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I. Introduction

A river is more than an amenity, it is a treasure.[1]

In October 2002, the United States observed the thirtieth anniversary of one of the most ambitious statutes ever enacted—the Federal Water Pollution Control Act Amendments of 1972,[2] better known as the Clean Water Act. The Act stands as a monument to those who believed and continue to believe that government, particularly the federal government—when given adequate resources and the proper tools—can successfully address major environmental problems. The Act's provisions, however, also reveal a more skeptical view of government stemming from a perception that administrative agencies are prone to capture by the regulated community.[3] The Clean Water Act tries to counter this perception and thus contains a series of mandatory duties, regulatory schedules,

1. New Jersey v. New York, 283 U.S. 336, 342 (1931) (Holmes, J.).

2. Pub. L. No. 92-500, 86 Stat. 816 (codified as amended at 33 U.S.C. §§ 1251-1376 (2000)).

3. *See generally* Martin Shapiro, Who Guards the Guardians? Judicial Control of Administration 65-67 (1988) (discussing the development of the capture theory); Robert V. Percival, *Checks without Balance: Executive Office Oversight of the Environmental Protection Agency*, 54 Law & Contemp. Probs. 127, 190 (1991) (stating that environmentalists had

and deadlines that limit administrative discretion. Furthermore, the Act contains a citizen suit provision that offers the public an opportunity both to compel the government to perform its duties, and to sue polluters should the government fail to enforce the requirements of the Act.[4]

The Clean Water Act gave birth to a huge regulatory and public works effort that continues to this day. Its regulatory program and provisions granting financial assistance for the construction of municipal treatment facilities have succeeded in significantly reducing the direct discharge of pollutants to the nation's rivers and lakes.[5] As a result, water quality in many areas has greatly improved.[6]

However, problems remain. For instance, permit compliance is often inconsistent,[7] and too many municipal systems discharge raw

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long believed that mission-oriented agencies had become "the captives of business interests").

4. *See* William L. Andreen, *The Evolving Law of Environmental Protection in the United States: 1970-1991*, 9 ENVTL. & PLAN. L.J. 96, 98-100 (1992) [hereinafter Andreen, *Envtl. Prot. in the U.S.*].

5. Between 1973 and 1987, for example, the amount of oxygen-consuming organic material directly discharged by industry fell 93%. *See* U.S. ENVTL. PROT. AGENCY, OFFICE OF POLICY, PLANNING, AND EVALUATION, ENVIRONMENTAL INVESTMENTS: THE COST OF A CLEAN ENVIRONMENT: A SUMMARY REPORT TO CONGRESS 5-4 to 5-5 (Dec. 1990). Much of this decline was due to the fact that many companies have chosen to divert wastewater to municipal treatment facilities rather than build their own treatment capacity. Industry, in fact, directs approximately 73% of its organic waste to publicly owned treatment plants. *See id.* Despite an increase of 35% in the amount of organic material sent to municipal treatment facilities between 1972 and 1996, these municipal plants have succeeded in reducing their discharge of organic material by 43%. *See* Andrew Stoddard et al., Progress in Water Quality: An Evaluation of the Environmental and Economic Benefits of the 1972 Clean Water Act, *in* PROCEEDINGS OF THE WATER ENVIRONMENT FEDERATION 83 (May 3-6, 1998, Denver).

6. Analyzing records aggregated over five-year periods from 1961-1965 and 1986-1990 for dissolved oxygen levels, a recent study found that "dramatic improvements" had occurred at many locations in the Northeast and Midwest. Stoddard et al., *supra* note 5, at 84. The greatest improvements were found in such places as the Lower Susquehanna, the Cuyahoga, the Lower Fox River in Wisconsin, and the Lower Spokane River in Washington. Moreover, the study found "significant improvement" in dissolved oxygen levels in eight of the eleven major river basins in the Midwest, Southeast, West Coast, and Middle Atlantic states. *Id.* at 85. *See also* Debra S. Knopman & Richard A. Smith, *20 Years of the Clean Water Act*, 35 ENV'T 16, 34 (1993) (discussing studies that revealed significant improvement in phosphorus and fecal coliform bacteria concentrations between 1974 and 1989).

7. From 1992-1994, 18-27% of major dischargers—industrial as well as municipal plants—were in significant noncompliance with the discharge limits in their water pollution permits, and the actual number could be twice as high. GEN. ACCOUNTING OFFICE, MANY VIOLATIONS HAVE NOT RECEIVED APPROPRIATE ENFORCEMENT ATTENTION 1-2, 4 (1996). A polluter is deemed to be in "significant noncompliance" by the U.S. Environmental Protection Agency (EPA) whenever its discharge of toxic pollutants exceeds the average monthly permit limit by 20% or more in any two months of a six-month period or whenever its discharge of other pollutants (known as conventional pollutants) exceeds the average monthly limit by 40% or more in any two months of a six-month period. *Id.* at 3.

sewage whenever it rains.[8] Too many streams and lakes continue to fail to meet water quality standards.[9] Most noticeably, the Act has never taken adequate aim at what has become the most significant source of water pollution in the country: non-point source pollution—the indirect discharge of polluted runoff from agricultural fields, parking lots, mining operations, forest clear cuts, construction sites, and livestock operations.[10]

Despite the progress it has achieved, the Clean Water Act has been the target of a great deal of criticism. Some scholars have contended that the regulatory approach of command-and-control statutes[11] like the Clean Water Act is unnecessarily rigid, expensive and inefficient.[12] Other scholars have criticized the way in which the Clean Water Act and similar statutes "centralized" pollution

8. Hundreds of municipal systems are plagued by sanitary sewer overflows that are releases of raw sewage from a collection system before the waste reaches the treatment plant. The overflows commonly result from the infiltration and inflow of large amounts of storm water that overwhelm the capacity of the existing sewer lines or the treatment plant or both. *See* U.S. ENVTL. PROT. AGENCY, 1996 CLEAN WATER NEEDS SURVEY, REPORT TO CONGRESS 7 (1997). Another problem is posed by the overflows that result from 1,100 older municipal systems, primarily in the Northeast and Midwest, that collect their sanitary sewage and storm water runoff in combined sewer systems. *See* NATURAL RESOURCES DEFENSE COUNCIL, WHEN IT RAINS . . . IT POLLUTES: A SURVEY OF RAW SEWAGE POLLUTION IN 14 U.S. CITIES (April 1992).

9. Out of a total of 16.8 million acres of lakes surveyed in 1996, 39% were impaired due to pollution or habitat degradation, and out of nearly 700,000 miles of surveyed rivers and streams, 36% failed to fully support their water quality classification. U.S. ENVTL PROT. AGENCY, OFFICE OF WATER, NATIONAL WATER QUALITY INVENTORY, 1996 REPORT TO CONGRESS 30, 47-48 (1998) [hereinafter 1996 NATIONAL WATER QUALITY INVENTORY].

10. *See id.* at 421; NANCY RICHARDSON HANSEN, HOPE M. BABCOCK & EDWIN H. CLARK II, CONTROLLING NONPOINT-SOURCE WATER POLLUTION 17-23 (1988); Daniel R. Mandelker, *Controlling Nonpoint Source Water Pollution: Can It Be Done?*, 65 CHI.-KENT. L. REV. 479 (1989). Other sources of nonpoint source pollution include seepage from septic tanks and the deposition of airborne pollutants such as nitrogen and acid precipitation. *See* 1996 NATIONAL WATER QUALITY INVENTORY, *supra* note 9, at 421.

11. Command-and-control regulatory statutes typically enforce uniform standards—often derived from the use of a particular kind of treatment technology—through a permit system. *See* Robert W. Hahn & Robert N. Stavins, *Incentive-Based Environmental Regulations: A New Era From an Old Idea?,* 18 ECOLOGY L.Q. 1, 5 (1991). Critics of the approach often intend to use the term in a pejorative manner. The design of the Clean Water Act is not exclusively command-and-control-oriented since permit conditions, otherwise based on technology-driven limitations, must be tightened when required to meet water quality standards. *See* EPA v. California *ex rel.* State Water Resources Control Bd., 426 U.S. 200, 205 n.12 (1976); Jeffrey M. Gaba, *Federal Supervision of State Water Quality Standards Under the Clean Water Act,* 36 VAND. L. REV. 1167, 1169-70 (1983).

12. *See, e.g.*, Eric W. Orts, *Reflexive Environmental Law*, 89 NW. U. L. REV. 1227, 1236-64 (1995); Cass R. Sunstein, *Paradoxes of the Regulatory State*, 57 U. CHI. L. REV. 407, 420-21 (1990); Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333, 1334-40 (1985).

control in the United States by transferring the primary authority for policy creation and standard setting to the federal government, while leaving, for the most part, the more mundane implementation and enforcement responsibilities to state governments.[13] Many politicians, business leaders, and state regulators have echoed these critiques and advocated for some degree of devolution in regulatory authority from the "Beltway" and the U.S. Environmental Protection Agency (EPA) to the states.[14] This critical climate was also reflected to some extent in the Clinton administration's efforts at "regulatory reinvention"[15] and the efforts of a number of academics, think tanks and industry groups to "rethink" environmental policy.[16]

Today, the Bush Administration continues to develop a number of Clinton-era initiatives, such as Project XL[17] and water quality

13. *See, e.g.,* Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority,* 14 YALE L. & POL'Y REV. 23 (1996); James E. Krier, *On the Topology of Uniform Environmental Standards in a Federal System—and Why It Matters*, 54 MD. L. REV. 1226 (1995); Richard L. Revesz, *The Race to the Bottom and Federal Environmental Regulation: A Response to Critics*, 82 MINN. L. REV. 535 (1997); Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race to the Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210 (1992).

14. *See* Clifford Rechtschaffen, *Deterrence v. Cooperation and the Evolving Theory of Environmental Enforcement*, 71 S. CAL. L. REV. 1181, 1182-87 (1998); Robert V. Percival, *Regulatory Evolution and the Future of Environmental Policy,* 1997 U. CHI. LEGAL F. 159, 167-70; Barry G. Rabe, *Power to the States: The Promise and Pitfalls of Decentralization, in* ENVIRONMENTAL POLICY 32, 47-51 (Norman J. Vig & Michael E. Kraft eds., 3d ed. 1997).

15. Although not as broad or as far-reaching as the Republican efforts, the reinvention projects at EPA during the Clinton years stressed such things as increased regulatory flexibility, compliance assistance, and new ways of assessing the vitality of the government enforcement program. *See* U.S. ENVTL. PROT. AGENCY, OFFICE OF REINVENTION, THE CHANGING NATURE OF ENVIRONMENTAL AND PUBLIC HEALTH PROTECTION: AN ANNUAL REPORT ON REINVENTION 2-4, 30 (1998); Walter A. Rosenbaum, *Escaping the "Battered Agency Syndrome": EPA's Gamble with Regulatory Reinvention*, *in* ENVIRONMENTAL POLICY, *supra* note 14, at 165, 176-81. Under Project XL, for example, the EPA allowed companies "to develop their own site-specific plans for achieving environmental benefits in exchange for exemptions from existing and future command and control requirements." Rena I. Steinzor, *Reinventing Environmental Regulation: The Dangerous Journey from Command to Self-Control*, 22 HARV. ENVTL. L. REV. 103, 122 (1998).

16. *See, e.g.*, NAT'L ACAD. PUB. ADMIN., SETTING PRIORITIES, GETTING RESULTS: A NEW DIRECTION FOR EPA (1995); WILLIAM D. RUCKELSHAUS & KARL HAUSKER, ENTERPRISE FOR THE ENVIRONMENT, THE ENVIRONMENTAL PROTECTION SYSTEM IN TRANSITION: TOWARD A MORE DESIRABLE FUTURE (1998); THINKING ECOLOGICALLY: THE NEXT GENERATION OF ENVIRONMENTAL POLICY (Marian R. Chertow & Daniel C. Esty eds., 1997). For a list of initiatives by groups such as the Aspen Institute and the National Environmental Policy Institute, see Percival, *supra* note 3, at 171 n.64.

17. For a brief description of Project XL, see *supra* note 15 and references cited therein.

trading,[18] that aim to move beyond command-and-control regulation by injecting more "flexibility" and lowering the costs of implementing the Clean Water Act.[19] The Bush Administration has also supported the movement in favor of shifting funds and responsibilities back to state governments. For the past two years, it has advocated significant cuts to the EPA's enforcement budget, while proposing a new federal grant program that supports state enforcement.[20]

This debate over the future direction of environmental policy is often conducted in largely theoretical terms involving risk assessment,[21] federalism[22] or civic republicanism,[23] or some sort of eco-

18. Under a water quality trading program, a municipal sewage plant, for example, could obtain a credit for water quality related nutrient or sediment requirements in its permit by paying a farmer to change his cropping practices and planting shrubs alongside a stream. *See Current Developments*, 33 Env't Rep. (BNA) 1106 (2002) (discussing the EPA's proposed policy for water quality trading program); *see also Current Developments*, 33 Env't Rep. (BNA) 828-31 (2002) (setting forth the text of EPA's proposed policy). Environmentalists worry, of course, that water quality trading will create loopholes and increase the "mushiness factor" in water pollution discharge permits. There is also concern about a situation where a decrease in a discharge in one portion of a waterway is used to offset an increase in a different portion of the waterway. *See Current Developments*, 33 Env't Rep. (BNA) 800, 801 (2002). As one environmentalist put it, "the devil is in the details." *Id.* at 801.

19. *See Current Developments*, 32 Env't Rep. (BNA) 499 (2001) (current EPA Administrator Christine Todd Whitman touting Project XL and the National Environment Performance Partnership System as "excellent" programs which create "incentives" and produce "positive results"); *Current Developments*, 32 Env't Rep. (BNA) 1919 (2001) (reporting on Bush-era EPA giving regulatory relief under Project XL to five sewage treatment facilities); *Current Developments*, 32 Env't Rep. (BNA) 2125 (2001) (Bush EPA putting final touches on the Performance Track incentives program launched by Clinton-era Administrator Carol Browner); *Current Developments*, 33 Env't Rep. (BNA) 1106 (Bush-era EPA seeks comments on proposed policy for water quality trading program—a program which began, in limited form, in 1996).

20. In 2001, the Bush Administration proposed cutting 270 positions in the EPA's enforcement program while also proposing to give the states $25 million in enforcement grants. Congress rejected both proposals. In 2002, the Administration went back to the drawing board and this time proposed cutting EPA's enforcement staff by 146 positions while creating a $15 million grant program to support state enforcement. *See Current Developments*, 33 Env't Rep. (BNA) 286 (2002). Apparently, the EPA's current leadership believes that the states will be the source of added enforcement. *See id.* (referring to comments by Administrator Christine Todd Whitman).

21. *See* STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION (1993); RISK V. RISK: TRADEOFFS IN PROTECTING HEALTH AND THE ENVIRONMENT (John D. Graham & Jonathan Wiener eds., 1995); Daniel C. Esty, *What's the Risk in Risk*, 13 YALE J. REG. 603 (1993).

22. *See* Richard L. Revesz, *Federalism and Environmental Regulation: A Normative Critique, in* THE NEW FEDERALISM: CAN THE STATES BE TRUSTED? 97 (John Ferejohn & Barry R. Weingast eds., 1997); Kirsten H. Engel, *State Environmental Standard-Setting: Is There a "Race" and Is It "to the Bottom"?*, 48 HASTINGS L.J. 271 (1997).

nomic analysis such as cost-benefit balancing, faith in market-based solutions,[24] or public choice theory.[25] To the extent that the history of environmental policy is explored, most of the literature focuses upon recent history—the period since 1970, the dawn of the "environmental era." American environmental policy, however, has much older roots,[26] and so does the Clean Water Act. The purpose of this article, therefore, is to provide those who are concerned about the future of the Clean Water Act with a more thorough understanding of the way in which water pollution control developed in this country over the last two centuries. By placing the Clean Water Act in broad historical context, I hope to enrich the quality of the current debate. Many lessons may be gleaned from this history, and some of what we learn may help us decide whether to and, if so, how to reform current regulatory policy. I do not mean to suggest that history or its interpretation should dictate the way in which we design regulatory programs any more than I would advocate economic efficiency as some sort of litmus test. Historical analysis, however, can yield valuable insights.

Progress, in terms of legislation or expenditures on public infrastructure, has often been driven by some sort of crisis or a series of events that thrusts an issue to the forefront of political attention. Such reactive decision-making can, at times, be short-sighted, geared to the political necessity of addressing a single, highly charged issue. Thus, it is not surprising that reform efforts occasionally cause serious new problems. For example, during the nineteenth century, many American cities constructed massive municipal water supply systems to provide their residents with clean, potable water.[27] These cities, however, generally did not spend the additional sums necessary to build sewerage systems to

23. *See* IAN AYRES & JOHN BRAITHWAITE, RESPONSIVE REGULATION: TRANSCENDING THE DEREGULATION DEBATE (1992); Mark Seidenfeld, *A Civic Republican Justification for the Bureaucratic State*, 105 HARV. L. REV. 1512 (1992); Cass R. Sunstein, *Beyond the Republican Revival*, 97 YALE L.J. 1539 (1988).

24. *See* Thomas O. McGarity, *The Expanded Debate Over the Future of the Regulatory State*, 63 U. CHI. L. REV. 1463, 1491-97 (1996).

