or her farming or conservation practices, or the land itself, in order to participate in any USDA program. 7 U.S.C. § 8791(b)(2) (2012).

114 OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 12.

115 *Id.* at 12–13.

116 OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 13 (referring to the fact that over 40,000 waters and water segments have been listed as impaired due to nonpoint source pollution under section 303(d)).

117 *Id.* at 13.

118 *See* U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 26; OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 33, 36; COPELAND, *supra* note 103, at 17.

119 *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 33.

grown worse—nearly forty-five years if one uses 1972 as the starting date. It is long past time to declare this "trial run" a failure.

B. Total Maximum Daily Loads

Another tool exists under the CWA to deal with nonpoint source discharges. Under section 303(d), states are directed to identify those waters that are not meeting water quality standards[120] and to establish a pollution budget—known as a "total maximum daily load" ("TMDL")—for those pollutants responsible for the water's impaired condition.[121] The TMDL is essentially a numerical target for the offending pollutants that must be met in order to bring a water body into compliance with water quality standards, while taking into account seasonal flow variations and also incorporating a margin of safety.[122] This budget or loading capacity must, in turn, be allocated, as appropriate, to point sources (referred to as a wasteload allocation) and nonpoint sources (called a load allocation).[123]

TMDLs are subject to EPA review. In the event that a state TMDL is found inadequate, EPA is not only empowered but ordered to adopt one.[124] Despite that mandate, EPA has no specific authority to implement TMDLs. That presents no particular problem for point source discharges, since wasteload allocations are defined as a form of water quality-based effluent limitation.[125] Thus, they should be included in section 402 permits as long as a state is properly implementing the permit program[126] or where EPA is the permitting agency. On the other hand, there is no statutory or regulatory provision requiring the implementation of load allocations for nonpoint sources. That task is left entirely to state discretion,[127] and most states lack any effective way in which to compel nonpoint sources to comply with load allocations or any best management practices designed to meet those allocations.[128]

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120 CWA § 303(d)(1)(A), 33 U.S.C. § 1313(d)(1)(A) (2012).

121 *Id.* § 303(d)(1)(C), 33 U.S.C. § 1313(d)(1)(C).

122 *Id.*

123 *See* 40 C.F.R. § 130.2(g), (h) (2015).

124 CWA § 303(d)(2), 33 U.S.C. § 1313(d)(2).

125 40 C.F.R. § 130.2(h).

126 States may obtain authority from EPA to administer the section 402 permit program, CWA § 402(b), 33 U.S.C. § 1342(b), and 46 states have been granted such authority. *NPDES State Program Information: State Program Authority*, EPA, https://www.epa.gov/npdes/npdes-state-program-information (last visited Mar. 26, 2016).

127 *See* Adler, *supra* note 28, at 868. The states, however, are directed to incorporate TMDLs (including load allocations) into their continuing planning processes. CWA § 303(d)(2), 33 U.S.C. § 1313(d)(2).

128 *See* U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 61.

States did little to set TMDLs until a host of citizen suits established the proposition that EPA had a duty to establish TMDLs for states that failed to do so themselves.[129] Since the early 1990s, nearly 50,000 TMDLs have been developed, many of which were the result of consent decrees in mandatory duty cases filed against EPA.[130] While state TMDL coordinators report that eighty-three percent of wasteload allocations for point sources have been met in long-established TMDLs,[131] relatively "few TMDLs have been implemented for nonpoint source pollution, and for those that have been implemented, progress has generally been incremental."[132] In fact, only twenty percent of load allocations for nonpoint sources have been achieved in long-established TMDLs.[133] The magnitude of the national problem is overwhelming, since approximately seventy-six percent of all TMDLs address waters that are impaired primarily or entirely by nonpoint source pollution.[134]

As state TMDL coordinators report, the reasons for this discrepancy in performance between point sources and nonpoint sources are two-fold: lack of sufficient funding and the absence of legal authority.[135] While the lack of adequate funding is a problem, especially for small-scale farmers and municipalities, the fundamental problem, according to these TMDL coordinators, is the fact that non-regulatory mechanisms have been overwhelmingly relied upon to implement TMDLs for the nonpoint source community.[136]

Most states depend primarily upon voluntary cooperation. Only a small number possess the authority to regulate nonpoint source pollution in any significant way.[137] However, even in instances where a state has a regulatory program of some sort for nonpoint source pollution, there may be little or no enforcement.[138] Pennsylvania, for

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129 *See* PERCIVAL ET AL., *supra* note 20, at 768.

130 U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 3.

131 *Id.* at 35. The GAO defined TMDLs approved by EPA before January 2008 as long-established TMDLs. 35,000 TMDLs fell into this classification. *Id.* at 3.

132 *Id.* at 62.

133 *See id.* at 35.

134 *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 4. EPA estimates that more than 40,000 waters (including those with TMDLs) are impaired either primarily or entirely by nonpoint source pollution. *See id.* at 13.

135 *See* U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 62.

136 *See id.* at 61; *see also id.* at 63 (stating that the goals of the CWA are likely to remain unfulfilled unless changes are made to the Act's voluntary approach to nonpoint source pollution).

137 *Id.* at 26 (citing California, Florida, Hawaii, Oregon, Pennsylvania, Washington, and Wisconsin); OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 36 (citing Florida, Maryland, Pennsylvania, Vermont, and Washington).

138 *Cf.* William L. Andreen, *Environmental Law and International Assistance: The Challenge of Strengthening Environmental Law in the Developing World*, 25 COLUM. J. ENVTL. L. 17, 28–

example, has been cited by both EPA and the Government Accountability Office ("GAO") as a state possessing a relatively comprehensive set of regulatory authorities pertaining to nonpoint source pollution.[139] One such regulation requires all farms that disturb a set amount of land through plowing or tillage to have a plan, including provisions for inspection and maintenance, to control sediment runoff.[140] This should be an important source of power, since approximately 1000 TMDLs in Pennsylvania list sediment as a pollutant impairing water quality, and farms have been identified as the source of sediment pollution in many of those TMDLs.[141] Nevertheless, this provision has never been enforced—farms have not been required to have such plans or to implement them— despite the fact that this rule has been in effect for over forty years.[142] The Pennsylvania program has simply, as one of its officials admitted to the GAO, "not been strict with the agricultural community over the years",[143] a primary reason, undoubtedly, that most sediment-impaired waters in Pennsylvania remain impaired.[144]

In short, the goals of the CWA are unlikely to ever be fulfilled unless something other than a voluntary approach is taken to nonpoint source pollution under both sections 319 and 303(d). And the scale of the problem—already massive—will likely worsen with the increased erosional impacts and larger nonpoint source loadings associated with the effects of climate change.[145]

III. ENVIRONMENTAL FLOWS AND THE CLEAN WATER ACT

A. Relationship of Streamflow to Water Quality

Water quality is intimately related to water quantity. Healthy aquatic systems simply cannot exist on rivers and streams with little or no flow.[146] All too often, however, water has been treated as a commodity

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29, 32 (2000) (referring to the lack of implementation and enforcement of various regulatory schemes).

139 *See supra* notes 22–23.

140 See U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 61; OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 39 (referring to 25 PA. CODE § 102.4).

141 See U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 61.

142 *Id.* The rule was broadened to include concentrated animal operations disturbing 5000 square feet or more of land in 2010. *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 39; 40 Pa. Bull. 4861 (Aug. 21, 2010).

143 U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 23, at 61.

144 *See id.*

145 *See supra* notes 42–48 and accompanying text.