25. *See* Daniel A. Farber & Philip P. Frickey, *The Jurisprudence of Public Choice*, 65 TEX. L. REV. 873 (1987); Richard B. Stewart, *Environmental Quality as a National Good in a Federal State*, 1997 U. CHI. LEGAL F. 199, 202-03 (1997).

26. *See* RICHARD N.L. ANDREWS, MANAGING THE ENVIRONMENT, MANAGING OURSELVES: A HISTORY OF AMERICAN ENVIRONMENTAL POLICY ix (1999).

27. *See* Stuart Galishoff, *Triumph and Failure, The American Response to the Urban Water Supply Problem, 1860-1923, in* POLLUTION AND REFORM IN AMERICAN CITIES, 1870-1930, at 35-36, 40 (Martin V. Melosi ed., 1980).

carry away the resulting wastewater.[28] A new health problem was thus created as massive amounts of sewage were deposited in the streets and backyards of the Victorian American city.[29] Eventually, this particular problem was solved in the late nineteenth and early twentieth centuries through the construction of massive sewer systems,[30] but since the wastewater was generally not treated, the health problems associated with polluted municipal wastewater were being exported to downstream communities.[31] Although Americans eventually secured safe drinking water through the use of purification technology, that advance came at the continuing expense of the rivers and lakes into which American cities poured an ever-increasing amount of untreated waste.[32]

Omissions of this sort may be due, at least in part, to insufficient relevant information or a failure to adequately analyze or credit the information that is available. Although some reformers had warned of the potential health hazards that could result from the construction of sewer systems without accompanying treatment facilities, other experts dismissed their concerns as naive.[33] Such problems may also arise from the desire to solve problems in the most cost-effective and politically expedient manner. Sanitary engineers in the late nineteenth century, for instance, generally urged large cities to build combined sewer systems—systems that both collect storm water runoff as well as wastewater—because they were cheaper than building two separate systems and appeared to present no real health risks.[34] Later, when confronted with the intolerable downstream health problems created by untreated discharges, these sanitary engineers faced a dilemma of their own creation. Because of the additional burden of dealing with storm water runoff, the combined sewers endorsed by the engineers had made sewage treatment a much more expensive option than if the cities had

28. *See* ANDREWS, *supra* note 26, at 116.

29. *See* JOEL A. TARR, THE SEARCH FOR THE ULTIMATE SINK: URBAN POLLUTION IN HISTORICAL PERSPECTIVE 10 (1966) [hereinafter TARR, URBAN POLLUTION].

30. *See* JOHN DUFFY, THE SANITARIANS: A HISTORY OF AMERICAN PUBLIC HEALTH 48, 79-91 (1990).

31. *See* Joel A. Tarr & Francis Clay McMichael, *Decisions about Wastewater Technology: 1850-1932*, 103 J. WATER RESOURCES PLAN. & MGMT. DIV., AM. SOC. CIV. ENGINEERS 55-58 (May 1977).

32. *See* Galishoff, *supra* note 27, at 53.

33. *See* TARR, URBAN POLLUTION, *supra* note 29, at 12.

34. *See* Tarr & McMichael, *supra* note 31, at 52-54. While these engineers knew that rivers loaded with sewage could present health hazards, they did not know how much waste would pose a risk nor how far downstream the risk would extend. *See id.* at 54.

built separate sanitary sewers. Although many physicians advocated sewage treatment as well as water treatment to solve the problem, sanitary engineers successfully argued that drinking water treatment alone was a more cost-effective and equitable solution.[35] Perhaps it was only a coincidence that their advice favored the short-term economic interest of their municipal clients.

Once a short-term remedy solves or appears to solve an immediate crisis, those who view the problem more broadly have found it difficult to generate public support in favor of further reform. It is true that subsequent developments vindicated the physicians who maintained in 1910 that municipal sewage should be treated. At the time, however, their cause was lost once the threat of typhoid fever receded, as it did between 1910 and 1923, due to the nearly universal adoption of drinking water purification technology.[36] In the absence of a current salient issue, the forces favoring the status quo are often unassailable.[37] It is little wonder, then, that the forces of reform in later years attempted to institutionalize their success in enacting the Clean Water Act by drafting the statute in a way that would help ensure that progress would be maintained despite the absence of headline-grabbing catastrophes.[38]

Many aspects of public opinion are cyclical in nature, including, it seems, the view of Americans on experts and the value of expertise. Early in the history of the Republic, Americans, remaining loyal to their English tradition, tended to place government in

35. *See id.* at 53-58. The medical profession believed at the time that the interest of public health would be best served if no city were allowed to discharge raw sewage. *See id.* at 57.

36. *See* Galishoff, *supra* note 27, at 51 (detailing the drop-off in typhoid death rates between the 1880s and 1923).

37. The physicians might have staked out stronger ground had they couched their argument more in terms of civic pride and general environmental degradation than solely on the basis of public health. The physicians also decided—probably because their focus was on the spread of infectious bacteria through drinking water—to virtually ignore the impact of industrial pollution. *See* TARR, URBAN POLLUTION, *supra* note 29, at 357-58.

During the 1920s, a more conservative group of public health officials joined with the sanitary engineers in advocating a gradual, "realistic, and cost-effective approach to state water quality policy that emphasized the reasonable use of streams for waste assimilation" while protecting drinking water with filtration and chlorine. Joel A. Tarr, James McCurley & Terry F. Yosie, *The Development and Impact of Urban Wastewater Technology: Changing Concepts of Water Quality Control, 1850-1930, in* POLLUTION AND REFORM IN AMERICAN CITIES, 1870-1930, 73-74 (Martin V. Melosi ed., 1980).

38. *See* Robert A. Kagen, *Trying to Have It Both Ways: Local Discretion, Central Control, and Adversarial Legalism in American Environmental Regulation*, 25 ECOLOGY L.Q. 718, 725 (1999) (discussing the desire of environmental organizations to "'lock in' hard-won policy victories" through the use of specific statutory language).

the hands of individuals of some learning and intelligence. The Jacksonian era rejected that tradition and replaced it with the philosophy that any good person could handle any job, including any government position. In the face of growing immigration in the 1840s and 1850s, many middle class Americans, concerned about corrupt urban political machines and the intelligence of the average voter, sought to place more government functions in the hands of apolitical professionals.[39] Expertise and professionalism were the watchwords of the new Progressive Movement—unbiased science and reason would lead America in the right direction.

The experts, however, often disagreed. Doctors and sanitary engineers—the "idealists" versus the "pragmatists"—differed markedly in their views about the value of sewage treatment early in the twentieth century. The sanitary engineers won that battle and eventually came to dominate the state agencies charged with water pollution control.[40] By the 1960s, however, faith in the value of expertise and the wisdom of experts began to wane as the public became aware of the environmental devastation wrought not only by water and air pollution, but also by the wholesale usage of pesticides such as DDT and the ecological disruptions caused by the exploitation of our natural resources.[41]

The sanitary engineers and the state water pollution control agencies they controlled fell out of favor for other reasons as well. For years, sanitary engineers had functioned in a relatively narrow policy community that consisted primarily of officials and engineers representing industrial and municipal interests. In such a closed community, and one in which many members viewed government regulation with alarm and suspicion, the state sanitary engineers had gained respect and some legitimacy by appearing to be reasonable and pragmatic.[42] This was not new to them. Early on they had trumpeted their practical experience and superior appreciation for economic realities in their struggle with public health doctors whom they denigrated as "sentimentalists" for rejecting the

39. *See* DUFFY, *supra* note 30, at 129-30. The Pendleton Act of 1883, which created a federal civil service based upon merit, was a product of this effort. *See id.* at 130.

40. *See* TERRENCE KEHOE, CLEANING UP THE GREAT LAKES: FROM COOPERATION TO CONFRONTATION 6, 22 (1997).

41. *See, e.g.*, LYNTON K. CALDWELL, SCIENCE AND THE NATIONAL ENVIRONMENTAL POLICY ACT: REDIRECTING POLICY THROUGH PROCEDURAL REFORM (1982) (discussing the growth of the public perception that modern scientific and technological developments often had, in addition to obvious benefits, many detrimental side-effects).

42. *See* KEHOE, *supra* note 40, at 6, 22.

concept of treatment by dilution.[43] And they continued for the next fifty years to view water pollution as a relative concept—dealing with discharges on a case-by-case basis, trying to balance the ability of a stream to assimilate waste with its current use, economic considerations, and other factors.[44] Their overall approach to regulation has been termed "cooperative pragmatism," a system "based on the principles of voluntarism and informal cooperation, administrative expertise, and localism."[45] They did their best to avoid legal confrontations.

Voluntary solutions were attractive to state agencies for a number of reasons. The agencies were generally understaffed and underfunded, and often lacked adequate enforcement authority.[46] There were also compelling political reasons to avoid confrontations with large local polluters, because those industries usually wielded a great deal of clout in the state capital.[47] When confrontations did occur, industrial interests were not reluctant to remind the governor that a particular company was the largest employer in an area or to warn the governor that a tough pollution program might drive businesses out of the state.[48] Whether or not industry would have actually left a state in pursuit of more a lenient regulatory climate[49] is not altogether relevant in this context. Industry was making what appeared to be a plausible threat, and politicians, especially state politicians who have relatively little "bacon" to deliver other than jobs and economic development, were apt to listen.[50] So a cooperative, voluntary approach was perhaps the only

43. *See* Tarr, McCurley & Yosie, *supra* note 37, at 73.

44. *See* KEHOE, *supra* note 40, at 7.

45. *Id.* at 5.

46. *See* ELIZABETH H. HASKELL & VICTORIA S. PRICE, STATE ENVIRONMENTAL MANAGEMENT: CASE STUDIES OF NINE STATES 243 (1973).

47. *See* HARVEY LIEBER, FEDERALISM AND CLEAN WATER 14 (1975); ANDREWS, *supra* note 26, at 232-33.

48. *See* KEHOE, *supra* note 40, at 37-39 (describing the political pressure and economic threats made when the Michigan Water Resources Commission tried to impose a cleanup schedule on the paper mills located along the Kalamazoo River in the early 1960s).

49. In most cases, the costs of environmental regulation alone are too small to significantly influence an industrial location or relocation decision. *See* Adam B. Jaffe et al., *Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us?*, 33 J. ECON. LIT. 132 (1995); Arik Levenson, *Environmental Regulations and Manufacturers' Location Choices: Evidence from the Census of Manufacturers*, 62 J. PUB. ECON. 5 (1996); Richard B. Stewart, *Environmental Quality as a National Good in a Federal State*, 1997 U. CHI. LEGAL F. 199, 207 (1997).

50. *See* TIMOTHY DOYLE & AYNSLEY KELLOW, ENVIRONMENTAL POLITICS AND POLICY-MAKING IN AUSTRALIA 129 (1995) (contending that such economic development issues have real salience in state capitals because state politicians lack access to most of the

practical course of action available to many of these agencies. Furthermore, their limited range of action was not considered a weakness by many agency professionals, but a virtue. In fact, it coincided nicely with their self-image as neutral, objective experts who were dedicated to cleaning up the state's waters through consensus.[51]

These agencies may not have been actually "captured" by corporate interests. Many state agencies, in fact, had made progress in abating water pollution.[52] Nevertheless, their organizational culture was markedly inconsistent with the nation's mood by the 1960s. Along with industry, they labeled the views of the growing environmental movement as simplistic and "emotional."[53] When criticized, they reacted defensively.[54] They failed to see that the public was growing weary with excuses and endless chatter; and that it wanted action. The magnitude of water pollution was becoming intolerable, and state agencies, at best, appeared too comfortable, too arrogant, too mired in the approach of a previous era. At worst, they seemed to be in much too cozy a relationship with the regulated community.[55]

When the state agencies failed to respond quickly enough, clean water activists and conservationists turned to the federal government,[56] which appeared ready and willing to help. Its water pollution program had grown steadily during the 1960s,[57] and its

macroeconomic instruments that federal politicians can use to deliver material benefits to their constituents); *see also* Kagen, *supra* note 38, at 728, 731 (explaining how the lack of revenue can cause a government to favor economic interests in a disproportionate fashion or to even fail to adequately staff a pollution control agency).

51. *See* KEHOE, *supra* note 40, at 30-32 (discussing how their limited success in abating pollution coincided with their whole approach to pollution control).

52. *See id.* at 8, 44-45 (recounting how in the years following the Second World War state agencies in the Great Lakes area had imposed some waste treatment limitations on the largest cities and industries in the region).

53. *Id.* at 9, 66. State officials were certainly not pleased by the entry of new players—such as "the conservationist, the recreationist"—into what had been a small policy community. *See, e.g.*, *id.* at 82 (quoting the head of the Illinois water pollution program in 1967). This reaction is consistent with Joseph Sax's observation that the Progressive and New Deal models of delegating policymaking to the expertise of mission-oriented agencies had failed because the experts had so supplanted the public that "[t]he public itself is thought to possess no expertise about the public." JOSEPH L. SAX, DEFENDING THE ENVIRONMENT: A STRATEGY FOR CITIZEN ACTION 60-61 (1972).

54. *See* KEHOE, *supra* note 40, at 55-56, 61, 64-65, 70.

55. *See* HASKELL & PRICE, *supra* note 46, at 244-45; LIEBER, *supra* note 47, at 14.

56. *See* KEHOE, *supra* note 40, at 44, 47, 54, 56-57. Support for strong federal action was really not new. Theodore Roosevelt, for example, had called for national legislation, as well as state legislation, to end water pollution in 1910. *See* TARR, URBAN POLLUTION, *supra* note 29, at 166.

57. *See* KEHOE, *supra* note 40, at 44, 46.

leadership had spoken firmly about the need for strong action and vigorous enforcement.[58] Expectations were changing, and the state agencies were simply overwhelmed by the changing times and circumstances. The growing blight of water pollution had, in short, offended the conscience of the nation,[59] and such a national problem[60] demanded a national solution.[61]

Calls for federal action were not new. They date back as far as the 1870s, to calls for the creation of a national board of health to help deal with various sanitation problems including sewage disposal.[62] The first attempt to enact a strong, comprehensive federal water pollution control program came not in the 1970s or 1960s, but in the midst of the New Deal.[63] That effort failed, and all Congress managed to accomplish before 1972 was to pass a series of largely ineffectual measures. Confronted in the early 1970s with severely degraded water quality and a failed federal response, Congress opted for an entirely new approach—one, however, that reflected many of the so-called lessons of history.

58. *See id.* at 9-10, 43-48, 178-80. Interest in "quality of life" issues such as health care, education, and conservation was rapidly growing on Capitol Hill and in the White House during the 1960s and early 1970s. *See id.* at 46-48. Calls for increased federal involvement in water pollution control, therefore, fell on many receptive ears.

59. *See* KIRKPATRICK SALE, THE GREEN REVOLUTION: THE AMERICAN ENVIRONMENTAL MOVEMENT, 1962-1992, at 18-19 (1993).

60. *See* Stewart, *supra* note 49, at 210 (commenting on the way Americans regard environmental protection "as an important national good that transcends individual or local interest"); *see also, e.g.,* 111 CONG. REC. 1519 (1965) (remarks of Sen. Muskie) (noting that water pollution "is not only a State and local problem, but a national problem"); *Id.* at 1544 (remarks of Sen. Dodd) (stating "we now recognize water pollution as a serious national problem"); *Id.* at 8653 (remarks of Rep. Madden) (noting that water pollution "involves the health and welfare of every citizen in the United States"); *Id.* at 8670 (remarks of Rep. Ottinger) (referring to the "fight to end pollution of the Nation's waterways"); *Id.* at 8671 (remarks of Rep. Wright) (remarking that "thousands of local crises are merging rapidly into one national crisis); *Id.* at 8674 (remarks of Rep. Wolff) (referring to "our aroused concern for protecting and improving the quality of the Nation's precious water resources"); *Id.* at 8675 (remarks of Rep. Monagan) (stating that "water pollution is a problem which affects every community and every State in the Nation").

61. The rise of federal dominance in this area certainly benefited environmental groups in a number of ways. Normally plagued by limited resources—an infirmity not shared by industrial interests—environmental organizations have found the federal government a much more efficient target for lobbying and litigation purposes than dealing with fifty state governments. *See* Daniel C. Espy, *Revitalizing Environmental Federalism*, 95 MICH. L. REV. 570, 650-51 (1996); Kagen, *supra* note 38, at 723. A more decentralized regulatory system—in which the federal government now also played a significant role—also benefited environmental interests by creating more accountability and more access points for advocacy. *See* KEHOE, *supra* note 40, at 111; Kagen, *supra* note 38, at 728.

62. *See* DUFFY, *supra* note 30, at 162-68.

63. *See, e.g.*, S. 3958, 74th Cong., 2d. Sess. (1936).

Frustrated by years of trying but failing to establish an effective regulatory program based on a complex and largely decentralized system of ambient water quality standards, Congress created a program requiring polluters to comply with uniform technology-based limitations. This program mandates the same level of treatment for every discharger in a particular industrial category regardless of what state a discharge is located in, a state's use classification for a particular stream, the volume of water in the stream, or the presence or absence of other polluters discharging the same or similar substances.[64] This change in strategy was crucial if water pollution was actually going to be tackled effectively within a reasonably prompt period of time since the implementation of water quality standards was fraught with so many technical and policy problems. This realization was not entirely original. The Pennsylvania program, in fact, had used the same efficiency argument to justify the adoption of a more rudimentary system of uniform effluent limitations in the mid-1940s.[65] Congress, however, was beginning to cobble together a number of lessons from the past in an effort to chart a more comprehensive and realistic approach to pollution control.

Another major weakness in the past lay in the area of enforcement. Federal and state efforts to exact compliance with water pollution control objectives had languished for years.[66] To facilitate enforcement and implement the new system of effluent limitations, as well as any more stringent conditions necessary to meet water quality standards, Congress established a permit system through which precise requirements would be set for individual dischargers. The permit defines compliance for the discharger and thus eases the task of government enforcement because enforcement would no longer be limited to the relatively few instances where the government could demonstrate that a particular polluter was responsible for a particular violation of water quality standards.[67] Again, Congress did not invent the mechanism. Many states had already developed permit schemes, although they were

64. *See* William L. Andreen, *Beyond Words of Exhortation: The Congressional Prescription for Vigorous Federal Enforcement of the Clean Water Act*, 55 GEO. WASH. L. REV. 202, 216 (1987) [hereinafter Andreen, *Clean Water Act Enforcement*].

65. *See* F.B. Milligan, *Discussion of Industrial Wastes*, 20 SEWAGE WORKS J. 278, 279-80 (1948).

66. *See* NATIONAL COMMISSION ON WATER QUALITY, STAFF REPORT V-29 (April 1976); Andreen, *Clean Water Act Enforcement*, *supra* note 64, at 203, 214 n.78.

67. *See* Andreen, *Clean Water Act Enforcement*, *supra* note 64, at 216-17.

generally limited to new discharges,[68] and the federal government in the early 1970s was trying to develop an industrial permit program for the 1899 Refuse Act.[69] What was unique about the Clean Water Act was not the concept, but its extension to all point source discharges, be they existing, new, municipal, or industrial.

Congress also thought there had been too much talk about pollution control and not enough action. The Act, therefore, is replete with detailed instructions, mandatory duties, and deadlines designed to spur the bureaucracy into taking strong action.[70] The concern that agencies had been too lethargic at times, too cozy with the regulated community and too stubbornly committed to pragmatic cooperation was again not new, but Congress took pains to try to create a scheme that would help ensure that the EPA would act and continue to act vigorously and effectively.[71]

The authors of the Clean Water Act had thus built upon the experience of decades of state, local, and federal efforts to control water pollution. Those earlier efforts were too often flawed because the problems were too narrowly defined and, as a consequence, the solutions too narrowly structured. Progress in the fight against water pollution, therefore, came in a series of fits and starts as the United States muddled through, using a process of trial and error and trying not to drastically increase expenditures or antagonize powerful interests. The authors of the Clean Water Act were fortunately able to take a broader view, crafting a more comprehensive and longer-range approach because they were building upon past achievements and learning from past failures. The breadth of their perspective contributed in no small measure to the strength and enduring quality of the regulatory approach found in the Act. As the nation considers how to amend the Act in the future, it would be wise to consult the history that helped shape the Act.

The purpose of this Article, however, is not to discuss the future direction of the Clean Water Act, but to set forth a detailed account of how water pollution control evolved in the United States. This account will be found in both these pages and in a subsequent installment that will appear in the June 2003 issue of the *Stanford Environmental Law Journal*. The first segment of the article begins

68. *See* N. William Hines, *Nor Any Drop to Drink: Public Regulation of Water Quality Part I: State Pollution Control Programs*, 52 IOWA L. REV. 186, 227 (1966) [hereinafter Hines, *Part I*].

69. *See* William H. Rodgers, Jr., *Industrial Water Pollution and the Refuse Act: A Second Chance for Water Quality*, 119 U. PA. L. REV. 761, 769 (1971).

70. *See* Andreen, *Envtl. Prot. in the U.S.*, *supra* note 4, at 98-100.

71. *See supra* notes 42-55 and accompanying text.

with an exploration of the way in which water pollution evolved from a relatively simple and exclusively local issue in the early years of the Republic into a complex state and regional problem by 1920. It then examines the development of state regulation from 1869 to 1972—an account that covers, among other things, the evolution of state agencies, innovations such as water quality standards and uniform effluent limitations, as well as the shortcomings of state regulatory efforts. The second installment will continue by turning to the long and surprisingly fascinating story of federal action between 1879 and 1972, including the serious, but largely forgotten, attempts during the New Deal to create a strong federal regulatory program based on a watershed management approach. Part II will conclude with an extensive look at the legislative history of the 1972 Clean Water Act.

I intend to complete this history of water pollution regulation in two future articles, the first of which will discuss the implementation of the Clean Water Act after 1972 and the second of which will evaluate the success of the regulatory scheme created by the Clean Water Act.

II. A Crisis in the Making: Water Pollution in America from Colonial Times to 1920

The temptation to cast into the moving water every form of portable refuse and filth, to be borne out of sight, is too great to be resisted.[72]

Water pollution is not a uniquely urban problem.[73] Humans can be sickened anywhere by drinking contaminated water, and such illnesses have occurred in both rural and urban areas for thousands of years. In the American colonies, however, the abundance of land and water and the relatively small size of cities[74] miti-

72. William Ripley Nichols & George Derby, *Sewerage: The Pollution of Streams: The Water-Supply of Towns*, *in* FOURTH ANNUAL REPORT OF THE MASSACHUSETTS STATE BOARD OF HEALTH 40 (1873).

73. *See* THEODORE STEINBERG, NATURE INCORPORATED: INDUSTRIALIZATION AND THE WATERS OF NEW ENGLAND 222 (1991) (recounting how "water supplies could become contaminated even in relatively unpopulated regions") [hereinafter STEINBERG, NATURE INCORPORATED]; DUFFY, *supra* note 30, at 64 (stating that dysentery, typhoid, and other enteric illness were prevalent in all areas of the United States, especially in the summer months, during the early 1800s).

74. The first federal census, taken in 1790, showed that only two cities in the United States had a population over 25,000. *See* MARTIN V. MELOSI, GARBAGE IN THE CITIES: REFUSE, REFORM, AND THE ENVIRONMENT 1880-1980, at 13 (1981).

gated severe sanitation problems.[75] Nevertheless, colonial cities did encounter problems. Human waste was typically discharged into backyard privies that sometimes overflowed into drainage ditches that came to resemble open sewers.[76] Although the privies were cleaned out on occasion, the scavengers who did this work often dumped the waste into empty lots or the nearest waterway.[77] Hogs and other domestic animals roamed the streets, eating garbage and depositing additional waste.[78] Tanneries, slaughterhouses, cloth-dyeing establishments, and small factories added to this noxious waste load. By 1730, the shallow drinking water wells in Manhattan had become so filthy that the water was "scarcely fit to drink."[79] Those who could afford to purchased spring water from water carriers. In fact, by 1761, this practice was so prevalent that the city government began licensing carriers.[80] The standard practice in colonial cities like New York was to obtain drinking water from nearby sources such as wells, springs, ponds or local streams.[81] However, this primitive approach to water supply and waste disposal began to break down as American cities grew and population densities increased in the late 1700s.[82]

A. *Epidemics and the Development of Municipal Water Systems*

In the years immediately following the American Revolution, a number of cities experienced rapid population growth. New York City's population climbed from 24,000 in 1786 to over 33,000 in 1790. Boston grew sixty percent between the end of the Revolution and 1800, and Philadelphia became the nation's largest city by

75. *See id.*

76. *See* ANDREWS, *supra* note 26, at 110; J.N. HAYS, THE BURDENS OF DISEASE: EPIDEMICS AND HUMAN RESPONSE IN WESTERN HISTORY 142-43 (1998). The drains in New York emptied into the slips in the harbor. In summertime, when the tide was out, the stench was appalling. *See* DUFFY, *supra* note 30, at 29.

77. *See* Tarr & McMichael, *supra* note 31, at 49.

78. *See* Hendrik Hartog, *Pigs and Positivism*, 1985 WIS. L. REV. 899, 901 (1985).

79. CARL BRIDENBAUGH, CITIES IN THE WILDERNESS: THE FIRST CENTURY OF URBAN LIFE IN AMERICA 1625-1742, at 374 (1968). *See also* DUFFY, *supra* note 30, at 30 (reporting "that even the horses were reluctant to drink it").

80. *See* DUFFY, *supra* note 30, at 30.

81. *See* MARTIN V. MELOSI, THE SANITARY CITY: URBAN INFRASTRUCTURE IN AMERICA FROM COLONIAL TIMES TO THE PRESENT 29 (2000) [hereinafter MELOSI, SANITARY CITY].

82. *See* HENDRIK HARTOG, PUBLIC PROPERTY AND PRIVATE POWER: THE CORPORATION OF THE CITY OF NEW YORK IN AMERICAN LAW, 1730-1870, at 148 (1983) (recounting how, by the end of the Revolution, Fresh Water Pond—once New York's primary source of drinking water—had become fouled with human and animal excrement).

1800 with a population of 80,000.[83] Despite this growth, cities did little to ensure cleaner, more plentiful water supplies until a series of yellow fever epidemics struck the United States during the 1790s.[84] The association of yellow fever with filth and contaminated water convinced a number of cities to act.[85] In 1795, the City of Boston chartered a private company to build an aqueduct from Jamaica Pond to the city, and by 1798, the residents of Boston had a centralized clean water supply.[86] In 1802, Philadelphia began operating the first municipally-owned waterworks that pumped potable water from the Schuylkill River throughout the city using a system of wooden pipes.[87] As the threat of yellow fever receded at the beginning of the nineteenth century, however, so too did the interest of most municipal authorities in constructing expensive water systems.[88]

During the first third of the nineteenth century, American cities continued to mushroom in size and density. This growth accelerated with the advent of the Industrial Revolution and a large influx of immigration in the 1840s and 1850s. Unfortunately, as Lewis Mumford wrote, "industrialism, the main creative force of the nineteenth century, produced the most degraded urban envi-

83. *See* DUFFY, *supra* note 30, at 37.

84. Yellow fever is a viral disease that in a milder form resembles the flu, with symptoms such as headache and chills. A more virulent form begins with a high fever, muscle ache, bleeding from the nose, gums, and tongue, vomiting, and hemorrhaging in the uterus and urethra. Death often follows due to liver failure. *See* HAYS, *supra* note 76, at 130; MARGARET HUMPHREYS, YELLOW FEVER AND THE SOUTH 5-6 (1992). For an excellent account of the awful impact which yellow fever had on one American city at this time, see J.H. POWELL, BRING OUT YOUR DEAD: THE GREAT PLAGUE OF YELLOW FEVER IN PHILADELPHIA IN 1793 (1949).

85. *See* DUFFY, *supra* note 30, at 38-48. Yellow fever seemed to confirm the miasmic theory of disease. It arrived in mid-summer just as the long sultry days were producing horrible odors from sewage and rotting garbage. Cleanliness, including access to pure water, had become essential to public health. *See id.* at 48. While we now know that yellow fever is actually spread by mosquitoes—no doubt breeding in foul, stagnant pools of water—the relationship between dysentery and other gastrointestinal ailments and dirty drinking water was obvious. *See id.* at 81.

86. *See id.* at 47.

87. *See id.*; TARR, URBAN POLLUTION, *supra* note 29, at 9. Wooden pipes did not prove durable, and they also tended to leak around the joints. Philadelphia, therefore, began installing cast-iron pipe imported from England in 1818. *See* DUFFY, *supra* note 30, at 75. The first suggestion that Philadelphia seek a clean source of water had come from Benjamin Franklin in 1789 following a yellow fever epidemic. *See* MELOSI, SANITARY CITY, *supra* note 81, at 31.

88. *See* DUFFY, *supra* note 30, at 50, 53. Pittsburgh, however, built a municipal water system in the 1820s providing its citizens with the "pure sweet water of the Allegheny." *See id.* at 76, 90.

ronment the world had yet seen; for even the quarters of the ruling class were befouled and overcrowded."[89] Thousands each year, especially in the growing slums, developed gastrointestinal afflictions due to unsanitary conditions and contaminated drinking water. The public, however, remained largely apathetic until 1832, when Asiatic cholera invaded the United States, and spread rapidly across the continent.[90] Unlike more common enteric diseases, cholera produced severe panic and dread. Its onset was sudden, marked by spasmodic vomiting and uncontrollable excretions. Because no effective treatment existed at the time, victims could die quickly—often within hours.[91] By 1834, thousands had died from this disease. Although the poor were the hardest hit, all social classes suffered because the disease was most often spread by the consumption of drinking water that had been contaminated by the excreta of cholera victims.[92]

The cholera epidemic of the early 1830s reinvigorated urban demands for cleaner water supplies. New York opened the Croton Aqueduct in 1842,[93] and Boston developed an upland water source that began supplying the city in 1848.[94] Cholera returned to the United States in 1849 to 1854 and again in 1866, prompting the construction of additional municipal water systems and the expansion of existing ones. By 1860, 136 public water systems had been constructed; by 1896, the number had risen dramatically to 3,196.[95]

89. LEWIS MUMFORD, THE CITY IN HISTORY: ITS ORIGINS, ITS TRANSFORMATION, AND ITS PROSPECTS 447 (1961). Appalling conditions were even found in smaller cities. An 1834 Albany, New York court described the confluence of the Hudson River and the Erie Canal as "foul, filled and choked up with mud, rubbish, and dead carcasses of animals," and thus "offensive and nauseous, corrupting the water, and causing noisome and unwholesome smells." People v. Corporation of Albany, 11 Wend. 539, 539-40 (N.Y. Sup. Ct. 1834).

90. *See* GEORGE ROSEN, A HISTORY OF PUBLIC HEALTH 253 (Johns Hopkins University Press 1993) (1958).

91. *See* CHARLES E. ROSENBERG, THE CHOLERA YEARS: THE UNITED STATES IN 1832, 1849, AND 1866, at 2-3 (1962); *see also* HAYS, *supra* note 76, at 136 (stating that "the drastic loss of body fluids collapsed the tissues; coagulated blood ceased to flow, the skin turned alarmingly blue, and the heart (or the kidneys) failed, often within a few hours").

92. *See* DUFFY, *supra* note 30, at 79-83.

93. *See* HARTOG, *supra* note 82, at 224-25; TED STEINBERG, DOWN TO EARTH: NATURE'S ROLE IN AMERICAN HISTORY 166 (2002) [hereinafter STEINBERG, DOWN TO EARTH].

94. *See* DUFFY, *supra* note 30, at 89. These actions reflect a gradual but steady shift in American attitudes about the cause of cholera. The prevailing belief in 1832, and a belief which continued in some quarters for many years to come, was that cholera represented a kind of Biblical punishment for the "intemperate, the imprudent, [and] the filthy." ROSENBERG, *supra* note 91, at 40. People who subscribed to this view differed, however, as to whether this punishment flowed directly from the hand of God or was the inescapable result of failing to follow the laws of nature. *See id.* at 40-47.

95. *See* Galishoff, *supra* note 27, at 35.

This huge investment in public infrastructure was not motivated solely by fears of pestilence, nor by the advocacy of the new American sanitation movement.[96] For not only were local ponds and wells contaminated, they were also inadequate to meet the growing domestic, industrial, and firefighting needs of the nineteenth century American city.[97]

B. *The Development of Modern Sewerage Systems*

The introduction of piped-in water was a major technological advance. The availability of water running freely and continuously at the tap encouraged increased consumption and the installation of modern bathroom conveniences such as the flush toilet. By 1880, approximately one-third of all urban households had flush toilets.[98] Per capita water use exploded between the 1850s and 1880s—increasing, for example, from 33 to 144 gallons a day in Chicago and from 55 to 149 gallons a day in Detroit.[99]

"Logically, sewer systems should have preceded water systems, but such was not the case."[100] In the absence of modern sewage systems, huge quantities of water were used and discarded into

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96. The disease and filth that afflicted congested urban areas at this time gave rise to a sanitation reform movement in Great Britain during the 1830s. In 1842, one of its leaders, Edwin Chadwick, published his "Report on the Sanitary Condition of the Labouring Population of Great Britain." The report established a correlation between disease and filthy environmental conditions including foul water and the lack of adequate drainage. *See* ROSEN, *supra* note 90, at 214-15; ROSENBERG, *supra* note 91, at 143; HAYS, *supra* note 76, at 144-47. Chadwick believed that cities should build comprehensive water and sewer systems. Such systems would provide each house with piped-in water, street drainage, and would connect each house with a sanitary sewer system to convey this domestic sewage to the edge of the city where it would be turned into fertilizer. *See* HAYS, *supra* note 76, at 145.

Inspired by Chadwick's work, a growing number of sanitary reformers in the United States began to conduct similar studies and to push for water and sewer systems, garbage collection, street cleaning, and the creation of city and later state health departments. *See* ROSEN, *supra* note 90, at 233-48; ROSENBERG, *supra* note 91, at 145-46.