146 *See* PUD No. 1 of Jefferson Cnty. v. Wash. Dept. of Ecology, 511 U.S. 700, 719 (1994) (declaring that "a sufficient lowering of the water quantity in a body of water could destroy all of its designated uses, be it for drinking water, recreation, navigation or . . . as a fishery").

for exclusive human use and consumption. Water withdrawals, impoundments, and diversions adversely affect natural flows and aquatic systems all over the country. In the West, many waters are over allocated for consumptive purposes, reducing some streams to a bare trickle, a situation that will only grow worse with climate change.[147] In the East, water diversions and withdrawals have already sparked regional conflict,[148] and the projected expansion of irrigated agriculture in the East will likely only create more pressure on stream flows, especially in the Southeast where longer dry spells and droughts are expected.[149] However, the problem involves much more than just ensuring minimum flows during dry periods, because the ecological health of our flowing waters depend upon their "natural dynamic character"[150]—consisting of high flows and low flows, the frequency of their occurrence, their predictability, and how quickly flow changes occur.[151] In short, the ecological integrity of our flowing waters depends upon the "master variable" of streamflow defined in terms of both variable quantity as well as timing.[152]

This more dynamic view of flow regimes is of rather recent origin. Prior to the early 1990s, river scientists focused primarily upon minimum flows (then called in-stream flows) and the protection of one or a few target species.[153] Fortunately, the CWA takes a broad view of maintaining and improving "the chemical, physical, and biological integrity of the Nation's waters"; as the House Report on the CWA declared, "the word 'integrity' . . . refers to a condition in which the natural structure and function of ecosystems [are] maintained."[154] Nonetheless, the CWA lacks specific provisions to deal with flows of either the older in-stream flow variety or the current more holistic

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147 Benson, *supra* note 11, at 202. Hydraulic fracturing will produce even greater stress in our more arid areas since the production of shale gas using this process typically requires the use of 2-4 million gallons of water per well. OFFICE OF RES. & DEV., EPA, DRAFT PLAN TO STUDY THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER 22 (2011).

148 *See* William L. Andreen, *Alabama Water Law, in* WATERS AND WATER RIGHTS AL-1, AL-17 to AL-32 (Amy K. Kelley ed., 3rd ed. 2016) (discussing the dispute between Georgia, Florida, and Alabama over the Apalachicola–Chattahoochee–Flint River system and the dispute between Alabama and Georgia over the Alabama-Coosa-Tallapoosa system).

149 *See supra* notes 51, 54–61 and accompanying text.

150 N. Leroy Poff et al., *The Natural Flow Regime: A Paradigm for River Conservation and Restoration*, 47 BIOSCIENCE 769, 769 (1997).

151 *See id.* at 770–71. Seasonal high flows, for instance, are critical because they "deposit sediments, shape channels, rejuvenate and maintain riparian vegetation and habitats, improve water quality, expand and enrich food webs, maintain the valley, and provide access to spawning and rearing sites in the floodplain." INSTREAM FLOW COUNCIL, INSTREAM FLOWS FOR RIVERINE RESOURCE STEWARDSHIP xxvi (rev'd ed. 2004).

152 *See id.* at 769.

153 *See id.* at 769–70, 779, 781; ARTHINGTON, *supra* note 15, at 149.

154 H.R. REP. NO. 92-911 at 76 (1972).

environmental flow approach. This already difficult problem is further complicated by the fractured nature of our institutional and governmental structures governing water management.

B. Federal and State Roles in Water Management

Although the pollution control programs found in the CWA are predicated on a dynamic form of cooperative federalism in which federal and state roles are overlapping and intertwined,[155] the management of fresh water resources in the United States has been traditionally viewed as primarily a function of state government.[156] State officials and many water users, moreover, are adamant in insisting that the federal government "must respect the 'primary' role of states in water allocation and management."[157] Although water rights have typically been considered a matter of state property law, there are significant areas of federal control and even ownership interests over water resources in the United States.[158] Both levels of government have substantial stakes in those resources, and both must play a part in ensuring their ongoing viability.

1. Federal and Federally Regulated Water Projects

The federal government has long shared authority over water management with the states.[159] Throughout the nineteenth century, the U.S. Army Corps of Engineers was involved in projects dealing with navigation and flood control as well as the construction of canals and even large-scale river basin planning for the Mississippi River.[160] This relatively low level of involvement quickly evolved into a much larger role in the twentieth century. In 1902, Congress appropriated funding to

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155 *See* William L. Andreen, *Delegated Federalism Versus Devolution: Some Insights from the History of Water Pollution Control, in* PREEMPTION CHOICE: THE THEORY, LAW, AND REALITY OF FEDERALISM'S CORE QUESTION 257–60 (William W. Buzbee ed., 2009).

156 *See* U.S. GOV'T ACCOUNTABILITY OFFICE, FRESHWATER: SUPPLY CONCERNS CONTINUE, AND UNCERTAINTIES COMPLICATE PLANNING 1 (2014).

157 Benson, *supra* note 64, at 687-88.

158 DAVID H. GETCHES, WATER LAW 12 (3d ed. 1997).

159 *See* BETSY A. CODY & NICOLE T. CARTER, CONG. RESEARCH SERV., R40573, 35 YEARS OF WATER POLICY: THE 1973 NATIONAL WATER COMMISSION AND PRESENT CHALLENGES 1 (2009). For a thorough treatment of federal water resource programs from 1800 to 1970, see BEATRICE HORT HOLMES, U.S. DEP'T OF AGRIC., A HISTORY OF FEDERAL WATER RESOURCES PROGRAMS, 1800–1960 (1972) and BEATRICE HORT HOLMES, U.S. DEP'T OF AGRIC., HISTORY OF FEDERAL WATER RESOURCES PROGRAMS AND POLICIES, 1961–70 (1979). Another useful reference is AM. PUBLIC WORKS ASS'N, HISTORY OF PUBLIC WORKS IN THE UNITED STATES 1776–1976 (1976).

160 *See* Andrea K. Gerlak, *Federalism and US Water Policy, in* FEDERAL RIVERS: MANAGING WATER IN MULTI-LAYERED POLITICAL SYSTEMS 42–43 (Dustin Garrick et al. eds., 2014).

build dams and water distribution systems in sixteen western states.[161] Then, in 1920, the Federal Power Commission (today's Federal Energy Regulatory Commission) was created in order to license non-federal hydroelectric projects on the nation's navigable waters,[162] and the Corps of Engineers was authorized in 1925 to survey those waters and develop plans for navigation, irrigation, the generation of electricity, and flood control.[163] This era of infrastructure development reached its peak during the New Deal and the following two decades, years that witnessed hundreds of dams constructed by the Corps of Engineers and the Bureau of Reclamation, as well as some fifty dams built by the Tennessee Valley Authority.[164]

Today, the Bureau of Reclamation operates water storage and distribution projects, as well as irrigation infrastructure, in seventeen western states, managing 337 reservoirs with a storage capacity of 245 million acre-feet.[165] Those projects provide nearly 31 million people and 10 million acres of farmland with water.[166] The Corps of Engineers, meanwhile, manages nearly 550 reservoirs across the entire nation with a storage capacity of 330 million acre-feet. [167] Seventy-five of those reservoirs contain hydroelectric generating units operated by the Corps that produce approximately twenty-four percent of the country's hydropower.[168] In addition, the Corps maintains nearly 15,000 miles of levee systems and navigation along 12,000 miles of inland waters.[169]

2. Federal Water Law

Federal law and policy impact water management in other ways as well. First, the federal common law of equitable apportionment applies to the allocation of interstate water resources among the relevant states—at least in the absence of an interstate compact (approved by Congress) or direct congressional action.[170] In applying equitable apportionment, the U.S. Supreme Court is not bound by state law; instead, it seeks to balance the equities presented by a particular case.[171]

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161 *See id.* at 43.

162 *See* Benson, *supra* note 64, at 700.

163 *See* Gerlak, *supra* note 160, at 43.

164 *See* Benson, *supra* note 64, at 700-01.

165 U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 156, at 12.

166 *Id.*

167 *Id.*

168 U.S. ARMY CORPS OF ENG'RS, USACE HYDROPOWER–RENEWABLE, RELIABLE, ENERGY INDEPENDENCE FOR AMERICA (2013), *available at* http://www.usace.army.mil/Portals/2/docs/civilworks/budget/strongpt/fy2014sp_hydropower.pdf.

169 U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 156, at 12.

170 *See* GETCHES, *supra* note 158, at 397, 404–15.

171 *See id.* at 405.