97. The population of New York, for example, had risen from 75,770 in 1805 to 515,000 in 1850. *See id.* at 237. It also experienced a major fire in 1829 that was made worse because of a shortage of water. *See* DUFFY, *supra* note 30, at 90. Overall, the urban population of the United States climbed from just over 300,000 in 1800 to over 6 million in 1860. *See* Martin V. Melosi, *Environmental Crisis in the City: The Relationship Between Industrialization and Urban Pollution, in* POLLUTION AND REFORM IN AMERICAN CITIES, 1870-1930, at 9 (Martin V. Melosi ed., 1980) (defining Americans living in areas with a population of 2,500 or more as "urban") [hereinafter Melosi, *Environmental Crisis*].

Business people often led the struggle for improved water supply systems. Industry needed more water, and a more reliable water system would serve to lower the premiums for fire insurance. *See* Galishoff, *supra* note 27, at 51.

98. *See* Tarr & McMichael, *supra* note 31, at 50.

99. *See* ANDREWS, *supra* note 26, at 116.

100. DUFFY, *supra* note 30, at 77.

cesspools, privy vaults, and street gutters.[101] Although the addition of running water improved the quality of life for the middle class, it actually aggravated sanitary problems for those who were exposed to overflowing cesspools and the like.[102] "Copious water supplies" had paradoxically become "a means of distributing fecal pollution over immense areas."[103]

The health and sanitary threats presented by this disposal problem, combined with the high cost middle class homeowners faced in having their cesspools pumped with increased regularity, prompted cities to start building sewerage systems.[104] Before the Civil War, both Chicago and Brooklyn built sewerage systems, modeled on London's system.[105] After the war, public pressure intensified all around the country, as public health advocates lobbied strenuously for construction of these expensive systems and attempted to quantify resulting health benefits.[106] They were joined in this effort by a growing number of civic groups and urban reformers like Jane Addams, who were concerned about the adverse impacts of poor sanitation, crowded slums, and dirty streets.[107] Eventually, various business and industrial interests realized that sewer systems would help attract new business, increase property values and alleviate the need for quarantines, which often dis-

101. *See* STEINBERG, NATURE INCORPORATED, *supra* note 73, at 224-25. It was generally illegal to dispose of human waste in city storm drains (where available), although this occasionally occurred. *See* Tarr & McMichael, *supra* note 31, at 50.

102. *See* ANDREWS, *supra* note 26, at 116. All too often, most of the water flowed toward affluent neighborhoods and the central business district. The poor and working class neighborhoods still had to rely in many instances on contaminated wells and other polluted water sources. *See* MELOSI, SANITARY CITY, *supra* note 81, at 88.

103. *See* Tarr & McMichael, *supra* note 31, at 50 (quoting Benjamin Lee, *The Cart Before the Horse*, *in* 20 PAPERS AND REPORTS OF THE AM. PUB. HEALTH ASSN. 20 (1894) (Benjamin Lee was the Secretary of the Pennsylvania Board of Health)).

104. *See* Tarr & McMichael, *supra* note 31, at 50-51.

105. *See* TARR, URBAN POLLUTION, *supra* note 29, at 12.

106. *See* Tarr, McCurley & Yosie, *supra* note 37, at 64-65.

107. *See* Martin V. Melosi, *Environmental Reform in the Industrial Cities: The Civic Response to Pollution in the Progressive Era*, *in* ENVIRONMENTAL HISTORY: CRITICAL ISSUES IN COMPARATIVE PERSPECTIVE 494 (Kendall E. Bailes ed., 1985); Harold L. Platt, *Jane Addams and the Ward Boss Revisited: Class, Politics, and Public Health in Chicago, 1890-1930*, 5 ENVTL. HIST. 194, 196, 202-08 (2000). Middle class civic reformers were additionally influenced by aesthetic and moral concerns which reflected the Victorian notion that cleanliness was not only a virtue in and of itself but also an essential component of a civilized and moral city—the City Beautiful which had become the ideal sought by so many in the wake of the 1893 Chicago World's Fair. *See* Melosi, *supra,* at 507; David Stradling & Peter Thorshelm, *The Smoke of Great Cities: British and American Efforts to Control Air Pollution, 1860-1914*, 4 ENVTL. HIST. 6, 14 (1999).

rupted normal trade patterns.[108]

By 1911, all major American cities had constructed sewer systems.[109] These systems collected huge amounts of wastewater and, in turn, carried it to nearby watercourses where, in most cases, it was discharged untreated.[110] The burden of human waste disposal had now been effectively transferred from land to water.

Some sanitarians recognized that these untreated discharges would produce serious stream pollution[111] and create health problems for downstream communities.[112] In 1869, the editors of *Scientific American* warned that the new sewage systems were choking "our rivers with foul deposits."[113] One potential solution was some form of treatment in which the waste material was either composted[114] or used directly to irrigate and fertilize certain agricultural crops.[115] However, such treatment was only practical in cases where a sewer system was designed to handle only sanitary sewage, not storm water runoff, because the addition of a high volume of storm water would simply overwhelm the capacity of the proposed treatment systems.[116]

As a result, a number of cities and towns built separate sewer systems. Perhaps the most famous example was the system constructed in Memphis, Tennessee following the yellow fever epidemics of 1873 and 1878.[117] Memphis accepted the recommen-

108. *See* Tarr, McCurley & Yosie, *supra* note 37, at 65-66.

109. *See* ANDREWS, *supra* note 26, at 116.

110. *See id.*

111. *See* Tarr & McMichael, *supra* note 31, at 54. As early as the 1850s, several new sewer systems in Great Britain had produced serious stream pollution problems. *See id.*

112. *See* Tarr, McCurley & Yosie, *supra* note 37, at 70.

113. *The Sewage Question*, SCIENTIFIC AMERICAN 57 (July 24, 1869) (quoting an article which had appeared in the *Chemical News*) [hereinafter *The Sewage Question*]. The *Scientific American* editorial urged that sewage be disposed of in such a way that "it can be utilized as fertilizing material, or in some manner that will not tend to impair the public health, or comfort." *Id.*

114. *See The Sewage Question*, *supra* note 113.

115. *See* Tarr & McMichael, *supra* note 31, at 52-53.

116. *See id.* at 54.

117. *See* DUFFY, *supra* note 30, at 144-46. A series of yellow fever epidemics recurred periodically throughout the American South from the 1840s to 1905. In the great epidemic of 1872, 2000 died out of a total population of 40,000 in Memphis. When the disease returned in 1878, 5000 perished out of a population that had declined to 33,000. *See* HUMPHREYS, *supra* note 84, at 1-5. The great American labor leader and progressive, Mother Jones, lost her husband and four small children during a yellow fever outbreak in Memphis in 1867. MARY HARRIS JONES, THE AUTOBIOGRAPHY OF MOTHER JONES 12 (Pittston Strike commemorative ed., reprinted 1990). The highest casualties during these epidemics were among immigrant families, like Mother Jones' family, who tended to live together in

dation of a newly created but short-lived federal agency—the National Board of Health—and built a separate sewer system designed by the famous sanitarian, Colonel George E. Waring. Waring's design would allow for the land treatment of sewage due to its lower flows; it also utilized small, tightly-fitting pipes to guard against sewer gas, thought at the time to be a major cause of infectious disease.[118] By 1892, however, only twenty-two cities and towns in the United States had Waring systems.[119]

In contrast, most cities built sewer systems in which both sanitary waste and storm water runoff were collected in one sewer and discharged without treatment. Combined sewers were popular because they were cheaper—one system solved the problems of both sanitary waste removal and storm water drainage. Most sanitary engineers, therefore, recommended combined systems as the most cost-effective approach to disposal problems. Another factor that led to the adoption of combined systems was the belief that untreated sewage would not pose an insuperable problem in receiving streams because running water would eventually purify the discharged waste.[120] Although engineers understood that segments of many streams could be overloaded with waste material, they did not know how much waste was necessary to produce such a result, nor did they know how far downstream the untoward consequences would extend.[121] Proceeding in the face of this uncertainty eventually proved costly.

By 1905, the nation's cities had built approximately 19,000 miles of sewer line, nearly eighty-two percent of which were combined systems.[122] Eighty-eight percent of the total collected wastewater—from combined as well as some separate systems—was poured into streams and lakes as raw sewage.[123] This wave of construction represented an effort to meet the sanitary needs of an urban population that was growing explosively. Between 1880 and

swampy, low-lying areas that became virtual cesspools during the rainy season. *See* ELLIOTT J. GORN, MOTHER JONES: THE MOST DANGEROUS WOMAN IN AMERICA 38-39 (2001).

118. *See* MELOSI, SANITARY CITY, *supra* note 81, at 155.

119. *See* Tarr & McMichael, *supra* note 31, at 52-53.

120. *See* STEINBERG, NATURE INCORPORATED, *supra* note 73, at 224, 226; Tarr, McCurley & Yosie, *supra* note 37, at 68-69.

121. *See* Tarr & McMichael, *supra* note 31, at 54.

122. In 1905, there were 15,189.4 miles of combined sewers and 3,423.4 miles of sanitary sewers in the United States, for a grand total of 18,612.8 miles. *See* TARR, URBAN POLLUTION, *supra* note 29, at 188. I have not included 846.9 miles of storm sewers in these calculations since they were not constructed to transport sanitary waste.

123. *See id.* at 190 (referring to a 1909 figure).

1890, the population of Chicago more than doubled to over one million inhabitants. During the same decade, Cleveland grew sixty-three percent and Detroit and Milwaukee increased by seventy-seven percent.[124] The experience of these midwestern cities was part of a broader pattern. Between 1860 and 1920, the urban population in the United States jumped from approximately 6 million to over 54 million people.[125] This growth was fueled both by a new rush of immigration and a substantial migration from rural areas to meet the burgeoning labor demands of American industry.[126]

C. *Exporting Infectious Waterborne Disease to Downstream Communities*

While the new sewer systems did improve local sanitary conditions, this progress produced considerable problems. Stream pollution increased, and serious health problems were exported downstream. During the 1880s and 1890s, the number of deaths and illnesses caused by infectious waterborne diseases grew alarmingly in cities and towns that drew drinking water from streams contaminated by upstream neighbors.[127] Ironically, many of these downstream communities themselves had spent considerable sums on the construction of new sewer systems and had expected to reap significant health benefits as a result. Instead, they suffered rising rates of infection and mortality from typhoid fever.[128]

Pittsburgh, for example, pumped its drinking water from the

124. *See* KEHOE, *supra* note 40, at 18.

125. *See* Melosi, *Environmental Crisis*, *supra* note 97, at 9. Compared to the rest of the world, the United States was experiencing a population explosion at the end of the nineteenth century and the beginning of the twentieth century. Between 1850 and 1920, the population of the United States rose by an incredible 357%, whereas the world population increased by a more modest 55%. *See id.*

126. *See id.* at 9-10.

127. According to the Ohio State Board of Health, nearly every town along the Ohio River discharged its sewage to the river and drew drinking water from it as well. One town, Bellaire, actually contaminated its own drinking water supply by locating its water intake downstream of its sewage outfall. *See* DUFFY, *supra* note 30, at 176.

128. *See* TARR, URBAN POLLUTION, *supra* note 29, at 12-13, 190. Typhoid fever is an infectious bacterial disease. The source of the infection is human waste either from persons who have the disease or from carriers who may harbor typhoid bacterium in their gallbladders for many years. Typhoid is commonly spread by drinking water or eating shellfish that has been contaminated by sewage. Flies can also spread the disease from sewage to food. Its symptoms include prolonged fever, diarrhea, abdominal pain, enlargement of the spleen and liver, and, if treatment is inadequate, complications such as intestinal bleeding, renal failure, and peritonitis may develop. *See* THE AMERICAN MEDICAL ASSOCIATION ENCYCLOPEDIA OF MEDICINE 1017 (1989); STEINBERG, NATURE INCORPORATED, *supra* note 73, at 232.

Allegheny River, a stream that was increasingly polluted by municipal and industrial discharges in communities located only a few miles upstream. The city's death rate from typhoid fever soared—with an annual rate ranging from 107 to 144 deaths per 100,000 residents between 1880 and 1905.[129] The nearby city of Allegheny suffered an even worse fate.[130] Atlanta, Louisville, Newark, Philadelphia, and Washington all experienced typhoid mortality rates exceeding seventy deaths per 100,000 in 1890.[131] Furthermore, two relatively small Massachusetts mill towns, Lowell and Lawrence, suffered severe typhoid epidemics in the 1890s because their source of drinking water, the Merrimack River, was seriously tainted by upstream sewage discharges.[132] Great Lake cities like Chicago were also afflicted, not because of their neighbors' conduct, but because of their own—the use of the lakes for both drinking water and as a sewage receptacle.[133]

The failure of cities to treat sewage discharges resulted partly

129. *See* TARR, URBAN POLLUTION, *supra* note 29, at 189.

130. *See* Galishoff, *supra* note 27, at 40.

131. *See* TARR, URBAN POLLUTION, *supra* note 29, at 189.

132. *See* STEINBERG, NATURE INCORPORATED, *supra* note 73, at 226, 232-33; JAMES RIDGEWAY, THE POLITICS OF ECOLOGY 31-32 (1970).

133. *See* Galishoff, *supra* note 27, at 40. In Chicago, 1008 persons died from typhoid outbreaks in 1890, and in 1891, the death rate rose to 166 persons per 100,000—with 1997 persons perishing from typhoid fever. *See* ARNOLD LEWIS, AN EARLY ENCOUNTER WITH TOMORROW: EUROPEANS, CHICAGO'S LOOP, AND THE WORLD'S COLUMBIAN EXPOSITION 29 (1997).

Eighty-five percent of Chicago's sewage was dumped into the Chicago River, whose flow had been reversed in 1871. As a result of the 1871 "deep-cut" canal and the pumping of water from Lake Michigan into the Chicago River, the river now flowed westward, carrying most of the city's sewage into the Mississippi River basin instead of Lake Michigan, the source of Chicago's drinking water. Unfortunately, the river would reverse course and flow once again into Lake Michigan whenever heavy rains overwhelmed the action of the pumps and the "modest declivity of the canal." LEWIS, *supra*, at 27. As a result, the lake would become polluted even at a point two miles from shore where most of Chicago's drinking water intakes were located. To ensure that Chicago's sewage would flow toward the Mississippi, a new and larger Sanitary and Ship Canal was opened in 1900. *Id.* at 28-29. So much lake water was diverted down the new canal to ensure both adequate flow away from the lake and sufficient dilution of Chicago's untreated sewage that the mean level of Lake Michigan and Lake Huron actually dropped six inches by 1927, while the level of both Lake Erie and Lake Ontario fell five inches. *See* Wisconsin v. Illinois, 278 U.S. 367, 407 (1929).

However, typhoid outbreaks continued to occur after the new sanitary canal was opened because a number of sanitary sewers still flowed directly into Lake Michigan. *See* Platt, *supra* note 107, at 204-05, 212. Even the construction of a new water intake—located four miles offshore in Lake Michigan—did not provide enough protection. So the city began to experiment with the use of chlorine in 1912, and extended its use to the entire drinking water supply in 1916. *See* Galishoff, *supra* note 27, at 48-49.

because until the 1890s, most medical experts believed that typhoid epidemics resulted from filthy conditions like dirty streets, improper drainage, inadequate waste collection, shoddy housing, improper ventilation rather than from consuming contaminated water. Scientists at the Massachusetts State Board of Health's Lawrence Experimental Station, however, had noticed a strong relationship between the severity of the disease and the source of a city's water supply. Consequently, they explored the link and confirmed in 1894 that typhoid was transmitted by ingesting water that had been polluted with human waste containing the typhoid bacillus.[134] Contrary to prevailing wisdom,[135] the Lawrence laboratory also proved that whatever purifying effect flowing water might have in certain cases, it was completely inadequate when it came to protecting downstream populations from the ravages of typhoid.[136]

D. *Industrial Pollution: Unavoidable, Inevitable, and Ignored*

Sewage was not the sole contaminant in river water. A wide range of industrial activity was concentrated in the nation's growing urban areas. Iron and steel plants, textile mills, food and animal processing facilities, paper manufacturers, and chemical factories used large amounts of water for cooling and processing purposes and produced prodigious amounts of wastewater and other contaminants. Nearby rivers and lakes presented a cheap and attractive way to dispose of these industrial wastes.[137] By 1900, approximately forty percent of the pollution loading to American rivers was industrial in origin.[138]

134. *See* DUFFY, *supra* note 30, at 201-02; STEINBERG, NATURE INCORPORATED, *supra* note 73, at 236-37.

135. For example, the president of the New York Board of Health, a professor of chemistry at Columbia University, declared in 1873 that the "natural process of purification" in our rivers "destroys the offensive bodies derived from sewage, and renders them harmless." MELOSI, SANITARY CITY, *supra* note 81, at 85.

136. *See* STEINBERG, NATURE INCORPORATED, *supra* note 73, at 239.

137. *See* Melosi, *Environmental Crisis*, *supra* note 97, at 7. For a vivid description of the kinds of pollutants discharged by textile mills, paper mills, and tanneries located along the Merrimack River, see STEINBERG, NATURE INCORPORATED, *supra* note 73, at 207-09.

138. *See* Melosi, *Environmental Crisis*, *supra* note 97, at 7. Prior to the construction of hundreds of municipal sewer systems in the later half of the nineteenth century, industrial discharges had clearly been the leading cause of water pollution in the United States. *See* ANDREWS, *supra* note 26, at 126; STEINBERG, NATURE INCORPORATED, *supra* note 73, at 210. In addition to sewage and industrial wastes, urban waters were also commonly fouled by trash and bodies of both animal and human origin. *See* HAYS, *supra* note 76, at 143. Meanwhile, water quality in many rural areas was suffering from the impact of mining activities, especially coal mining. *See, e.g.*, SUSAN Q. STRANAHAN, SUSQUEHANNA: RIVER OF DREAMS 153-

Public health authorities, however, placed a much higher priority on dealing with the threats posed by sewage rather than industrial waste. A number of factors help explain this emphasis. First, public health authorities were primarily concerned with controlling intestinal illnesses such as typhoid, which were conveyed by pathogens found in human waste, not industrial waste.[139] Second, the toxic components found in industrial pollution were generally regarded as "beneficial sterilizing additives" that would kill the bacteria found in municipal discharges.[140] Third, because the problem of industrial pollution was so complex, involving hundreds of different processes and pollutants, it appeared to be just too difficult and expensive to control.[141] Therefore, many public health officials were resigned to industrial pollution as an "unavoidable" and "inevitable product of urban, industrial life."[142] Fourth, combating industrial pollution would mean regulating extremely powerful economic interests—ample reason perhaps to concentrate on providing municipal water and sewer services rather than risk defeat by tackling such a formidable foe.[143] Finally, typhoid was a much easier target because public opinion was already aroused by this disease whose "dreaded germs infiltrated insidiously" into the homes of rich and the poor alike.[144]

E. *Fighting Waterborne Disease: Sewage Treatment vs. Water Filtration*

Bacteria-laden sewage was therefore considered the primary

54 (1993) (describing fish kills from mine acid drainage along the West Branch of the Susquehanna that occurred as early as 1907).

139. *See* Joel A. Tarr, *Industrial Wastes and Public Health: Some Historical Notes, Part I, 1876-1932*, 75 AM. J. PUB. HEALTH 1059, 1060 (1985) [hereinafter Tarr, *Public Health*]. The only cases where public health authorities were worried about direct infection arising from industrial pollution involved the possible spread of anthrax as a result of discharges from tanneries and wool scouring operations. *See id.*

140. *See* CRAIG E. COLTEN & PETER N. SKINNER, THE ROAD TO LOVE CANAL: MANAGING INDUSTRIAL WASTE BEFORE EPA 24 (1996). There were voices at the turn of the century that called upon public health authorities to pay attention to the overall health of U.S. rivers and not to focus exclusively upon the impact of sewage upon human health. For example, Marshall O. Leighton, a hydrographer with the U.S. Geological Survey, argued that the major water pollution problem of the day was industrial pollution that destroyed fish and aquatic life and interfered with natural processes. Leighton's pleas, however, largely fell upon deaf ears. *See* Tarr, *Public Health*, *supra* note 139, at 1060.

141. *See* Tarr, *Public Health*, *supra* note 139, at 1060; EARL FINBAR MURPHY, WATER PURITY: A STUDY IN LEGAL CONTROL OF NATURAL RESOURCES 80 (1961) (referring to the lack of technical knowledge for treating industrial waste at this time).

142. STEINBERG, NATURE INCORPORATED, *supra* note 73, at 211.

143. *See* ANDREWS, *supra* note 26, at 128-29.

144. Platt, *supra* note 107, at 202.

problem. Accordingly, the Lawrence Experimental Station also conducted research on ways to treat sewage prior to discharging it into various waterways. In the early 1890s, scientists at Lawrence refined a system for intermittent filtration of sewage, a method that could be quite effective given adequate land and appropriate soil.[145] Intermittent filtration thus joined land treatment (known to many as sewage farming)[146] as the most widely utilized form of sewage treatment.[147] The use of either system, however, was limited by cost. Large amounts of land were needed, especially if a city had built a combined sewer system to handle storm water runoff as well as sanitary sewage. Nevertheless, by 1900 engineers were claiming that resources were available "to bring about the purification of sewage to any reasonable degree. This costs money . . . , [sic] but not so much as is often believed."[148] Around the turn of the century, engineers introduced the trickling filter, a mechanical treatment technology that, while not cheap, eliminated the need to acquire and use large tracts of land.[149] After 1910, an even more promising technology became available—the activated sludge process—which utilized "good" bacteria to treat sewage.[150]

The use of sewage treatment technology was not the only method of controlling bacteria. The Lawrence laboratory discovered that slow sand filters could remove the typhoid bacillus from river water. Through the construction of such a filtration system in 1893, the drinking water in Lawrence was restored to health.[151] By 1900, some twenty cities had built slow sand filters, though most cities favored new mechanical filters that were easier and cheaper

145. Intermittent filtration utilized sand beds and natural aeration to remove most suspended material and a good deal of bacteria. By 1900, over thirty cities and towns were using intermittent filtration. *See* MELOSI, SANITARY CITY, *supra* note 81, at 168.

146. In land treatment, agricultural fields were irrigated with sewage. In the United States, land treatment proved most attractive in the arid areas of the West. By 1914, for example, land treatment was being used by some thirty-five communities in California to grow fodder for livestock as well as walnuts and oranges. Elsewhere, however, the process suffered from nagging public health concerns, such as the possible contamination of neighboring streams from runoff, the potential exposure of agricultural workers to disease organisms, and the fitness of the resulting crops for human or animal consumption. *See id.* at 167-68.

147. *See* TARR, URBAN POLLUTION, *supra* note 29, at 162-63.

148. *Id.* at 163 (quoting *The Water Supply of Large Cities*, ENGINEERING REC. 41, 73 (1900)).

149. *See* RIDGEWAY, *supra* note 132, at 33-35. Developed by the Lawrence laboratory around 1890, the first large-scale trickling filter was built in Madison, Wisconsin, in 1901. *See* MELOSI, SANITARY CITY, *supra* note 81, at 170.

150. *See* MELOSI, SANITARY CITY, *supra* note 81, at 172.

151. *See* STEINBERG, NATURE INCORPORATED, *supra* note 73, at 238.

to operate.[152] Another breakthrough came in 1908, when the Jersey City Water Company became the first large urban water supplier to use chlorine on a continuous basis to disinfect its water supply.[153]

Given these advances in technology, cities now had a choice to make. They could provide safe drinking water to their own citizens, while also aiding their downstream neighbors by cleaning up their sewage. Alternatively, they could opt to simply purify their own drinking water and force their neighbors to contend with bacteria-laden river water. The resulting debate over which course to follow increasingly divided the public health community into two opposing camps from 1900 to 1914.[154] Eventually, most cities would opt to simply treat their own drinking water while continuing to discharge raw sewage.[155]

Although many sanitary engineers had been pleased by the recent improvements in sewage treatment technology, a number of leading engineers were now more impressed with the filtration systems that so effectively removed bacteria from drinking water. These new systems were cheaper to build and operate than sewage treatment facilities, especially in cities that had chosen to build combined sewer systems. There was now a way to avoid the huge capital costs of either converting to separate sewers or building treatment facilities large enough to handle storm events—a fact that probably provided great relief to many sanitary engineers and their client cities. In 1903, the *Engineering News* argued that it was often "more equitable" for an upstream city to discharge raw sewage and for its downstream neighbor to filter the river water than to force the upstream city to treat its waste.[156] Not only was filtration less expensive,[157] it also guaranteed that a city's water supply

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152. *See* Galishoff, *supra* note 27, at 45. By 1914, mechanical filters were being used by 303 cities and towns whereas sand filters were being used in forty-two locations. *See* ALLEN HAZEN, CLEAN WATER AND HOW TO GET IT 86-88 (1914).

153. *See* Galishoff, *supra* note 27, at 45. Although chlorine had been used to treat sewage in Europe during the late nineteenth century, it had not been used to purify drinking water. *See* DUFFY, *supra* note 30, at 202. By 1920, a survey of 1000 U.S. cities revealed that almost half were using chlorine or some other form of disinfectant. *See* MELOSI, SANITARY CITY, *supra* note 81, at 144-45.

154. *See* TARR, URBAN POLLUTION, *supra* note 29, at 163.

155. *See infra* notes 178-80.

156. *Sewage Pollution of Water Supplies*, 4 ENGINEERING REC. 117 (1903) [hereinafter *Sewage Pollution*].

157. *See* HAZEN, *supra* note 152, at 36 (stating that "per million gallons the cost of purifying water is much less than the cost of purifying sewage").

was free from dangerous pathogens, a result that sewage treatment systems in upstream communities could not absolutely guarantee.[158] An influential engineering book first published in 1907 thus concluded that it was "both cheaper and more effective" to purify drinking water than to treat raw sewage.[159] "The water works man therefore must, and rightly should, accept a certain amount of sewage pollution in river water, and make the best of it."[160]

Many public health physicians disagreed. The report of a stream pollution committee that was submitted to the 1909 Conference of State and Provincial Boards of Health recommended in general against the discharge of untreated sewage into streams that were subsequently used for public water supplies.[161] They advocated instead for a system of double protection in which both sewage and drinking water would be treated.[162] The report also saw value in protecting some streams for their recreational value: "The fact that many of our streams and lakes have been ruined for boating, bathing, and fishing, by reason of their pollution cannot be else than a material loss to the people at large and a serious diminution in the value of the resources of the country."[163] These kinds of arguments appealed to many conservationists and advocates of progressive reform. For example, in 1909, New York Governor Charles Evans Hughes declared that the state could "no longer afford to permit the sewage of our cities and our industrial wastes to be poured into our watercourses."[164] Further, in 1910, former President Theodore Roosevelt called for state and federal water pollution legislation observing that "civilized people should be able to dispose of sewage in a better way than by putting it into drinking water."[165]

158. Storm overflows, a discharge from a vessel, or an area still served by privies could be more than enough to contaminate a city's water supply with the typhus bacillus. *See id.*

159. *Id.* Hazen noted, however, that sewage treatment was justified in some situations to avoid the creation of local nuisances such as foul odors or floating substances. *See id.* at 34-35. Nevertheless, "the fact must be fully recognized that the discharge of crude sewage from the great majority of cities is not locally objectionable in any way to justify the cost of sewage purification." *Id.* at 36.

160. *Id.* at 37.

161. *See The Pollution of Streams*, 60 ENGINEERING REC. 157, 159 (1909).

162. *See id.* at 158. However, the report noted that the filtration of drinking water supplies might be all that was necessary in some places for some time to come. *See id.*

163. *Id.* 159. As a general rule, the report recommended "partial" sewage treatment when necessary to protect the "normal use and enjoyment" of a stream. *See id.* at 159.

164. TARR, URBAN POLLUTION, *supra* note 29, at 166.

165. *Id.* For a general treatment of the conservation movement in the early years of the twentieth century, see SAMUEL P. HAYS, CONSERVATION AND THE GOSPEL OF EFFICIENCY:

A number of state legislatures were moving in this direction as well. In Pennsylvania, the legislature reacted to a series of typhoid outbreaks by passing a statute in 1905 that prohibited the discharge of untreated sewage from new municipal sewer systems. Older systems could continue dumping untreated sewage, but could not expand unless they obtained permits from the state Department of Health.[166]

F. *Pittsburgh: A Critical Showdown in the Debate Over Sewage Treatment*

Pittsburgh had long suffered from chronically high levels of typhoid due to the use of contaminated river water. In 1907, however, the city completed a slow sand filtration plant that reduced the death rate from typhoid fever from over 100 per 100,000 persons to approximately 22 per 100,000 persons by 1910. Pittsburgh, nevertheless, continued to discharge raw sewage into the Allegheny, Monongahela, and Ohio Rivers, thus contributing to high rates of typhoid in a series of smaller downstream communities. Therefore, when Pittsburgh applied for permission to expand its sewer system in 1910, given the continued problems with sewage discharge, the state Department of Health instructed the city to prepare a comprehensive plan for the construction of a sewage treatment plant. The City was also ordered to consider converting the city's sewer system from combined sewers to a separate sanitary sewer in order to increase the efficiency of the treatment plant.[167]

Pittsburgh hired the distinguished engineering firm of Allen Hazen and George Whipple to prepare the plan. Their report was strong medicine—it all but accused the state health authorities of being unfair to the City of Pittsburgh. No city had ever gone to the tremendous expense of cleaning up its own sewage or replacing a combined system with a separate system in order to protect the water supply in a downstream community.[168] Furthermore, the

THE PROGRESSIVE CONSERVATIONIST MOVEMENT, 1890-1920 (1959); ROBERT H. WIEBE, THE SEARCH FOR ORDER: 1877-1920 (1967).

166. *See* TARR, URBAN POLLUTION, *supra* note 29, at 167.

167. *See id.* at 168. The Department issued similar orders to a number of cities, including Philadelphia. *See A Plea for Common Sense in State Control of Sewage Disposal*, 67 ENGINEERING NEWS 412 (1912) [hereinafter *A Plea for Common Sense*].

168. *See The Most Important Sewerage and Sewage Disposal Report Made in the United States: Messrs. Hazen & Whipple Advise the City of Pittsburg to Disregard the Recommendations of the Pennsylvania Health Department*, 65 ENGINEERING REC. 209 (1912) [hereinafter *Hazen & Whipple Issue Pittsburgh Report*]. In a few "exceptional" cases, however, large cities had paid

Health Department's request was impractical and unrealistic. According to the report, the cost of converting Pittsburgh's combined sewer system into a separate system and building a treatment plant would be higher than the cost of providing filtered water for all of the twenty-six towns immediately downstream from Pittsburgh.[169]

Hazen and Whipple contended that the only possible reason Pittsburgh should build a system with limited treatment capacity would be to prevent the creation of a local nuisance.[170] For example, some settling tanks could be constructed near the outlets of the largest sewers in order to remove heavier suspended solids. In this way, Pittsburgh could reduce "the deposits of sewage mud" which apparently became "offensive" during summer low-flow conditions, but in no case would this kind of rudimentary treatment render the river water fit to drink.[171] Hazen and Whipple added, however, that it might not always be advisable or even practical for

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smaller upstream communities to treat their waste in order to benefit the larger, downstream community's water supply. *Id.*

169. *See* Tarr & McMichael, *supra* note 31, at 57.

170. *See Hazen & Whipple Issue Pittsburgh Report*, *supra* note 168, at 211. Plaintiffs at this time occasionally won cases for local nuisances that were filed against upstream communities. *See, e.g.,* Platt Brothers & Co. v. City of Waterbury, 45 A. 154 (Conn. 1899) (causing noxious odors and inability to use river water for industrial purposes); Edmondson v. City of Moberly, 11 S.W. 990 (Mo. 1889) (producing sickening stench); Chapman v. City of Rochester, 18 N.E. 88 (N.Y. 1888) (contaminating plaintiff's pond); Markwardt v. City of Guthrie, 90 P. 26 (Okla. 1907) (cause of action stated for contaminating reservoir maintained for plaintiff's livestock). Results, however, varied tremendously from jurisdiction to jurisdiction. *Compare* City of Valparaiso v. Hagen, 54 N.E. 1062, 1062 (Ind. 1899) (denying relief and asking "[i]f the city is required to go so far to recompense the effect of its sewage, where may it stop short of the sea?"), *with* Peterson v. City of Santa Rosa, 51 P. 557 (Cal. 1897) (holding any pollution actionable which renders it unfit for domestic purposes). Engineering publications, therefore, admonished sanitary engineers to pay close attention to the case law in their own jurisdictions and to be careful—a court might stop sewage pollution if it is "great enough to be apparent to the senses." *Sewage Pollution, supra* note 156, at 117.

Plaintiffs, however, often experienced difficulty showing (1) that they had suffered material harm; (2) that they had suffered in some way different from the public as a whole (and thus could pursue a case for private nuisance as opposed to a public nuisance which could generally only be brought by the government); and (3) that the polluter's action was unreasonable. Perhaps the biggest hurdle that plaintiffs faced was proving which polluter amongst possibly many possible culprits was responsible for producing a particular harm. Even if a nuisance was recognized, a plaintiff might only receive damages, injunctive relief being denied after the court balanced the equities—balancing the benefit of the polluting activity (such as providing a city with sanitary services) against the value of the adversely affected interest. *See* Hines, *Part I*, *supra* note 68, at 196-200.

171. *See Hazen & Whipple Issue Pittsburgh Report, supra* note 168, at 211; *A Plea for Common Sense*, *supra* note 167, at 413 (declaring that the report had proven that the sanitary engineer was "the greatest of conservationists, zealous to safeguard health and prolong life, but sparing no pains to see that each dollar is spent to the best advantage").

a large city to treat its sewage in a way that would prevent the creation of local nuisances. The test, they argued, should be whether the benefit derived from eliminating the nuisance was reasonably equivalent to the cost of treatment.[172]

The report was a hit in the engineering community,[173] but it did not please Dr. Samuel G. Dixon, the Pennsylvania Commissioner of Public Health. Dixon reproached the city, declaring that he had expected Pittsburgh to take a regional, rather than a parochial, approach to the problems of water pollution in Western Pennsylvania. He contended that the short-term costs of sewage treatment had to be weighed against the long-range interests of public health in order to keep the rivers from becoming "stinking sewers and culture beds for pathogenic organisms."[174] Dixon, however, eventually recognized the inherent political, financial, and possible legal difficulty in trying to force Pittsburgh to borrow $37 million to clean up its sewage when downstream communities certainly had the ability to filter and disinfect their own drinking water.[175] He reluctantly gave the city a temporary discharge permit.[176]

The struggle in Pittsburgh symbolizes the battle in the nation as a whole. While the debate between public health physicians and the engineering community was often strident, with some engineers calling the physicians radical or sentimental,[177] the eventual outcome was clear almost from the outset. The crisis had been defined primarily as a one of public health—the problem of drinking bacteria-laden water. Since death rates from typhoid were now falling as cities began to filter and disinfect their drinking water sup-

172. *See Hazen & Whipple Issue Pittsburgh Report, supra* note 168, at 211.