Second, through the commerce power, the federal government controls the navigational capacity of the nation's waters, although the states either retained or were ceded ownership of the streambeds themselves.[172] Third, the federal public trust doctrine provides that the states may not sell or otherwise alienate state land underlying navigable waters, thus protecting the public's right to use these waterbodies for commerce, recreation, and fishing, among other things.[173]

And, fourth, the doctrine of federal reserved rights seeks to ensure that Indian reservations and federal lands retained for particular purposes, such as parklands, national forests, or military bases, will have enough water to fulfill their congressional purposes.[174] Any such tribal or federal reserved rights in the West will tend to have early priority dates under western prior appropriation water law since the date of priority extends back to the time the tribal or federal reservation was made.[175] Federal and tribal reserve rights could, therefore, trump state water allocations made after the date of the federal or tribal reservation.[176] It would thus be accurate to say, as Professor David Getches did, that "[a] state's authority to allocate rights in water . . . applies to all waters in the state except those that the federal government reserves for itself . . . ."[177] Such reserved rights, however, often go unclaimed for years, a situation that causes uncertainty and concern among many stakeholders.[178] If the reserved rights are claimed, then the matter is adjudicated in state court. Such forums are not always

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172 *See id.* at 352.

173 Illinois Cent. R.R. Co. v. Illinois, 146 U.S. 387, 435–37, 452–54 (1892).

174 Winters v. United States, 207 U.S. 564, 576–77 (1908) (holding that an Indian tribe had a federally implied water right for the water necessary for irrigation purposes); Arizona v. California, 373 U.S. 546, 597–601 (1963) (clarifying Indian reserve rights and holding that other federal lands could have reserve rights for federal purposes).

175 *See* GETCHES, *supra* note 158, at 308, 20–22. The doctrine of prior appropriation, or first in time, first in right, developed in the West in response to the general scarcity of water in the region. Under this approach, water may be diverted by anyone, and their right to use the water perfected so long as the water is used beneficially. These rights are for the use of a specific amount of water, for a specific purpose, at a specific location. The date of the appropriation sets the user's priority to use the water, with the holders of senior rights having superior rights to more junior users. *See id.* at 74–76. In the East, by contrast, water rights operate under the riparian rights doctrine. Under this doctrine, riparian owners have a right to the reasonable use of the water flowing past their land. *See id.* at 17–20. Since the 1950s, many of the eastern states have supplemented the riparian rights system with an administrative permit scheme (often limited to large diversions) that determines the rights of the holders. *See id.* at 56.

176 Robin Kundis Craig, *Climate Change, Regulatory Fragmentation, and Water Triage*, 79 COLO. L. REV. 825, 838 (2008). Dean Frank Trelease, however, was unable to find a single case in which any private rights-holder was able to prove that the establishment of a federal or tribal reserved right had extinguished any private water right. Frank J. Trelease, *Federal Reserved Water Rights Since PLLRC*, 54 DENV. L.J. 473, 491–92 (1977).

177 GETCHES, *supra* note 158, at 315–16.

178 *See id.* at 316.

hospitable to the federal government[179] even though the Supreme Court has emphasized that the state courts have a duty to follow federal law in resolving such claims.[180]

3. Federal Planning Efforts

Recognizing the need to better coordinate federal water programs and policies, Congress passed the Water Resources Planning Act in 1965.[181] The Act aimed to encourage the conservation and utilization of water and related land resources in a comprehensive, coordinated fashion by all relevant stakeholders, including federal, state, and local governments.[182] To support this effort, the Act created the Water Resources Council, which operated as a sub-cabinet committee.[183] It operated with fifty professional staff members and a number of cabinet secretaries sat, at least nominally, on the Council itself.[184] Congress charged the Council with assessing the nation's water supplies,[185] reviewing basin plans developed under the Act,[186] and allocating funds to the states to assist in developing comprehensive water and land resource plans.[187]

The Council prepared and published highly detailed national water assessments in both 1968[188] and 1978.[189] In addition, dozens of river basin studies and other planning studies were also issued by the Council.[190] Another significant report on water use and conservation was published in 1973, but it was prepared by another entity, the National Water Commission.[191]

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179 *See* Jeremy Nathan Jungreis, *"Permit" Me Another Drink: A Proposal for Safeguarding the Water Rights of Federal Lands in the Regulated Riparian East*, 29 HARV. ENVTL. L. REV. 369, 379 (2005).

180 Arizona v. San Carlos Apache Tribe of Arizona, 463 U.S. 545, 571 (1983).

181 Pub. L. No. 89-80, 79 Stat. 245 (1965) (codified as amended at 42 U.S.C. §§ 1962-1962d-18 (2012)).

182 42 U.S.C. § 1962.

183 *See id.* § 1962a.

184 See CODY & CARTER, *supra* note 159, at 14.

185 42 U.S.C. § 1962a-1(a).

186 *Id.* § 1962a-3. The President was authorized to create river basin commissions upon the request of the Council or a state. *Id.* § 1962b. The basin commissions, comprised of both state and federal members, were to prepare joint plans for the coordinated development of water and related resources. *Id.* §§ 1962b(b), 1962b-1.

187 *Id.* § 1962c-1.

188 U.S. WATER RES. COUNCIL, *supra* note 65.

189 U.S. WATER RES. COUNCIL, THE NATION'S WATER RESOURCES 1975-2000: SECOND NATIONAL ASSESSMENT (1978).

190 *See* CODY & CARTER, *supra* note 159, at 14.

191 NAT'L WATER COMM'N, WATER POLICIES FOR THE FUTURE: FINAL REPORT TO THE PRESIDENT AND TO THE CONGRESS OF THE UNITED STATES (1973). The use of such a study commission was not unusual. At least twenty national commissions or similar groups had been

The Commission was created by Congress in 1968 to "provide for a comprehensive review of national water resource problems and programs."[192] Unlike the National Water Council, none of the commission members, although appointed by the President, could be affiliated with the federal government in any other way. The members were largely chosen for their expertise relating to water resources.[193] Although the Council had "a very competent and hardworking staff",[194] the Council reached out to academics and others who "knew the most about the various subject areas . . . ."[195]

The Commission completed its five-year term of office with the publication of its final report. The Commission found that many of the nation's water policies were predicated on outdated objectives and flawed assumptions about future needs. Hundreds of well-considered recommendations for change were made.[196] Among other things, the Commission called for updated laws and legal institutions, increased conservation and efficiency, and a changed emphasis from water development towards the improvement of water quality.[197] With respect to stream flows, the Commission made two major recommendations: first, that prior appropriation states establish minimum stream flows and take steps to protect them,[198] and second, that riparian rights states should create permit systems and establish minimum flows to protect the aquatic ecosystem, the public's interest in recreation, and private investments made in reliance upon streamflow and lake levels.[199] Surprisingly the only thing that drew congressional ire was the Commission's decision not to recommend against inter-basin transfers, a position that disconcerted senators from the Pacific Northwest.[200]

The National Water Council, on the other hand, ran into a firestorm when it issued a number of issue papers on water resources in July

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created by Congress or the President to study water resources prior to the establishment of the National Water Commission. *Id*. at x.

192 Pub. L. No. 90-515, 82 Stat. 868 (1968).

193 *See* CODY & CARTER, *supra* note 159, at 4–5. According to Theodore M. Schad, who served as the Executive Director of the Commission staff, the Commission "membership was very well balanced politically, geographically, and environmentally;" MARTIN REUSS, OFFICE OF HISTORY & INST. FOR WATER RES., U.S. ARMY CORPS OF ENG'RS, WATER RESOURCES PEOPLE AND ISSUES: INTERVIEW WITH THEODORE M. SCHAD 168 (1998).

194 REUSS, *supra* note 193, at 178.

195 *Id.* at 180.

196 *See generally* NAT'L WATER COMM'N, *supra* note 191.

197 *See* CODY & CARTER, *supra* note 159, at 6.

198 *See* NAT'L WATER COMM'N, *supra* note 191, at 274, 278–79.

199 *See id.* at 280–81.

200 *See* REUSS, *supra* note 193, at 192–93.

1977.[201] The papers were prepared as part of a comprehensive review of federal water resources policy that was called for by President Jimmy Carter in his Environmental Message of May 1977.[202] The papers were designed to facilitate the preparation of a report, containing concrete recommendation that was to be presented to the President by the end of the year.[203] The President's goal was to reform federal water resources policy, with water conservation as its cornerstone.[204] President Carter, however, had already created a good deal of rancor among pro-water development interests in both the states and Congress when he issued a list of water projects his administration considered unsound.[205]

Federal task forces with assistance from some state representatives prepared the issue papers,[206] addressing a number of issues, such as planning for new water resource projects, cost-sharing arrangements between the federal government and the states, institutional arrangements, and water conservation.[207] Among the problems identified were inadequacies in the planning process for new water projects, the perceived lack of coordination between water quality and water quality planning efforts, the failure of state water laws to provide for instream flows, the failure of many state water laws to account for the relationship between groundwater and surface water, low water prices, and the undefined and rarely enforced concepts of beneficial use and reasonable use in western water law.[208] Some of the options that were floated to solve these problems were guaranteed to raise a furor. For example, one option provided that

> The Federal Government could review existing State water law systems and determine whether or not they promote equity, efficiency and environmental quality consistent with Federal policy. In States where the water laws failed to meet the Federal standard, future water related Federal programs and projects such as reclamation, flood control and insurance, water quality control and others could be delayed or conditioned upon compliance by the State.[209]

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201 Water Resource Policy Study, 42 Fed. Reg. 36,788 (Jul. 15, 1977); Water Resource Policy Study, 42 Fed. Reg. 37,940 (Jul. 25, 1977).

202 Message to Congress on the Environment, 1 PUB. PAPERS 967 (May 23, 1977).

203 *See* Water Resource Policy Study, 42 Fed. Reg. at 36,788.

204 Message to Congress on the Environment, *supra* note 202, at 976.

205 *See* Warren Viessman, Jr., *A History of the United States Water Resources Planning and Development*, *in* THE EVOLUTION OF WATER RESOURCE PLANNING AND DECISION MAKING 14, 37 (Clifford S. Russell & Duane D. Bauman eds., 2009).

206 *See* Water Resource Policy Study, 42 Fed. Reg. at 36,788.

207 *See id.* at 36,788, 36,790, 36,792, 36,794.

208 *See id.* at 36,788–90, 36,793, 36,794.

209 *Id.* at 36,794.

The issue papers, in short, were ambitious and aggressive as well politically naïve in many respects.

A large number of states, especially in the West, quickly took offense to these papers. They objected to the fact that the states had not been consulted before the issuance of the papers and were given inadequate time to prepare for the hearings on the papers.[210] In addition, many bridled at the suggestion that the states were inappropriately managing their surface and groundwater resources.[211] There was also certainly resentment about the possibility that some western water projects might not be built.[212] The Senate subsequently passed a resolution expressing its concern about possible interference with the state's traditional role over water allocations and the need for consultation with Congress before issuing a new national water resources policy.[213]

The administration was sufficiently chastised, at least in part. While President Carter's 1978 Message on Federal Water Policy did set forth an outline for tougher principles and standards to govern federal water projects, it failed to mention state water law.[214] President Carter did, however, direct federal agencies to cooperate with the states in maintaining instream flows and directed that "[n]ew and existing [federal] projects . . . be planned and operated to protect instream flows, consistent with State law and in close consultation with States."[215] Unfortunately for the National Water Council, its effective demise was sealed in 1979 when President Carter ordered the Council to develop standards and principles for the evaluation of federal water projects and to review project justifications prepared by the federal water agencies.[216] Congress prohibited the Council from undertaking such reviews, and no funding for the Council has been approved since 1983.[217] Since the Council's 1978 assessment of U.S. water resources, no comprehensive review of national water availability and use has been performed.[218] The resulting lack of relevant water data is an amazing situation for the leading nation in the world.

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210 *See* 123 CONG. REC. 32,387–88 (1986) (statement of Sen. Carl Curtis of Nebraska, citing a report by the Interstate Conference on Water Problems).

211 *See id.* at 32,388. Senator Clifford Hansen of Wyoming complained that the papers appeared "to advocate a Federal takeover or at least the imposition of a heavy Federal hand to alter the system of prior appropriations as it exists in the West." *Id*. at 32,389.

212 *See* Viessman, *supra* note 205, at 37.

213 S. Res. 284, 95th Cong., 1st Sess. (1977).

214 Message to Congress on Federal Water Policy, 1 PUB. PAPERS 1044, 1046–48 (Jun. 6, 1978).

215 *Id.* at 1051.

216 Exec. Order No. 12113, *reprinted in* 1 PUB. PAPERS 8 (Jan. 4, 1979).

217 *See* CODY & CARTER, *supra* note 159, at 14.

218 *See* U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 156, at 17.

4. The Endangered Species Act

The Endangered Species Act[219] has, in some instances, figured highly in regulating various hydrologic modifications, including releases from dams. The Act requires all federal agencies, in consultation with the U.S. Fish and Wildlife Service in the case of inland waters, to ensure that no action funded, permitted, or carried out by them is likely to jeopardize the continued existence of any endangered or threatened species.[220] The Act also regulates state and private activities by making it illegal to "take" any such species.[221] The term "take" includes "harm,"[222] which has been administratively defined to include "significant habitat modification . . . where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering."[223] Although the Act has not affected the way in which water is used on most waterways, it has led to recovery and management plans for a number of waters[224] and has occasionally dictated the release of minimum volumes from federally operated dams.[225]

C. Back to the Clean Water Act

Consistent with its broad purposes, the CWA recognizes that the alteration of stream flows can constitute water pollution. "Pollution," in the Act, is broadly defined as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water."[226] The biological and physical integrity of water can be adversely impacted by reduced stream flows[227] and by other kinds of flow impairments.[228] Moreover, the Act explicitly states that "pollution" can result from "changes in the movement, flow, or circulation" of our rivers and streams.[229] Congress thus recognized that flow dynamics are a crucial aspect of stream health, a fact that led the Supreme Court to declare that "[i]n many cases, water quantity is closely related to water

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219 16 U.S.C. §§ 1531–1544 (2012).

220 *Id.* § 1536.

221 *Id*. § 1538(a)(1)(B).

222 *Id*. § 1532(19).

223 50 C.F.R. § 17.3 (2015).

224 *See* William L. Andreen, *Developing a More Holistic Approach to Water Management in the United States*, 36 ENVTL. L. REP. 10,277, 10,284 (2006).

225 *See, e.g.*, Andreen, *supra* note 148, at AL-22 to AL-25.

226 CWA § 502(19), 33 U.S.C. §1362(19) (2012).

227 *See* PUD No. 1 of Jefferson Cnty. v. Wash. Dep't of Ecology, 511 U.S. 700, 719 (1994).

228 *See supra* notes 13–18, 150–52 and accompanying text.

229 CWA § 304(f), 33 U.S.C. § 1314(f).

quality."[230] In short, the CWA must be concerned with water quantity in its efforts to maintain water quality.[231] The two are physically and biologically joined together as the Act acknowledges and any effort to separate them is "an artificial distinction".[232]

Unfortunately, Congress did not explicitly provide for the control of all forms of water pollution. It did create permit programs for point source discharges of pollutants, one of which applies to the placement of dredged or fill materials, including dams or other structures, in waters of the United States.[233] It also established the section 319 program for nonpoint source pollution[234] and the TMDL program that can apply to pollutants emanating from nonpoint sources.[235] The CWA, however, "did not focus so clearly on other forms of water 'pollution'" including many kinds of hydromodifications such as water withdrawals and diversions or water flows downstream from impoundments. [236] They were identified as problems, because they can interfere with stream flow and impact stream integrity, but the mechanisms for dealing with them are far from comprehensive.[237]

Despite recognizing that water quantity issues may affect water quality, Congress was also aware of state sensitivity toward perceived infringements on their traditional authority over water allocation. Therefore, in 1972, Congress provided in section 510 that nothing in the CWA may "be construed as impairing or in any manner affecting any right or jurisdiction of the States with respect to the waters (including boundary waters) of such States."[238] If anyone doubted for a moment that section 510 applied to the state regulation of water rights, all doubts were laid aside in 1977 during the congressional uproar over the issue papers published by the National Water Council.[239]

The 1977 amendments to the CWA added a new subsection to section 101 of the Act, declaring that "[i]t is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction [or existing rights established by any state] shall not be

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230 *PUD No. 1 of Jefferson Cnty.*, 511 U.S. at 719.