173. *See id.* at 209 (declaring it the "most important . . . in the United States.").

174. TARR, URBAN POLLUTION, *supra* note 29, at 170.

175. The availability of effective water treatment technology had already prompted some water customers, who had come down with typhoid fever, to sue their local water systems for negligence. *See* Ritterbush v. City of Pittsburg, 269 P. 930 (Cal. 1928); Keever v. City of Mankato, 129 N.W. 158 (Minn. 1910); Stubbs v. City of Rochester, 124 N.E. 137 (N.Y. 1919); Aronson v. City of Everett, 239 P. 1011 (Wash. 1925).

176. *See* TARR, URBAN POLLUTION, *supra* note 29, at 169-70.

177. *See id.* at 173, 175; *see also A Plea for Common Sense, supra* note 167, at 412 (accusing the health department of having assumed "an unwarrantably radical if not a quixotic position"). The *Engineering News* went so far as to suggest that the Pennsylvania Department of Health had "joined blindly in what may be termed the doctors' or physicians' campaign against the discharge of untreated sewage into streams, with little or no regard to the local physical and financial conditions." *Id.* at 413. The journal, therefore, concluded that questions regarding sewage and water supply "should be decided by engineers, not by physicians." *Id.*

plies,[178] the immediate crisis appeared to be over, solved by a technological fix.[179] Expenditures of large additional sums for sewage treatment seemed unnecessary. Thus, despite the existence of fairly effective wastewater treatment technology, cities generally opted not to use it. Water quality, as a result, continued to decline as pollutant loadings continued to climb.[180]

III. The Development of State Regulation: 1869-1972

God made the rivers, but men made them sewers.[181]

A. *The Early Years: 1869-1920*

As we have seen, a series of tragic nineteenth and early twentieth century epidemics prompted American cities to invest huge sums of money first in the construction of municipal water systems and later in the construction of sewerage systems and water treatment facilities.[182] The episodic outbreaks of cholera and typhoid also led groups of reform-minded citizens to push for the creation of permanent governmental bodies that could continuously fight unsanitary conditions at the local level. The first modern city health department was thus established in New York City in 1866.[183] Cities such as Chicago, Cincinnati, St. Louis, and Pitts-

178. *See* Galishoff, *supra* note 27, at 35, 51; Melosi, Sanitary City, *supra* note 81, at 145, 147. By 1914, over forty percent of the public water supplies in the United States were filtered. *See* Melosi, Sanitary City, *supra* note 81, at 146. By 1923, the only public water supplies that did not undergo some form of purification were those that flowed from artesian wells. *See* Galishoff, *supra* note 27, at 51. As a result, the death rate from typhoid dropped from 31.3 per 100,000 in 1900 to 7.6 in 1920. *See* Duffy, *supra* note 30, at 202.

179. The issue had become redefined as a technical matter for specialists rather than a public issue. Thus the push for cleaner water failed to develop into a broad public movement. *See* Robert J. Brulle, Agency, Democracy, and Nature: The U.S. Environmental Movement from a Critical Theory Perspective 180-81 (2000).

180. *See* Andrews, *supra* note 26, at 125. Surveys conducted between 1913 and 1925 indicate that nearly ninety percent of all American cities were dumping raw, untreated sewage into nearby water bodies. *See* Murphy, *supra* note 141, at 87. The shad fishery in the lower Delaware River Basin provides an excellent example of the devastation that urban sewage caused. Between 1899 and 1921, the annual catch of shad fell from 16.5 million pounds to just 210,000 pounds, due in large measure to extremely low dissolved oxygen levels found in the river below Philadelphia's massive sewage discharge. *See* Steinberg, Down to Earth, *supra* note 93, at 168.

181. *Stream Pollution: Hearings on S. 3958, S. 3959, S. 4342, and S. 4627 Before a Subcomm. of the Senate Comm. on Commerce,* 74th Cong., 2d Sess. 9 (1936) (reprinting a speech Sen. Lonergan gave in December 1935).

182. *See supra* notes 84-87, 93-95, 104-09, 127-36, 147-60, 178-80 and accompanying text.

183. *See* Duffy, *supra* note 30, at 120-21; Rosen, *supra* note 90, at 221-24. Although several local health boards had been created before the New York Metropolitan Board of

burgh soon followed suit.[184] By 1900, most large American cities possessed health departments.[185]

Although many of these health departments succeeded in keeping an eye on local sanitary conditions and reducing a wide array of nuisances, water pollution was no longer an exclusively local problem. Municipal officials in downstream communities were powerless to regulate upstream sources of pollution; so at approximately the same time that urban health departments were emerging in the latter half of the nineteenth century, sanitary and civic reformers also began to urge state legislatures to create state-wide boards of health.[186]

Massachusetts created the first working state health board in 1869,[187] and by 1909 every other state had followed suit.[188] Most state health boards, however, were weak and ineffectual bodies, and almost all were poorly funded.[189] These boards generally spread their limited resources among a wide number of health and sanitation issues.[190] Even if they had adequate time and personnel to deal with water quality problems, their authority tended to be quite modest. Typical early state pollution laws included simple bans on the poisoning of drinking water[191] and the dumping of dead animals into streams,[192] and declarations that the discharge

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Health was established, the earlier boards usually served only in an advisory capacity, and many of them were created only to deal with a particular emergency. *See* DUFFY, *supra* note 30, at 62, 148.

184. *See* DUFFY, *supra* note 30, at 122-23.

185. *See id.* at 205.

186. *See id.* at 148.

187. *See* Elizabeth Fee, *Public Health and the State: The United States, in* THE HISTORY OF PUBLIC HEALTH AND THE MODERN STATE 224, 232 (Dorothy Porter ed., 1994). Although the Louisiana State Board of Health was actually established fourteen years earlier, in 1855, its authority rarely extended beyond the boundaries of New Orleans. *See id.* For a history detailing the establishment and early years of the Massachusetts State Board of Health, see BARBARA GUTMANN ROSENKRANTZ, PUBLIC HEALTH AND THE STATE: CHANGING VIEWS IN MASSACHUSETTS, 1842-1936 (1972).

188. *See* TARR, URBAN POLLUTION, *supra* note 29, at 162.

189. *See* DUFFY, *supra* note 30, at 153. Out of all of these states, only three (Florida, Massachusetts, and Rhode Island) spent more than two cents per person on public health services. *See* Fee, *supra* note 187, at 232.

190. *See* TARR, URBAN POLLUTION, *supra* note 29, at 162. Common responsibilities included maintaining vital statistics, dealing with sub-standard housing, and supervising the marketing of food. *See id.*

191. *See* FLA. STAT. Ch. 8, §§ 2658, 2665 (1891); Act of Dec. 19, 1896, No. 57, § 1, 1896, *reprinted in* GA. ACTS 84; IDAHO. PENAL CODE § 4916 (1901); Act of Feb. 19, 1891, ch. 82, § 1, 1891, *reprinted in* ME. LAWS 67 (as amended at 1905 ME. LAWS 100); Act of May 17, 1899, No. 80, 1899, *reprinted in* MICH. PUB. ACTS 115.

192. *See* Act of March 16, 1901, ch. 158, sec. 98, § 374, 1901, *reprinted in* CAL. STAT.

of grossly offensive material constituted public nuisances.[193] Even a highly respected and relatively well-funded agency like the Massachusetts Board of Health was constrained by a limited statutory regime.[194]

A few state legislatures eventually enacted stronger legislation. In 1893, Ohio gave its Board of Health the authority to approve all new sewage discharges,[195] and Pennsylvania passed legislation in 1905 authorizing the Commissioner of Health to regulate the discharge of sewage not only from new sewer systems, but also from older systems that were being expanded.[196] Neither the Ohio nor the Pennsylvania statutes, however, applied to industrial pollution, and as in Pittsburgh, public health authorities often came under enormous pressure to allow new and expanded sewage discharges without any waste treatment.[197]

B. *Despite a Few Innovations, A Bad Situation Gets Worse: 1920-1945*

Bacterial and organic water pollution from municipal sources continued to grow as more and more cities built underground sewers that emptied untreated sewage into the nation's waterways. By 1920, 47.5 million Americans were served by underground sewer systems, but only 9.5 million lived in cities where this waste re-

433, 457 (codified at CAL. PENAL CODE § 374 (1901); IOWA CODE ANN. § 4979 (1897); KY. STAT. § 1278 (Carroll 1899); NEB. STAT. §§ 6892, 6893 (1897); OKLA. STAT. ANN. Ch. 56, §§ 3732, 3733 (Wilson 1903); WIS. STAT. ANN. ch. 57, § 1418 (Sanborn 1899-1906).

193. *See* Act of Oct. 9, 1903, No. 542, § 15, 1903, *reprinted in* ALA. ACTS 499, 508; ILL. REV. STAT. § 202 (Hurd 1901). For a comprehensive review of state legislation, see EDWIN B. GOODELL, A REVIEW OF THE LAWS FORBIDDING POLLUTION OF INLAND WATERS IN THE UNITED STATES (2d ed. 1905, U.S. Geological Survey).

194. Although the 1878 Massachusetts stream pollution act prohibited the discharge of sewage and other forms of pollution within twenty miles of a water supply, all existing discharges were exempt as were any new discharges located along the state's most polluted streams—the Merrimac and Connecticut Rivers—and the portion of the Concord River flowing through the city of Lowell. *See* Act of Apr. 26, 1878, ch. 183, §§ 2, 3, 1878 Mass. Acts 133. For a discussion of the 1878 act, see STEINBERG, NATURE INCORPORATED, *supra* note 73, at 229-31.

195. *See* Act of Mar. 14, 1893, § 2, 1893, *reprinted in* OHIO LAWS 87, 94.

196. *See* Act of Apr. 22, 1905, No. 182, § 4, 1905, *reprinted in* PA. LAWS 260, 261.

197. *See supra* notes 153-62 and accompanying text; *A Plea for Common Sense*, *supra* note 176 (expressing strong opposition to the construction of sewage treatment facilities in Philadelphia and Meadville, Pennsylvania); TARR, URBAN POLLUTION, *supra* note 29, at 13 (noting that except for communities that faced severe local nuisance problems, most cities and towns resisted building sewage treatment plants that would only benefit downstream communities).

ceived even a rudimentary level of treatment.[198] Discharges of untreated industrial waste also grew, and enormously so during the First World War as American production rose to meet wartime demands.[199] These industrial discharges were increasingly responsible for severe fish kills and the destruction of aquatic habitats.[200]

By the 1920s, many streams had become little more than sewers carrying a noxious mix of sewage and industrial pollutants.[201] In fact, one of the largest cities in Ohio found it necessary to chlorinate its water supply twice in addition to filtration.[202] At the same time, other communities in Ohio, Pennsylvania, and elsewhere reached the point where chlorination was no longer a practicable treatment option because chlorine produced objectionable tastes and smells when added to raw water supplies containing certain industrial pollutants.[203] Such problems were widespread. According to the American Water Works Association, at least 248 water supplies had been adversely affected by industrial discharges.[204] Therefore, reformers in a number of states called upon their legislatures to enact more effective laws to control industrial pollution.

198. *See* TARR, URBAN POLLUTION, *supra* note 29, at 174.

199. Although state health officials were generally more concerned about sewage than industrial waste because of the clear relationship between human waste and infectious disease, state health departments did offer advice to industrial polluters and often tried to convince them to improve their disposal methods. *See* MURPHY, *supra* note 141, at 80-81.

200. *See* Tarr, *Public Health*, *supra* note 139, at 1060. Coal silt in the North Branch of the Susquehanna, as a result of mining activity, was 15-25 feet deep by 1917, and the silt was carried downstream by the current as far as Harrisburg, over 100 miles away. *See* STRANAHAN, *supra* note 138, at 153. For years, these river deposits of coal silt supported a bizarre fleet of steamboats and barges that vacuumed up as much as 300,000 tons of anthracite per year from the bottom of the Susquehanna. Although most of this submarine mining ended by the mid-1950s, dredging continued behind the Safe Harbor Dam until 1973. *See id.* at 148; *see also* H.R. DOC. No. 469-70 (describing similar condition on the Schuylkill River and explaining that the anthracite industry discharged unusually high amounts of sediment because—due to its market—the mines used mechanical breakers together with water to produce coal of very particular sizes and deposited the wastewater and finer pieces of coal in the adjacent streams).

201. In the early 1920s, a Harvard engineering professor wrote that "[t]here is now greater indifference to stream pollution, a greater laxity in enforcing laws, than was the case before the World War." George C. Whipple, *Shall Waterways Be Sewers Forever?, in* AMERICAN CITY 196-97 (Aug. 1926).

202. *See* John Emerson Monger, *Administrative Phases of Stream Pollution Control*, 16 AM. J. PUB. HEALTH 788, 790 (1926).

203. *See* Joel A. Tarr, *Searching for a 'Sink' for an Industrial Waste: Iron-Making Fuels and the Environment*, 18 ENVTL. HIST. REV. 9, 20 (1994) [hereinafter Tarr, *Searching for a 'Sink'*].

204. *See* COLTEN & SKINNER, *supra* note 140, at 24 (citing a 1922 report).

1. *The initial development of water quality standards.*

A number of states did take a tougher approach by establishing a waterway zoning system based upon beneficial uses—the forerunner of the modern water quality standards program. Pennsylvania, for example, created a Sanitary Water Board in 1923 that was authorized, first, to classify streams according to their use and then to protect those uses.[205] In 1925, the Ohio legislature gave its State Health Department the power to zone existing and potential sources of public water supplies. To protect these waters, the Ohio statute required new industries whose waste might pollute these streams and existing industries wishing to increase or change the nature of their discharges to devise an adequate way of treating their wastes.[206]

Although this legislation represented progress in the fight against water pollution, serious problems remained. For example, the Sanitary Water Board of Pennsylvania adopted a Class C use category for those streams "which it is economically inadvisable to restore to a clean condition."[207] The Ohio approach did not even apply to streams that were not used, nor contemplated for use, as drinking water supplies. As the Director of the Ohio State Health Department wrote: "The frankly expressed purpose of [our] legislation was not to protect fish life or recreational aspects, but rather to protect our [drinking] water supplies from the mounting tide of pollution which was slowly but surely destroying the safety of these supplies . . . ."[208] Moreover, states acting alone could not protect their public water supplies from interstate pollution.

205. *See* Tarr, *Searching for a 'Sink,' supra* note 203, at 22. A number of departmental chiefs or their representatives served on the Board, and its policies were administered by the Bureau of Sanitary Engineering in the Department of Health. *See* KEHOE, *supra* note 40, at 23. This approach was designed to minimize the conflicts between the public health authorities, on the one hand, and the new conservation commissions and departments, on the other. *See id.*

206. *See* Monger, *supra* note 202, at 791.

207. *Discussion of Administrative Phases of Stream Pollution Control*, 16 AM. J. PUB. HEALTH 795, 797 (1926) (comments of E. Phelps) [hereinafter *Discussion of Stream Pollution Control*]. The Board then decided that over one-third of the streams in Pennsylvania were so polluted that they were "not worth saving" and thus deserved a Class C classification. STRANAHAN, *supra* note 138, at 155.

208. Monger, *supra* note 202, at 791. A number of public health officials, however, disagreed with the proposition that the protection of public water supplies should be the sole aim of anti-pollution activities. *See, e.g.*, *Discussion of Stream Pollution Control*, *supra* note 207, at 796, 798 (comments of C.M. Baker).

2. *Early interstate cooperation.*

In at least one case, the federal government was able to encourage states to work together to control an interstate threat to the purity of municipal drinking water. In the early 1920s, the U.S. Public Health Service concluded that the drinking water in twenty-five cities located along the Ohio River and its tributaries had become virtually undrinkable.[209] The chlorine that the cities used to kill the bacteria in their drinking water supplies—drawn, of course, from the local rivers—was reacting with massive amounts of phenolic wastes discharged by new by-product coke ovens and producing a strong antiseptic flavor and odor.[210] These ovens were primarily located in the Pittsburgh and Youngstown areas, as well as in northeastern West Virginia. The U.S. Surgeon General, therefore, convened two national conferences with representatives from the affected states and other federal agencies.

The conferences led the Ohio River basin states of Pennsylvania, Ohio, and West Virginia to enter into an agreement in 1924 that established a common policy for dealing with phenolic pollution.[211] The states agreed not to regulate or sue the coking facilities, but to seek their cooperation in correcting the problem. They also agreed to appoint a board of public health engineers to oversee the process. By 1929, seventeen of the nineteen coke producers along the Ohio Valley had voluntarily installed phenol re-

209. *See* F. Holman Waring, *Results Obtained in Phenolic Wastes Disposal under the Ohio River Basin Interstate Stream Conservation Agreement*, 19 AM. J. OF PUB. HEALTH 758, 763 (1929).