231 *See id.*

232 *Id.*

233 *See* Adler, *supra* note 5, at 774–75 (referring to CWA §§ 402, 404, 33 U.S.C. §§ 1342, 1344).

234 *See supra* Section II(A).

235 *See supra* Section II(B).

236 Adler, *supra* note 5, at 774.

237 *See* Benson, *supra* note 11, at 227–28.

238 CWA § 510(2), 33 U.S.C. § 1370(2).

239 *See supra* notes 201–13 and accompanying text.

superseded, abrogated[,] or otherwise impaired by this Act."[240] The authors of this subsection, Senators Malcolm Wallop of Wyoming and Gary Hart of Colorado, were troubled, as others were, by the portions of the Water Resource Policy Study[241] that they believed suggested the possibility of federal interference with state authority over water allocation.[242] Senator Wallop, however, recognized on the floor of the Senate that "legitimate and necessary water quality considerations" could impact individual water rights.[243] In short, the purpose of the amendment, according to Senator Wallop, was "to insure that State allocation systems are not subverted, and that effects on individual rights, if any, are prompted by legitimate and necessary water quality considerations."[244]

According to the Supreme Court, section 510 together with the 1977 amendment act to "preserve the authority of each State to allocate water quantity as between users."[245] These two provisions, however, as the Court hastened to add, "do not limit the scope of water pollution controls [including minimum stream flows] that may be imposed on users who have obtained" a water allocation under state law.[246]

The federal government has a considerable stake in the management of the nation's waters. That national interest extends beyond water quality to include the impact that flows may have on water quality as well as on endangered and threatened species.[247] Moreover, the federal government operates hundreds of dams and water projects throughout the West together with hundreds of dams in the rest of the nation, not to mention countless other navigation and flood control activities.[248] In addition to those infrastructure projects, federal law often impacts water management through the federal common law of equitable

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240 Clean Water Act of 1977, Pub. L. No. 95-217, § 5(a), 91 Stat. 1567, 1575 (codified at CWA § 101(g), 33 U.S.C. § 1251(g)).

241 Water Resource Policy Study, 42 Fed. Reg. 36,788 (July 15, 1977).

242 *See* 123 CONG. REC. 26,762 (1977) (statement of Sen. Malcolm Wallop in introducing the amendment during the Senate consideration of the Senate committee report); 123 CONG. REC. 39,211 (1977) (statement of Sen. Malcolm Wallop during the Senate debate on the conference report).

243 123 CONG. REC. 39,212 (1977). He also stated that "[w]ater quality standards and their upgrading are legitimate and necessary under this act." *Id.* Furthermore, Senator Wallop acknowledged that section 402 and section 404 permits as well as section 208 management plans could in some cases impact individual water rights. *See id.*

244 *Id.*

245 PUD No. 1 of Jefferson Cnty. v. Wash. Dep't of Ecology, 511 U.S. 700, 720 (1994).

246 *Id.* In California v. Fed. Energy Regulatory Comm'n, 495 U.S. 490, 498 (1990), the Court interpreted somewhat similar language in the Federal Power Act and declared that "minimum stream flow requirements neither reflect nor establish 'proprietary rights'" to water.

247 *See supra* Section III(B)(4).

248 *See supra* Section III(B)(1).

apportionment, the federal navigation power, and the federal public trust doctrine.[249] Even state water law can be directly impacted through the assertion of federal reserved rights.[250]

Recognizing the federal government's significant and sometimes dominant role in water management does not gainsay the legitimate interests of state government in the allocation and management of their water resources. It does nevertheless mean that the interests of the federal government and the states are closely intertwined in this complicated and important area. And the stakes are getting higher as climate change threatens water security and water quality alike. It is long past time to recognize the significance of a long neglected directive found in section 101(g), which was enacted along with the Wallop amendment in 1977. The provision directed federal agencies to "co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce[,] and eliminate pollution in concert with programs for managing water resources."[251]

Despite this call for a more integrated approach to water management, the regulation of water quantity and water quality have remained highly compartmentalized. It is an approach that defies logic, science, and the apparent will of Congress. Most states have been reluctant to regulate water quantity in order to protect water quality.[252] Some have even forbidden the institution of any restrictions on water rights due to water quality concerns.[253] Many states do have minimum flow requirements of varying kinds; however, they are often of the flat-line minimum flow variety and limited only to particular waters.[254] While many western states have programs that can reserve some water to protect those minimum flows, they have no impact on more senior appropriations due to their relatively junior priority.[255] These programs thus cannot "provide a means of putting water back into streams that have been dewatered."[256]

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249 *See supra* notes 170–73 and accompanying text.

250 *See supra* notes 174–80 and accompanying text.

251 CWA § 101(g), 33 U.S.C. § 1251(g) (2012).

252 *See* Benson, *supra* note 11, at 214.

253 *See id.* (citing statutes to that effect in Colorado and Washington).

254 *See* DAVID M. GILLILAN & THOMAS C. BROWN, INSTREAM FLOW PROTECTION: SEEKING A BALANCE IN WESTERN WATER USE 137–43 (1997). Florida, however, is an example of a state that permits minimum flows to be calculated to reflect seasonal variations, when appropriate. *See* ROBERT W. ADLER ET AL., MODERN WATER LAW: PRIVATE PROPERTY, PUBLIC RIGHTS, AND ENVIRONMENTAL PROTECTIONS 244–45 (2013).

255 *See* CHARLES F. WILKINSON, CROSSING THE NEXT MERIDIAN: LAND, WATER, AND THE FUTURE OF THE WEST 285 (1992).

256 GILLILAN & BROWN, *supra* note 254, at 140.

Only eight states have established explicit narrative water quality criteria to protect existing uses, and even those criteria are generally vague and at times are limited to low flow conditions.[257] However, on occasion, states have used their power under section 401 of the CWA to impose flow conditions upon federal licensing activities that adversely affect water quality.[258] In one such instance, the Supreme Court upheld a state agency's use of a use designation (i.e. a designation for salmon migration, rearing, spawning, and harvesting) rather than a water quality criterion in order to impose minimum flow conditions on a hydroelectric project.[259] In another, the Supreme Court upheld a Maine section 401 certification that not only stipulated a minimum stream flow but also included fish passage requirements in the federal re-licensing of five hydroelectric dams.[260] Such state actions, nevertheless, are relatively rare.[261] Much, much more remains to be done, and it is clear that the federal government will have to play a significant role in addressing the juncture of water quality and water quantity in the face of climate change.

IV. EXPLORING SOLUTIONS FOR TWO INCREASINGLY SERIOUS PROBLEMS

A. Context

While we have made significant progress with regard to point source pollution, progress has eluded us on two fronts: nonpoint source pollution and flow modifications. Modest federal financial assistance and voluntary state programs have proven inadequate strategies for controlling nonpoint sources.[262] And the near total ceding of environmental flows to state discretion has resulted in substantial

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257 *See* REGION 4, EPA, STAKEHOLDER COMMENTS ON THE ALABAMA WATER AGENCIES WORKING GROUP REPORT 10–11 (Nov. 2012).

258 CWA § 401, 33 U.S.C. § 1341 (2012). State water quality certifications under section 401 "are essential in the scheme to preserve state authority to address the broad range of pollution . . . ." S.D. Warren Cnty. v. Me. Bd. of Envtl. Prot., 547 U.S. 370, 386 (2006).

259 PUD No. 1 of Jefferson Cnty. v. Wash. Dep't of Ecology, 511 U.S. 700, 714–23 (1994).

260 *S.D. Warren Cnty.*, 547 U.S. at 375.

261 *See* Andreen, *supra* note 155, at 260–61 (referring to instances where a state has conditioned or vetoed a federal license on water quality grounds); ROBERT W. ADLER ET AL., THE CLEAN WATER ACT: TWENTY YEARS LATER 204 (1993) (stating that section 401 authority is not often used); Debra L. Donahue, *The Untapped Power of Clean Water Act Section 401*, 23 ECOLOGY L.Q. 201, 204 (1996) (referring to section 401 as a "largely untapped fount of state authority"). The EPA, however, has attempted to demonstrate to the states how section 401 certification could be an effective tool for protecting water quality. *See, e.g.*, OFFICE OF WETLANDS, OCEANS, & WATERSHEDS, EPA, CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION: A WATER QUALITY PROTECTION TOOL FOR STATES AND TRIBES (2010).