210. *See id.* at 759 (describing the water as having "a sort of iodoform taste and odor" much "more objectionable" than the "medicinal flavor" phenol normally produced in water absent chlorine). Coke is nearly pure carbon, and it is produced by slowly heating coal in the absence of air. By-product coke ovens were generally located near large, integrated steelmaking operations. These steel plants used coke as fuel in their blast furnaces and the coal gas as fuel for other steelmaking processes. The by-product process also produced various dyes, inks, protective coatings, and other chemicals such as benzene, xylene, and toluene. *See* PHILIP A. MORRIS & MARJORIE L. WHITE, BIRMINGHAM BOUND: AN ATLAS OF THE SOUTH'S PREMIER INDUSTRIAL REGION 7, 33, 35 (1997).

211. *See* Monger, *supra* note 202, at 794; Tarr, *Searching for a 'Sink,' supra* note 203, at 24. All of the states in the Ohio River Valley—New York, Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, Tennessee, and Illinois—formally entered into an interstate compact to control water pollution in 1939. *See* Ohio River Valley Water Sanitation Compact (1930), *reprinted in* DOCUMENTS ON THE USE AND CONTROL OF THE WATERS OF INTERSTATE AND INTERNATIONAL STREAMS, COMPACTS, TREATIES, AND ADJUDICATIONS 231-37 (T. Richard Witmer ed., 1968) [hereinafter DOCUMENTS ON INTERSTATE WATERS]. For a discussion of various interstate water pollution control agreements, see N. William Hines, *Nor Any Drop to Drink: Public Regulation of Water Quality, Part II, Interstate Arrangements for Pollution Control*, 52 IOWA L. REV. 432 (1966).

duction processes. The process adopted by most of these producers, however, merely redirected phenolic pollution from one environmental medium to another. Rather than dumping the phenolic wastewater into adjacent streams, the plants were now using it to quench hot coke, a process that produced clouds of phenol, cyanide, and ammonia-laden steam for the nearby communities to breathe.[212]

Although some engineers objected to this practice, critics were unable to demonstrate how industrial air pollutants actually affected human health. In view of the limited knowledge of the day, most industrial and public health officials concluded that coke quenching was the most cost-effective solution to this serious water pollution problem.[213] Furthermore, to the public, it appeared as if the government had taken decisive action to safeguard public health.

3. *Public health concerns continue to dominate state programs.*

Unfortunately, the obvious impacts of industrial pollution on water supplies—obnoxious tastes, repulsive odors, and solids that clogged filters—were garnering more attention from public health authorities than the more subtle, but more devastating effects that industrial pollutants—acids, solvents, heavy metals, and other toxic chemicals—were having upon public health and the environment.[214] The limitations of science in the 1920s and 1930s made it extremely difficult to determine the biological impact of long-term exposure to small amounts of these industrial pollutants. In addition, the sanitary engineers who dominated water pollution research, as well as pollution control policy, were not particularly disposed to studying the toxic characteristics of industrial chemicals.[215] Nor could they have investigated these questions. The collaboration of physicians and biologists with engineers that had proved so fruitful in the fight against typhoid and other bacteriological diseases had run its course. The sanitary engineers now had "few means for expanding their health agenda beyond that set by their earlier medical collaborators," namely the bacterial threats to

212. *See* Tarr, *Searching for a 'Sink,' supra* note 203, at 24-26.

213. *See id.* at 26.

214. *See* COLTEN & SKINNER, *supra* note 140, at 24; MELOSI, SANITARY CITY, *supra* note 81, at 227-28; Herman G. Baity, *Aspects of Governmental Policy on Stream Pollution Abatement*, 29 AM. J. PUB. HEALTH 1297, 1299 (1939).

215. *See* Christopher Sellers, *Factory as Environment: Industrial Hygiene, Professional Collaboration and the Modern Sciences of Pollution*, 18 ENVTL. HIST. REV. 55, 70 (1994).

drinking water posed by sewage.[216] And so industry continued, in the vast majority of instances, to discharge untreated wastes.[217]

A few states tried to protect uses other than drinking water. Connecticut passed a statute in 1925 that created a state water pollution control commission, independent of the state health department, and authorized action to protect fish and recreation.[218] In many other states, however, the efforts of sportsmen and conservation groups, such as the Izaak Walton League,[219] to pass tougher legislation were unsuccessful.[220] Generally, state agencies—whether the state health department itself, an arm of the health department, or an independent pollution control body—continued to focus on purifying drinking water.

4. *The New Deal: Federal financing of local sewer projects.*

By 1930, American cities discharged more untreated sewage than they had in 1920,[221] and the pressure that the early Depression years exerted on municipal budgets produced even more trouble. Casting about for something to cut, many cities found sewage treatment budgets and personnel obvious targets for budget

216. *Id.* at 57.

217. *See* Tarr, McCurley & Yosie, *supra* note 37, at 75. Industry and some engineers argued that pollutants like mine acid drainage and pickling liquor from steel plants actually improved the sanitary condition of the receiving streams because they had a germicidal effect on sewage. *See, e.g.* TARR, URBAN POLLUTION, *supra* note 29, at 345; *Pollution of Navigable Waters, Hearings Before the Comm. on Rivers and Harbors, Part 2*, 67th Cong., 2d Sess. 122 (1921) (statement of the Vice President of the Hudson Coal Co. of Scranton, Pa.). The city engineer of Wilkes-Barre eventually contended that sewage was good for the receiving water because "it counteracted the acid in the river." STRANAHAN, *supra* note 138, at 164.

218. *See Discussion of Stream Pollution Control*, *supra* note 207, at 800 (comments of Warren J. Scott).

219. The Izaak Walton League was founded in Chicago in 1922 to represent the interests of sportsmen. It joined three other national conservation groups that had been organized during the Progressive Era: the Sierra Club, the Audubon Society, and the National Parks and Conservation Association. *See* Robert Cameron Mitchell et al., *Twenty Years of Environmental Mobilization: Trends Among National Environmental Organizations, in* AMERICAN ENVIRONMENTALISM: THE U.S. ENVIRONMENTAL MOVEMENT, 1970-1990, at 12-13 (Riley E. Dunlap & Angela G. Mertig eds., 1992).

220. *See* Monger, *supra* note 202, at 790-91. Interest in outdoor recreation was booming amid the prosperity of the 1920s. Sales of outboard motors, for example, grew 150 percent between the period of 1920-1924 and 1925-1929. *See* KEHOE, *supra* note 40, at 23.

221. The urban population served by sewers increased substantially during the 1920s, to some 60 million Americans. However, those whose sewered waste went untreated also rose, from 38 million in 1920 to 42 million in 1930. *See* TARR, URBAN POLLUTION, *supra* note 29, at 194. Sewage treatment, nevertheless, even if just a complement to dilution, was beginning to experience more acceptance as a necessary technical and public service. *See* MELOSI, SANITARY CITY, *supra* note 81, at 247-48.

reductions because they could be slashed without provoking an immediate public outcry.[222] The New Deal, in contrast, brought some relief as thousands of Americans were put to work building new sewage treatment plants.[223] By 1939, fifty-four percent of the sewered population was served by waste treatment facilities, although half of those facilities only provided primary treatment, a form of treatment that reduces carbonaceous biochemical demand by about thirty percent by removing most materials that float or settle.[224]

5. *Enforcement shunned in favor of cooperation and compromise.*

During the 1930s, industrial pollution went virtually unchecked.[225] Most state agencies possessed little pertinent regulatory authority.[226] Streams with use classifications were frequently relegated to the status of open sewers.[227] State agencies, furthermore, tended to shun enforcement—even the application of simple nuisance law—in favor of persuasion, education, cooperation, and compromise.[228] The sanitary engineers who dominated the agencies at this time argued that this cooperative approach was really

222. *See* Editorial, *New Occasions—New Duties*, 22 AM. J. PUB. HEALTH 1169 (1932).

223. *See* BEATRICE HORT HOLMES, U.S. DEP'T OF AGRICULTURE, A HISTORY OF FEDERAL WATER RESOURCES PROGRAMS, 1800-1960, at 13, 15-16 (1972); *see also* MELOSI, SANITARY CITY, *supra* note 81, at 240-44 (discussing New Deal-era sewage treatment construction projects).

224. Of a total sewered population of 73 million, 19 million were served by primary treatment facilities (providing about thirty percent removal of total organic material) and nearly 21 million were served by substantially more efficient facilities. The waste of the remaining 33 million Americans was discharged raw. *See* NATIONAL RESOURCES COMMITTEE, WATER POLLUTION IN THE UNITED STATES, THIRD REPORT OF THE SPECIAL ADVISORY COMM. ON WATER POLLUTION, H.R. Doc. No. 155-76 [hereinafter THIRD REPORT OF THE SPECIAL ADVISORY COMM. ON WATER POLLUTION]. Out of approximately 5000 sewage plants in operation in 1939, hundreds used activated sludge technology. More popular, however, were the Imhoff tank and trickling filter. *See* MELOSI, SANITARY CITY, *supra* note 81, at 249, 254.

225. *See* TARR, URBAN POLLUTION, *supra* note 29, at 373; W.B. Hart, *Waste Treatment Problems from the Viewpoint of Industry*, 20 SEWAGE WORKS J. 273, 273-74 (Mar. 1948). Although no reliable estimates exist that would indicate the total amount of industrial pollution discharged to the nation's waters in the late 1930s, the serious polluters were ranked in the following order of significance: food products, paper and pulp, textiles, petroleum products, and metallurgical products. There were estimates at the time, however, that the bituminous coal industry was responsible for the discharge of some 2.7 million tons of sulphuric acid annually. *See* MELOSI, SANITARY CITY, *supra* note 81, at 249-54; Baity, *supra* note 214, at 1299.

226. State agencies also continued to suffer from a lack of adequate funding. *See* KEHOE, *supra* note 40, at 23.

227. *See* Whipple, *supra* note 201.

228. *See, e.g.*, Waring, *supra* note 209, at 764, 770 (the Chief Engineer of the Ohio Department of Health urging cooperation with industry rather than enforcement and cit-

the only "practical" one, and that the "impatient" conservationists who sought tougher enforcement, even federal regulation and federal enforcement, were in hopeless pursuit of a "panacea."[229] A leading sanitary engineer asserted that "the critics appear to be so unacquainted with the technical bases of pollution abatement as to fail even to recognize that the scientific problems are difficult, complex, and slow of solution."[230]

Such attacks were not only arrogant and condescending, but also misleading. While no adequate technologies existed at the time to treat certain more exotic industrial discharges, industrial discharges were often organic in nature and thus amenable to the same sorts of biological treatment that were already used in conjunction with municipal wastes.[231] In other instances, sanitary engineers could have used simple sedimentation ponds that would have allowed various oils to be skimmed from waste streams prior to disposal. These engineers could also have easily devised various systems for reusing wastewater. Clearly, the claim that industrial treatment was difficult, perhaps technically impossible, to achieve helped mask the primary political and economic objections to stronger regulatory efforts aimed at industrial pollution. The agencies were undoubtedly concerned that the cost of compliance might slow future economic growth and might provoke some domestic industries to seek more hospitable business environments in other states.[232] The more immediate and pressing concern, however, was entirely political—fear of the personal and institutional price that might be exacted if powerful, entrenched industrial interests were taken to court.[233] The logic behind a cooperative ap-

ing the Ohio River Basin Agreement as a model approach); Monger, *supra* note 202, at 792; Baity, *supra* note 214, at 1303.

229. *See* Baity, *supra* note 214, at 1302.

230. *Id.* at 1303. Dr. Baity's paper was read at the 1939 Annual Meeting of the American Public Health Association in Pittsburgh, Pennsylvania.

231. *See* THIRD REPORT OF THE SPECIAL ADVISORY COMM. ON WATER POLLUTION, *supra* note 224, at 48; H. Sidwell Smith, *The Industrial Point of View, in* WATER POLLUTION AND ABATEMENT 134, 135 (Ted L. Willrich & N. William Hines eds., 1967).

232. *See* COLTEN & SKINNER, *supra* note 140, at 77; Galishoff, *supra* note 27, at 54; MELOSI, SANITARY CITY, *supra* note 81, at 231; Hines, *Part I,* supra note 68, at 186, 235; KEHOE, *supra* note 40, at 38; Monger, *supra* note 202, at 792; Tarr, *Searching for a 'Sink,' supra* note 203, at 22-23, 27; U.S. EPA History Program, Oral History Interview with William D. Ruckelshaus 5-7 (1993) (recalling industry's threat to "move to the south" whenever the Indiana program pushed too hard back in the 1960s) [hereinafter Ruckelshaus].

233. *See, e.g.*, Hines, *Part I, supra* note 68, at 205 (1966) (referring to the "enormous" political clout and economic power possessed by some large scale polluters—a fact that was recognized by the state pollution control agencies); Monger, *supra* note 202, at 792 (argu-

proach thus appeared to be unassailable to these state officials. One, therefore, also wonders whether little more than self-interest may have been behind two other claims commonly made by state officials—namely, that industry wanted to cooperate with them, and that cooperation produced faster and better results than more formal regulatory tools.[234] Self-interest, as well as an attempt at self-justification, may have also motivated those sanitary engineers who placed an inordinate amount of emphasis on the capacity of receiving streams to assimilate industrial waste and their own ability to determine the proper balance of uses for every stream.[235]

6. *The impact of World War II.*

World War II brought total industrial mobilization, a near complete dedication of resources to the war effort, and a huge rise in water pollution. The federal public works program that had constructed so many municipal waste treatment facilities during the 1930s was an early victim of the war budget.[236] Traditional industries like iron, steel, oil, coal, automobiles, and shipbuilding, and newer ones such as aluminum and aircraft experienced massive expansions and tight production schedules. Prodigious quantities of munitions and chemicals were produced, while electricity generation rose by over fifty percent. Wartime shortages and military research spending also resulted in dozens of new products and chemical formulations, such as synthetic rubber and nylon, artificial detergents and solvents, DDT, and other pesticides.[237] The priority given to rapid increases in the nation's capacity to wage war meant that virtually all new industrial wastewater, just like old wastewater, would be dumped—untreated—into the nation's waterways.[238] "[C]onditions that were bad enough before the war [thus] became much worse."[239] Not surprisingly, given their prior track

ing that public opinion at the time would not support strict enforcement efforts); Ruckelshaus, *supra* note 232, at 5-6 (stating that the Governor's office in Indiana would call to remind the state program that "the offending industries would leave the state if pressed too much").

234. *See* Monger, *supra* note 202, at 792; Waring, *supra* note 209, at 764, 769-70.

235. *See* Baity, *supra* note 214, at 1298, 1305-06. Those emphasizing the self-purifying capacity of streams sometimes failed to point out the almost complete lack of data concerning the composition, toxicity, and volume of industrial discharges, plus the fact that toxic chemicals are seldom if ever purified by the action of a flowing stream. *See id.*

236. *See* Murphy, *supra* note 141, at 89.

237. *See* Andrews, *supra* note 26, at 180-81.

238. *See* Melosi, Sanitary City, *supra* note 81, at 314.

239. Hart, *supra* note 225, at 273. The Delaware River had become so polluted with

record and the demands of wartime, state agencies turned a blind eye.[240]

C. *Too Little, Too Late: 1945-1972*

By the war's end, industrial discharges were the greatest source of water pollution in the United States. Industrial waste effluents now outpaced municipal sewage by a ratio of seven to six.[241] World War II, moreover, was followed by an era of unprecedented growth and prosperity. Between 1946 and 1970, chemical production increased six times over, rubber and plastic production rose nearly five-fold, and aluminum production quadrupled. Furthermore, car sales doubled, phosphate detergents came into large-scale use, and pesticide usage climbed 168 percent.[242] At the same time, industry was not eager to be subjected to government regulation. At the federal level, industry leaders argued that pollution control should be treated as a state matter,[243] and, at the state level, they contended that strict regulation would drive business into less regulated jurisdictions.[244] Consistent with those positions, these businessmen often argued that they should be allowed to control their own polluting activities through trade association guidance and self-regulation.[245]

1. *The reorganization of state water pollution control efforts.*

Whether it was because of the grossly polluted condition of the nation's waters or because of "the specter of [possible] federal intervention," many states did attempt to reform their water pollution programs during the post-war era.[246] One approach they took was to reorganize their water pollution control effort. Up to this

industrial chemicals that the commandant of the Philadelphia Naval Yard complained that the river was responsible for eating the paint off his ships. *See* STRANAHAN, *supra* note 138, at 166 n.8.

240. *See* COLTEN & SKINNER, supra note 140, at 139 (citing a 1947 article that appeared in the *Engineering News-Record*); MURPHY, *supra* note 141, at 89. As the Governor of Indiana explained, "it would be irrational to attempt punitive action against industries . . . exerting themselves on war production." *Id.*

241. *See* MURPHY, *supra* note 141, at 89; TARR, URBAN POLLUTION, *supra* note 29, at 375 (quoting U.S. Surgeon General Dr. Thomas Parran).

242. *See* ANDREWS, *supra* note 26, at 186-88.

243. "Left unsaid was the fact that because of their firms' greater economic importance and political clout at the state level, business executives simply found it easier to exert influence over state officials . . . ." KEHOE, *supra* note 40, at 35.

244. *See* MURPHY, *supra* note 141, at 89.