262 *See supra* notes 19–28, 36–39, 65–145 and accompanying text.

aquatic impairment.[263] Both problems are serious and will only grow worse as climate change exacerbates nonpoint pollution and places even more stress upon flows that are necessary to meet both human and environmental needs. Legal and technical fixes can be proposed and debated. The real challenge will lie in summoning the political will that is necessary to deal with these problems in a prudent and pragmatic way.

The record demonstrates that most states have been unequal to the task of dealing effectively with either problem.[264] The record also demonstrates that well-designed federal programs—programs in which state governments have played important roles—can be remarkably effective tools for both protecting and developing our nation's water resources.[265] Unfortunately, any effort to expand the federal government's role in either area will inevitably collide with both philosophical and special interest objections.

In terms of political philosophy, the obstacles involve what some might view as aspects of state sovereignty that must be vigorously defended: namely, that the federal government must not encroach upon the state's traditional authority over land use or the allocation of water and water rights. Of course, nonpoint source controls do not prescribe permissible uses of the land but only require mitigation of environmental harm. The federal government, moreover, has long played a substantial role in both water management activities and water pollution control as it has responded to serious national problems.

Self-interest is likely the most intractable obstacle. More effective controls on nonpoint source pollution have long been opposed by agricultural, mining, and logging interests,[266] while water use interests often strongly oppose federal involvement in matters verging on water rights and water quantity.[267] The clout that these interests wield in our political system is staggering and they have been extremely effective in fending off attempts to regulate nonpoint source pollution and to come to grips with the need to establish environmental flows.

The problems, however, are too grave and too national in magnitude to continue thinking and acting in boxes—in convenient jurisdictional silos—that permit the quality and availability of our water resources to decline even further in the face of climate change. The strengths,

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263 *See supra* notes 34–35, 40, 157–58, 227–61 and accompanying text.

264 *See supra* notes 23–35, 118–19, 128–45, 252–61 and accompanying text.

265 *See* Benson, *supra* note 64, at 690.

266 *See* Linda A. Malone, *The Myths and Truths That Ended the 2000 TMDL Program*, 20 PACE ENVTL. L. REV. 63, 85–86 (2002).

267 *See* Benson, *supra* note 11, at 255.

resources, expertise, and the programs of both levels of government must be mobilized in joint enterprises to deal effectively with nonpoint source pollution and the decline of our aquatic systems due to inadequate flows. In this joint enterprise, the interests of both state and federal governments must be respected and protected. But we simply cannot afford to continue idling at a policy impasse.[268] New approaches and new strategies are needed if we are to overcome the bi-polar conflicts of the past. Perhaps the necessity of coping with climate change will provide the animus for action.

B. Nonpoint Source Pollution

When section 319 was enacted in 1987, a number of members of Congress appeared skeptical about whether a voluntary approach to controlling nonpoint source pollution could work.[269] They were prescient. Twenty-nine years later, it is clear that the "trial run," as Senator Stafford put it,[270] has failed to clean up the vast majority of our nonpoint source-impaired waters. At the current pace, it will be 700 years before even the current nonpoint source impaired waters are restored to health.[271] The time is ripe for a new approach, an approach that would include regulatory controls for those nonpoint sources that contribute to the impairment of water quality.

The 1990 Coastal Zone Act Reauthorization Amendments ("CZARA")[272] offer some valuable insights on how such a regulatory program could be developed. CZARA requires each state with an approved management plan under the Coastal Zone Management Act ("CZMA")[273] to develop a Coastal Nonpoint Pollution Control Program and submit it to EPA and the National Oceanic and Atmospheric Administration ("NOAA") for approval.[274] These coastal nonpoint source control programs must provide for the implementation of management measures that conform to guidance developed by EPA and NOAA.[275] That guidance sets forth a number of technology-based options for controlling nonpoint source pollution and gives state

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[268] *See* Adler, *supra* note 28, at 870 (referring to the lack of progress on nonpoint source pollution as an "Ongoing Policy Impasse").

[269] *See supra* notes 93–96 and accompanying text.

[270] 132 CONG. REC. 32,382 (1986).

[271] OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 13.

[272] 16 U.S.C. § 1455b (2012).

[273] *Id.* §§ 1451–1466 .

[274] *Id.* § 1455b(a)(1). The CZARA program was not intended to replace the existing state nonpoint source program but rather to update and expand upon it. *Id.* § 1455b(a)(2).

[275] *Id.* § 1455(b).

officials flexibility in choosing among them.[276] If a state fails to submit an approvable program, it is subject to the loss of a portion of its CZMA grant.[277]

The CZMA requires that state CZARA programs contain "enforceable policies and mechanisms" to implement nonpoint source management measures.[278] While "enforceable policy" is statutorily defined to mean "legally binding" laws and regulations,[279] EPA and NOAA approve voluntary or incentive-based programs in order to provide the states with more flexibility.[280] So far, all of the states participating in the CZMA program have submitted nonpoint source programs, and all have received either full or conditional approval.[281] The federal agencies have had little choice. A cut in funding would hurt water quality, and, in any case, federal funding of the program has been dwindling.[282]

As the administrative implementation of CZARA demonstrates, the forces aligned against the broad regulation of nonpoint source pollution remain strong. In order to be more politically expedient, a better approach under a revised section 319 of the CWA would be to target mandatory best management practices ("BMPs") towards nonpoint source impaired waters. Political opposition to such an approach would still be powerful, but, as Professor Jonathan Cannon has written, perhaps "less vehement" than resistance to more "generally applicable requirements."[283] Moreover, by focusing more intently upon the restoration of nonpoint source impaired waters, Congress could perhaps garner support for the program from local communities. Rather than a diffuse and opaque program applied on a national scale, the BMPs would be applied to specific bodies of water. Such a localized approach

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276 *See* OFFICE OF WATER, EPA, GUIDANCE SPECIFYING MANAGEMENT MEASURES FOR SOURCES OF NONPOINT POLLUTION IN COASTAL WATERS (Jan. 1993). The guidance manual provides options broken down by category of nonpoint source pollutant, such as Agriculture, *id.* at 2-1, Hydromodification, *id.* at 6-1, and Wetlands, Riparian Areas, and Vegetated Treatment Systems, *id.* at 7-1, among others, as well as options for monitoring and tracking techniques to better assess nonpoint source pollution, *id.* at 8-1.

277 16 U.S.C. § 1455b(c).

278 *Id.* § 1455(d)(16).

279 *Id.* § 1453(6a).

280 EPA & NAT'L OCEANIC & ATMOSPHERIC ADMIN., FINAL ADMINISTRATIVE CHANGES FOR THE COASTAL NONPOINT PROGRAM GUIDANCE 4 (Oct. 16, 1998). The agencies added, however, that voluntary or incentive-based programs must be "backed by existing state enforcement authorities" that could be used to prevent nonpoint source pollution, if necessary. *Id.*

281 HAROLD E. UPTON, CONG. RESEARCH SER., RL34339, COASTAL ZONE MANAGEMENT: BACKGROUND AND REAUTHORIZATION ISSUES 9 (2010).

282 *Id.* at 9–10.

283 Cannon, *supra* note 113, at 622.

could stir the passions of all of those citizens and groups that would love to see their favorite stream or lake restored to health.

Under a revised section 319, states would be required to establish enforceable BMPs for those nonpoint sources contributing to water quality impairment. These BMPs could be drawn from a menu of technology-based options set forth by EPA in order to give the states some flexibility in selecting the practices that are most appropriate for their state. However, EPA should not be confronted with a Hobson's choice in the event a state fails to submit a plan containing adequate, enforceable controls. The reduction or elimination of funding for nonpoint source programming are neither reasonable nor pragmatic responses to the problem. Instead, EPA should have the authority to disapprove an inadequate state plan and, if a satisfactory revision is not forthcoming, to promulgate a federal plan in its stead.

Increased and more stable federal funding is also necessary to provide small-scale farmers and other appropriate grant recipients with the wherewithal to comply with these new requirements. Further, the new requirements would have to be implemented over a period of years in order to give the newly regulated entities the time and, where appropriate, access to the funding necessary to come into compliance. A monitoring program should also be established to help ensure that the BMPs and the related financial investments are meeting their intended goals. If not, a revised plan should be submitted and implemented—a process in keeping with an adaptive approach to such complex problems.

Prying more funding out of Congress will not be an easy task, but additional funding is absolutely necessary to help defuse opposition from the nonpoint source community and enlist at least grudging support from the pragmatists in that community. The problem, moreover, is already severe—more than 40,000 waters are currently impaired primarily by nonpoint sources[284]—and the situation will only deteriorate as more intense rainfall events associated with climate change produce more polluted runoff and more wildfires caused by higher temperatures and dryer conditions produce more erosion. Although EPA funding of the section 319 should certainly be increased, some additional financial support could possibly come from collaboration with other government bodies. Improved targeting of the funding given to the U.S. Department of Agriculture ("USDA") for its various conservation programs could do much to reduce nonpoint source impairment. In short, Congress could make expenditures to

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[284] OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 13.

support the implementation of these BMPs a priority,[285] as well as requiring more cooperation between USDA, EPA, and the respective state agencies with respect to grant decisions, monitoring and reporting.

This could be coupled with a broader USDA program to assist farmers in adapting to climate change. As Robert Adler has recounted, climate change will affect almost all agricultural producers.[286] Some will face increased drought and water scarcity.[287] Others will confront losses from increased flooding and heightened levels of erosion.[288] Higher temperatures will adversely affect crop yields as well as the viability of livestock production at least in some regions.[289] And more heavily polluted waters from more intense precipitation can negatively impact economic productivity in many ways. Agriculture, especially irrigated agriculture, is not immune to these adverse effects.[290] Perhaps a new initiative aimed at helping American agriculture adjust to climate change (for example, by utilizing more efficient forms of irrigation,[291] shifting to less-water intensive crops, utilizing low-till or no-till cropping to retain moisture, and improving the efficiency of fertilizer and pesticide usage to reduce water pollution)[292] could be combined with a more rigorous approach to addressing nonpoint source problems. Of course, the enactment of any such grand bargain would depend upon a successful navigation of the jealously guarded silos of committee jurisdiction that exist on Capitol Hill.[293]

The new approach to section 319 should be coupled with revisions to the TMDL provisions in the CWA, requiring that load allocations developed for specific nonpoint sources be implemented and enforced under the new section 319 regulatory program.

The new section 319 regulatory program should not end the efforts of our states to mitigate nonpoint source pollution on non-impaired

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285 *See* Cannon, *supra* note 113, at 628 (suggesting that USDA conservation payments for water quality measures be directed at nonpoint source impaired waters).

286 Adler, *supra* note 28, at 874.

287 *See id.*

288 *See id.* at 875.

289 *See id.*

290 *See id.* at 876.

291 Although the number of irrigated acres using sprinkler and micro-irrigation systems has grown, 44% of irrigated acreage still relies upon surface (flood) systems. *See* JOAN F. KENNY ET AL., U.S. DEP'T OF INTERIOR & U.S. GEOLOGICAL SURVEY, ESTIMATED USE OF WATER IN THE UNITED STATES IN 2005, at 1 (2009).

292 *See* Adler, *supra* note 28, at 879.

293 *See* E. SCOTT ADLER & JOHN D. WILKERSON, CONGRESS AND THE POLITICS OF PROBLEM SOLVING 92–93 (2013); GEORGE GOODWIN, THE LITTLE LEGISLATURES: COMMITTEES OF CONGRESS 33–35, 45 (1970); David C. King, *The Nature of Congressional Committee Jurisdiction*, 88 AM. POL. SCI. REV. 48, 48, 59 (Mar. 1994).

waters.[294] Those programs help prevent additional degradation of our nation's waters, and they promote some progress towards the CWA's goal of eliminating the discharge of pollutants to the nation's waters.[295] Therefore, the scope of an amended section 319 should include a requirement that the states submit programs providing for either regulatory or voluntary programs for implementing BMPs on waters that have not been impaired by nonpoint source pollution. Ideally, these BMPs would be drawn from EPA's list of technology-based options, supplemented with education, training, technical and financial assistance, and demonstration projects. These programs should also be subject to EPA review, and if approved, eligible for continued section 319 funding. While a large share of federal funding should be aimed at the restoration of impaired waters, the states have long depended upon federal funding of their overall section 319 programs and that funding should continue, albeit in an enhanced form.

C. Environmental Flows

Although EPA has at times encouraged states to bridge the divide between water quality and water quantity, it has done little more than exhort states to act.[296] The agency's reluctance to tackle the problem more forcefully is likely due, at least in part, to the passage of the Wallop Amendment in 1977.[297] The amendment explicitly stated that nothing in the CWA, as a matter of policy, was to be construed to impair traditional state authority over the allocation of water.[298] The impetus for the amendment was not related to anything that EPA was doing or the fact that inadequate flows could be considered a threat to water quality. Congress, in fact, had previously indicated that pollution, the artificial alteration of the biological or physical integrity of water,[299] could result from changes in stream flow.[300] Instead, in passing the Wallop Amendment, Congress was reacting to hastily prepared and poorly vetted issue papers from the National Water Council that many

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294 Many if not all state programs cover activities in more than just those waters that are impaired in whole or in part due to nonpoint source pollution. *See* OFFICE OF WETLANDS, OCEANS & WATERSHEDS, EPA, *supra* note 22, at 33–86.

295 These broad, statewide programs and initiatives "play a key role" in both increasing the understanding of nonpoint source pollution and reducing its impact. *Id.* at 65; *see also id.* at 65–86 (describing many such programs and initiatives). The current section 319 program serves to support those state efforts through start up financing as well as ongoing financial assistance. *See id.* at 27–28, 65.

296 *See* Benson, *supra* note 11, at 204; *see also supra* note 33 and accompanying text.

297 *See supra* notes 239–44 and accompanying text.

298 CWA § 101(g), 33 U.S.C. § 1251(g) (2012).

299 *Id.* § 502(19), 33 U.S.C. § 1362(19).

300 *Id.* § 304(f), 33 U.S.C. § 1314(f).

interpreted as a broad federal attack on state water law. This belief carried through in the Wallop Amendment, despite the protection already afforded those systems by virtue of CWA section 510.[301]

Senator Wallop confirmed that the amendment was, in effect, just a reiteration as well as a clarification of existing statutory language aimed at preserving the authority of each state to allocate water among various users.[302] He explained that the amendment was aimed squarely at some of the over-reaching options developed by the National Resources Council and was not designed to obstruct the protection of either water quality or wetlands, even when those efforts might affect water usage in some way.[303] Moreover, the Supreme Court read section 510 and the Wallop amendment in the same way; namely, that these provisions do not limit the scope of legitimate pollution controls, including the setting of minimum stream flows, despite the fact that water quantity is involved.[304]

EPA could therefore lawfully require state agencies to set water quality criteria for environmental flows, since appropriate timing and quantity of flows are necessary to sustain the vast majority of designated uses including the protection and propagation of fish and wildlife. In fact, EPA's regulations already direct states to include in their water quality standards "criteria sufficient to protect the designated use."[305] A resource starved and politically harassed agency like EPA,[306] however, is unlikely to take such a bold step. It is particularly improbable, since these criteria cannot be enforced under the current TMDL program which is limited by statutory language restricting TMDLs to "pollutants" introduced into waters[307] rather than the broader term "pollution" that would include flow modifications.[308]

EPA could, however, continue urging the states to include flow considerations in their water quality criteria, while also taking a number of modest steps to facilitate that process. For example, the agency could

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301 *See supra* notes 201–11, 238–42 and accompanying text. Many members were also nursing resentment about the possible cancellation of a number of western water projects. *See supra* notes 205, 211 and accompanying text.

302 123 CONG. REC. 39,212 (1977) (declaring that this amendment "is not intended to change present law, for a similar prohibition is contained in section 510 of the Act . . . . [rather it seeks] to clarify the policy of Congress concerning the proper role of Federal water quality legislation in relation to State water law").

303 *Id.* at 39,211–12.

304 *See* PUD No. 1 of Jefferson Cnty. v. Wash. Dep't of Ecology, 511 U.S. 700, 720 (1994); *see also* Benson, *supra* note 11, at 212 (observing that the Court rejected arguments that these two sections precluded CWA regulation of water quantity).

305 *See* 40 C.F.R. § 131.6 (2015).

306 *See* Andreen, *supra* note 3, at 31–34

307 CWA § 303(d)(1)(C), 33 U.S.C. § 1313(d)(1)(C) (2012).

308 *See supra* notes 226–32 and accompanying text.

provide the states with information on various methods for determining appropriate flows[309] and guidance on methods or measures for addressing flow impairment.[310] EPA could also make flow impairment a priority for restoration activities under the nonpoint source program in section 319.[311]

Ultimately, however, Congress will have to act, just as it will have to act in order to invigorate the nonpoint source program—assuming, of course, that the nation will one day emerge from the dysfunctional gridlock that has gripped Congress for much of the past quarter century.[312] Hopefully, many of the states will also act, because any initiative to deal with flows will, in the final analysis, have to be implemented primarily through their systems for allocating water.[313] Flow, after all, lies at the confluence of water quality and water management.

The obstacles to any comprehensive approach are obvious but perhaps not insurmountable. Flow problems are already a serious matter in the West. Many Western rivers and streams are already over-allocated,[314] and climate change will only aggravate these problems, particularly in the Southwestern states.[315] All regions in the country, moreover, will likely experience longer dry periods, and most areas will likely suffer through more short-term droughts.[316] Higher temperatures mean increased water use and consumption, much of which will go to meet the needs of irrigated agriculture.[317] In short, the vulnerability of our water supply to shortage is growing, and the threat of serious economic dislocations and more acute environmental degradation is growing with it.[318] The increasing likelihood of severe water shortages is

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309 See CWA § 304(a)(2)(a), 33 U.S.C. § 1314(a)(2)(a).

310 *See id.* § 304(f)(2)(F), 33 U.S.C. § 1314(f)(2)(F).

311 For an excellent discussion of these steps and additional ones that EPA could take, as well as measures that the states could take, see Benson, *supra* note 11, at 257–65.

312 *See* CHRISTOPHER MCGRORY KLYZA & DAVID J. SOUSA, AMERICAN ENVIRONMENTAL POLICY: BEYOND GRIDLOCK 1–2 (2013).

313 State water quality criteria dealing with flows, however, could be applied to federal licensing actions such as Army Corps of Engineers permits under CWA section 404 and Federal Energy Regulatory Commission licenses for hydroelectric projects under the authority that states possess pursuant to the water quality certification requirements of CWA section 401. *See* CWA § 401, 33 U.S.C. § 1341.

314 *See* Benson, *supra* note 64, at 688.

315 *See supra* notes 49–58 and accompanying text.

316 *See supra* note 51 and accompanying text.

317 *See supra* notes 54–56 and accompanying text.

318 *See supra* note 57 and accompanying text. Irrigated agriculture currently accounts for approximately 80 percent of the nation's consumptive water use and more than 90 percent in many Western states. *See Irrigation & Water Use*, ECON. RES. SERVICE, U.S. DEP'T OF AGRIC., http://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use.aspx (last visited Dec. 2, 2015).

not limited to the American West, as the amount of land devoted to irrigated agriculture is projected to rise substantially in the East, particularly the Southeast. The resulting increase in water consumption may well place serious strains on in-stream flows in many Eastern streams.[319]

Action is becoming imperative. If Congress were willing to act it has many tools at its disposal, such as strengthening the CWA to deal with environmental flows, supplying federal financial assistance to assist the states in establishing and maintaining adequate flows, and also providing the financial wherewithal to help meet the challenges posed by climate change.

With respect to designing the CWA to better deal with flows, Congress could

- explicitly find that environmental flows are a necessary ingredient of water quality criteria;
- require EPA to provide the states with information on various methods for determining appropriate, variable flows as well as guidance both on methods for expressing flow criteria and on measures for addressing flow impairment;
- provide additional funding to enable the states to undertake the research and analysis that will be necessary to set flows reflecting natural variations in stream levels as well as the subsequent monitoring to fine-tune the flows in an adaptive manner;
- require states to place flow-impaired waters on their TMDL lists;
- extend TMDLs to include "pollution" rather than just "pollutants" or at least encourage states to consider flow restoration in developing TMDLs for their pollutant-impaired streams;
- make flow impairment a priority under the section 319 nonpoint source program;
- require all federally-owned or operated hydromodifications, including dams and water diversions, to comply with state instream flow criteria; and
- require all federally licensed dams to comply with state instream flow criteria as a condition of either initial licensing or the issuance of a renewal license.

That, of course, is quite a "wish list," but reforms of this nature might well be a more realistic approach if coupled with a broader agenda that

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[319] *See supra* notes 59–61 and accompanying text.

would also provide federal funding for a variety of water resource-related projects that would enable the nation to better cope with the effects of climate change.[320]

Such funding could be directed towards a number of different projects including

- projects designed to address severe water shortages in the American West and elsewhere;
- projects intended to assist water supply authorities reduce leakage from their systems and to encourage their customers to use water more efficiently;
- large-scale stream and aquatic restoration projects that exceed the scope of funding available under an enhanced section 319 program;
- assistance to state governments to assist them in purchasing water rights for flow restoration and perhaps similar assistance for Eastern states that utilize a form of regulated riparianism;[321]
- projects designed to reduce flooding through the targeted acquisition, restoration, and protection of wetlands and floodplains; and
- additional funding to assist communities deal with the threats to their water infrastructure, including increases in sewage overflows[322] and heightened stormwater flows, both of which will be generated by more intense precipitation events.[323]

That, of course, is not an exhaustive list of possible adaptation projects. What is crucial, however, is for Congress to recognize the gravity of the challenge facing the nation. Additional water management funding is necessary to meet federal objectives and state needs in the face of climate change. The provision of substantial federal funding, in terms of both financial assistance and incentives, will go a long way towards sealing a grand new bargain on water policy in the United States.[324]

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320 *See* Benson, *supra* note 64, at 713 (arguing that climate change and population growth may combine over time and thus build pressure "for greater federal investment—and hence involvement—in water solutions").

321 Over half of the Eastern states have adopted permitting programs that are commonly referred to as regulated riparianism. *See* ADLER ET AL., *supra* note 254, at 244–46.

322 Many of our publicly owned wastewater treatment systems already suffer from sewage overflows during rainfall events. *See* Andreen, *supra* note 3, at 32.

323 *See* U.S. GLOBAL CHANGE RES. PROGRAM, *supra* note 42, at 89.

324 *See* Benson, *supra* note 64, at 712–17 (proposing a new federal water policy for the American West—including significant federal expenditures—to address over-allocation issues in the West that will only grow worse in the face of climate change).

Finally, Congress should act promptly to address what the GAO has described as the "dearth of data related to water availability and use" in this country.[325] There has been no comprehensive assessment of water availability, water use, and critical water problems in this country since 1978.[326] The Water Resources Council, which produced that assessment, has not been funded since the early 1980s.[327] This omission must be corrected either by funding the Council or by detailing a group of agencies to do the work. We simply must have a firmer grasp on the ability of our ground and surface water resources to meet future requirements, as climate change acts to constrict the availability of those resources. A more comprehensive data base would certainly aid the efforts of Congress, our state and local governments, as well as water managers at all levels of government to design effective adaptive strategies for the future.

V. CONCLUSION

Progress towards achieving the CWA's goals of restoring and maintaining "the chemical, physical, and biological integrity of the nation's waters" has stalled largely because we have failed to control nonpoint source pollution and to ensure that our waters receive the environmental flows that are necessary to sustain their aquatic ecosystems. Both problems will only grow increasingly dire as climate change produces more polluted runoff all across the nation and places severe stress upon the adequacy of water supplies and stream flows in much of the nation. However, solutions can be crafted, and this article has suggested a number of possible approaches. Many objections will be raised in an effort to halt the enactment of broad new strategies for tackling both problems, but perhaps necessity will eventually prove a source of wisdom.

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325 U.S. GOV'T ACCOUNTABILITY OFFICE, *supra* note 156, at 17.

326 *See id.*

327 *See supra* notes 187–89, 217 and accompanying text.