245. *See* COLTEN & SKINNER, *supra* note 140, at 89.

246. KEHOE, *supra* note 40, at 25.

time, most substantive state authority had been located in the state health department. This organizational scheme had been roundly criticized by conservationists and other reformers,[247] who alleged that health departments were unduly influenced by powerful economic interests, and that as a result, their efforts at anti-pollution enforcement were exceedingly lax.[248]

Although in some cases a "go-slow" enforcement policy may have been justified by the sheer complexity of certain problems, all too often "the laxness in enforcement may well have been attributable to an unwillingness to face up to the difficult policy decisions required for successful pollution control."[249] The critics of the status quo also felt that the health departments had too many different programs to administer to allow them to focus adequate attention on water pollution. Furthermore, their emphasis on the bacteriological aspects of water pollution limited their ability to deal with pollution in a more modern, comprehensive fashion.[250]

In response to this critique, a number of states created new independent pollution control agencies during the 1950s.[251] Others chose to reorganize the pollution control functions within their health departments.[252] By 1966, thirteen states had established independent pollution control agencies, while twenty-one states had created a statutory agency within the health department or other designated body to administer water pollution programs. In sixteen states, however, primary authority for pollution control remained vested with the state department of health.[253]

247. *See* Hines, *Part I*, *supra* note 68, at 204-07.

248. *See id.* at 204-05. State regulatory agencies are more likely to be "captured"—thus minimizing their ability to act in the public interest—since they face the task of regulating a relatively small number of companies, some of which are extraordinarily powerful, in the relatively parochial environment of a state capital. *See* AYRES & BRAITHWAITE, *supra* note 23, at 55. But whether or not any of these agencies were, in fact, captured, it was impossible for them to ignore threats, such as those repeatedly made by the Wisconsin paper industry, that the industry would just leave and go to a state, most likely a southern state, "where its presence would be more appreciated." MURPHY, *supra* note 141, at 105.

249. *See* Hines, *Part I*, *supra* note 68, at 205.

250. *See id.* at 206; Murray Stein, *Problems and Programs in Water Pollution*, 2 NAT. RESOURCES J. 388, 405-06 (1962); *see also* HASKELL & PRICE, *supra* note 46, at 245 (offering a broad but succinct analysis of the inability of state health departments to administer effective pollution control programs).

251. *See* Hines, *Part I*, *supra* note 68, at 204.

252. *See id.* at 204.

253. *See id.* at 216. In most instances, a part-time board or commission was set up to make major policy decisions for the new agency, regardless of whether it was a completely independent agency or just a reorganized portion of the health department. *See* KEHOE, *supra* note 40, at 25. Some of these boards were composed wholly of state officials includ-

2. *The difficult challenge of implementing water quality standards.*

Many states also tried to specify the level of pollution that could be tolerated in a given body of water. Pennsylvania was the first state to adopt this kind of approach,[254] and by 1963, ten more states had followed suit, establishing fairly comprehensive systems to set water quality standards.[255] Under this approach, streams or particular reaches of a stream would be classified for a particular use such as industrial operations, agriculture, fish and wildlife, shellfish harvesting, recreation, or drinking water supply. To maintain the designated use, technical criteria would be set to define maximum amounts of such things as bacteria and solids, and the minimum level of dissolved oxygen that could be present in the receiving stream.[256] While these standards had the advantage of being adaptable to local conditions, the criteria were difficult to set. In addition, they were extremely difficult to implement because the ambient criteria, in order to be enforceable, had to be translated into specific discharge limitations.[257] In doing so, how were regulators supposed to allocate the assimilative capacity of the stream? Should the allocation be based on the number of employees in each industry, the number of citizens in each town, or something else? Would it have to be recalculated every time there was a new, modified, or expanded discharge? Should a mixing zone in the receiving stream be taken into account when setting discharge limits? If so, how large should the zone be—two feet below the

ing, for example, representation from the highway, health, agriculture, commerce, and conservation departments. Others also had members from various interest groups. *See* Hines, *Part I*, *supra* note 68, at 218. Statutes generally specified that these members would represent groups such as industry, agriculture, municipal governments, and labor. Statutes also often included one or two members from conservation groups or the general public. *See* HASKELL & PRICE, *supra* note 46, at 244.

254. *See supra* notes 198 & 200, and accompanying text.

255. *See* 109 CONG. REC. 19,662-63 (1963) (comments of Sen. Sherman Cooper of Kentucky) (listing Massachusetts, Nebraska, New Hampshire, New York, North Carolina, Oregon, South Carolina, Utah, Vermont, and Washington). Some other states that did not have formal water quality standards did classify streams on an informal basis in order to try to set discharge limitations for particular areas. *See* KEHOE, *supra* note 40, at 33. Others, like Mississippi, had established some minimum water quality criteria (for dissolved oxygen, for example) while others, like Idaho and Maryland, had set some minimum effluent standards (like primary or secondary treatment). *See* 109 CONG. REC. 19,660 (1963).

256. *See, e.g.,* N.Y. WATER POLLUTION CONTROL BOARD, RULES AND CLASSIFICATIONS AND STANDARDS OF QUALITY AND PURITY FOR WATERS OF NEW YORK STATE (1950); FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WATER QUALITY CRITERIA: REPORT OF THE NATIONAL TECHNICAL ADVISORY COMMITTEE TO THE SECRETARY OF THE INTERIOR vii (1968); Hines, *Part I*, *supra* note 68, at 226.

257. *See* Hines, *Part I, supra* note 68, at 226.

discharge pipe, 200 feet, or two miles downstream?[258]

Aside from these technical problems, many critics also feared that stream standards would be "permanently fixed" at too low a level and that, once fixed, inertia would transform them into "veritable licenses to pollute."[259] These fears were sometimes realized. In Mississippi, for example, the Game and Fish Commission, in order to protect fish and wildlife, set a minimum average dissolved oxygen concentration of three milligrams per liter in 1946,[260] despite the fact that it was already well-recognized that five milligrams per liter was necessary to maintain a diverse fish population in inland waters.[261] The Mississippi standard, however, remained unchanged for over twenty years until 1967 when, under federal prodding, the standard was raised to a still inadequate standard of four milligrams per liter.[262] After surveying the history of water quality standards in the Great Lakes area during this same period, Terence Kehoe, an environmental historian, concluded that these standards had "led to a system of de facto 'zoning' in which some rivers and lake areas were allowed to deteriorate and even relatively clean waters were exposed to waste discharges that received less treatment than appeared feasible at the time."[263]

3. *The early development of uniform effluent limitations.*

Many clean water advocates argued that all polluters should be forced to clean up their discharges according to some uniform approach, despite the condition of the receiving stream.[264] In fact, uniform effluent limitations had been in use for nearly as long as water quality standards.[265] The Pennsylvania Sanitary Water Board

258. *See* Milligan, *supra* note 65, at 279. Milligan was an industrial wastes engineer with the Pennsylvania Department of Health. The EPA and every state program in the country still wrestle with the kinds of questions he raised in 1948 about waste load allocations and mixing zones.

259. *See* Hines, *Part I*, *supra* note 68, at 224.

260. *See* Mississippi Comm. on Natural Res. v. Costle, 625 F.2d 1269, 1273 (5th Cir. 1980).

261. *See, e.g.*, THIRD REPORT OF THE SPECIAL ADVISORY COMM. ON WATER POLLUTION, *supra* note 234, at 64; M.M. Ellis, *Detection and Measurement of Stream Pollution*, 48 BULL. U.S. BUREAU OF SPORT FISHERIES AND WILDLIFE 365, 376 (1937).

262. *See* Mississippi Comm. on Natural Res., 625 F.2d at 1273.

263. KEHOE, *supra* note 40, at 10. Hines similarly concluded that "[t]he history of state control of pollution does not support optimism toward the control agency's development of rigorous standards." Hines, *Part I*, *supra* note 68, at 224.

264. *See* KEHOE, *supra* note 40, at 10.

265. *See* New York Harbor (Tri-State) Interstate Sanitation Compact Art. VII (1935), *reprinted in* DOCUMENTS ON INTERSTATE WATERS, *supra* note 220, at 227 (requiring all sewage

adopted this approach in the mid-1940s, requiring sewage treatment facilities to make certain percentage reductions in their discharges and requiring industry to treat its waste to an equivalent degree.[266] In Pennsylvania, effluent limitations did not replace water quality standards; rather, they were used in conjunction with water quality standards. Just like the federal Clean Water Act of 1972, the Pennsylvania program in the 1940s aimed at imposing more stringent requirements than minimum effluent limitations in order to meet ambient stream standards.[267]

Industry chafed under the Pennsylvania approach. Many companies felt that the use of effluent limitations required, at least in many cases, "treatment for treatment's sake."[268] As an Atlantic Refining official put it in 1948, "[w]aste treatment is only a tool . . . to be used in building the recovery of a stream which has been spoiled . . . But what will it matter if twenty or a thousand establishments discharge their waste into a stream if that stream fulfills all its values . . . ?"[269] In such a case, the use of effluent limitations could lead to an unnecessarily high level of cleanup.

Defenders of the Pennsylvania program justified its approach in two ways. First, they argued that it was only fair that each discharger do its share to clean up state waters. A company that does the right thing by investing in pollution control technology and keeping it in good operating condition should not be "penalized with respect to a similar plant having poor housekeeping."[270] Second, effluent limitations were used for practical reasons. The problems with actually applying water quality standards as a regulatory device were so "overwhelming" that an approach "based solely on the condition of the receiving streams [was] simply not feasi-

discharges in Class A areas to have been treated to remove all floating solids and at least sixty percent of suspended solids); Ohio River Valley Water Sanitation Compact art. VI (1939), *reprinted in* DOCUMENTS ON INTERSTATE WATERS, *supra* note 220, at 233 (requiring, within a reasonable time, the treatment of municipal sewage to remove substantially all settleable solids and not less than forty-five percent of suspended solids).

266. *See* Milligan, *supra* note 65, at 280. A number of other states also relied, at least in part, upon the use of effluent limitations. *See, e.g.,* MD. ANN. CODE. art. 96A, § 23 (1957); OHIO REV. CODE ANN. § 6111.03 (West 1964).

267. *See* Milligan, *supra* note 65, at 279-80 (describing what was in the author's opinion a compromise between "one extreme of arbitrary percentages of reduction for each source of pollution and the opposite extreme of requirements based only on the condition of the receiving body of water").

268. *See* KEHOE, *supra* note 40, at 10.

269. Hart, *supra* note 225, at 277.

270. Milligan, *supra* note 65, at 280.

ble."[271] If the Pennsylvania program had been denied the use of effluent limitations, many disinterested engineers and chemists agreed that the state's "stream improvement program would be delayed for years."[272] Perhaps that is precisely why industry preferred the ambient water quality approach.[273]

4. *Weak enforcement continues.*

Enforcement remained a major weakness in most state programs throughout the post-war period and up until the 1970s.[274] This was not due to a paucity of enforcement tools, but to the belief among state regulators that persuasion was more effective than formal enforcement tools.[275] The Indiana State Pollution Control Board, for instance, justified its reliance upon persuasion and cooperation by claiming that it was able to "maintain better relations with offenders which results in a greater likelihood of effective operation of the pollution abatement facilities with a minimum of supervision by State-employed personnel."[276] This approach undoubtedly helped state agencies maintain cordial relations with the regulated community, but the "policy of entreatment" failed to produce cleaner streams.[277]

The reliance upon voluntarism and informal cooperation reflected the limited political power that most of these agencies possessed.[278] The reality of having to deal with politically powerful

271. *Id.* at 279.

272. *Id.* at 280.

273. Industry's argument against the Pennsylvania use of effluent limitations seems to have been misdirected in at least in one respect. It argued for clear and well-defined regulatory requirements, and directed its criticism at the requirement that industrial treatment levels were to be somehow equivalent to municipal treatment. *See* Hart, *supra* note 225, at 276. However, over the long run, a mature system of effluent limitations likely produces more certainty and better-defined limitations than a system based solely upon water quality standards. *See, e.g.*, Hines, *Part I*, *supra* note 68, at 226.

274. *See* WATER RESOURCES COUNCIL, STAFF REPORT TO THE NATIONAL COMMISSION ON WATER QUALITY, STAFF REPORT V-29 (April 1976).

275. *See* Hines, *Part I*, *supra* note 68, at 227; Stein, *supra* note 250, at 406, 408-09; MURPHY, *supra* note 141, at 115-16, 143; *see also* Stein, *supra* note 250, at 407-08 (setting forth a statistical compilation of state enforcement activity primarily during the 1950s).

276. KEHOE, *supra* note 40, at 35 (quoting from the agency's *Annual Report, 1962-1963*).

277. Hines, *Part I*, *supra* note 68, at 227. Many officials and employees in the state agencies had likely deceived themselves into thinking that the path of least resistance was, in fact, the most effective way to reach compliance.

278. All too often these agencies were small, "overworked, understaffed, underfinanced, and [possessed] very little power." Arnold W. Reitze, Jr., *Wastes, Water, and Wishful Thinking: The Battle of Lake Erie*, 20 CASE W. RES. L. REV. 5, 80 (1968) [hereinafter Reitze,

cities and industries with major economic clout[279] made moderation a virtue in the eyes of the pragmatic engineers who ran the agencies. This moderation—compromise, in the eyes of the conservation community—meshed well with the professional values that dominated the engineering community at the time. Sanitary engineers were proud individuals, proud of their professional competence and common sense, and convinced that important resource decisions ought to be made by hardheaded, technically trained experts like themselves.

These experts in "horn-rimmed glasses and dark suits" also defined professional success by reference to "well-established professional norms."[280] These norms dictated that the engineer as regulator needed, above all, to set a practical course that could generate support in the community and provide for economic prosperity. The need for wastewater treatment and the degree necessary to clean up, therefore, depended upon the use of the stream, its assimilative capacity, and the economic impact of pollution control upon the community. "Any other approach struck the engineers as wasteful and inefficient."[281]

It was not uncommon for state regulators to become "overly sympathetic" to the interests of those they regulated.[282] This ten-

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Lake Erie]; *see also* ANDREWS, *supra* note 26, at 232 (stating that prior to 1970, most state governments had "developed little institutional capacity to control pollution"). In 1965, for instance, the Ohio Water Pollution Control Board's entire engineering staff included just nine professionals, while the state spent only $240,000 on the agency's budget. Even with a federal grant-in-aid of $214,000, the state agency's total budget fell far short of the $2 million a year that the Federal Water Pollution Control Administration recommended for the agency's budget. *See* Reitze, *Lake Erie, supra,* at 80-81. The Ohio League of Women Voters also detected a rather perverse tendency to match increases in federal aid with decreases in state funding. *See id.* at 81 (citing LEAGUE OF WOMEN VOTERS OF OHIO, WATER POLLUTION CONTROL, POLLUTION CONTROL BOARD POLICIES, PROGRAMS, AND LAWS IN OHIO 6 (1966)).

279. Industry also consistently intimidated state agencies by trotting out the old argument about competitive disadvantage—the contention that strong regulation would penalize in-state companies and thus disadvantage them vis-à-vis industry located in other states. This assertion, according to Kenneth Reid, the Executive Director of the Izaak Walton League, explained why so many states failed to make "any real effort" to enforce their water pollution laws. *Pollution of Navigable Waters: Hearings on H.R. 519, H.R. 587, and H.R. 4070 Before the House Comm. on Rivers and Harbors,* 79th Cong. 230 (1945). Mr. Reid added, "I think the only thing that will make pollution control effective is uniformity . . . because no State is going to enforce pollution control against its industries . . . if competing industries in the neighboring States are not compelled to do the same thing." *Id.* at 235.

280. KEHOE, *supra* note 40, at 31.

281. *Id.* at 32.

282. HASKELL & PRICE, *supra* note 46, at 244. For a discussion of how major polluters exercised influence over many state agencies, see ARNOLD W. REITZE, JR., 1 ENVIRONMENTAL

dency on the part of the professional staff was often echoed by state governing boards that were generally dominated by representatives of local governments and industrial interests. While the boards were theoretically designed to guarantee broad representation, "in practice these bodies [were] run as the private clubs of the regulated interests."[283]

5. *A few success stories.*

Nevertheless, during these years the states made some progress. A number of states created permit systems to regulate the discharge of water pollutants, although in most instances the permit requirements only applied to new facilities or to substantial modifications to existing ones.[284] New municipal treatment facilities were also built.[285] Ohio virtually doubled its sewage treatment capacity during the 1950s,[286] and in the mid-1960s New York Governor Nelson Rockefeller's Pure Waters program—including a $1 billion bond issue to build sewage treatment plants—was enacted into law.[287] Ohio, furthermore, reported that by 1959, two-thirds of the state's industries that discharged into Lake Erie or its tributaries had attained satisfactory levels of waste treatment.[288] Such claims, however, were often misleading. The Ohio authorities, for example, did not define the level of treatment that was satisfactory, and industrial wastewater treatment in the Great Lakes area at this time typically left significant amounts of pollution in a plant's effluent discharge.[289]

6. *The rising tide of dissatisfaction with state efforts.*

In the face of a growing population and rapidly expanding manufacturing activity, state regulatory efforts were proving too lit-

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LAW 4-137 (1972); *see also* DENNIS C. WILLIAMS, THE GUARDIAN: EPA'S FORMATIVE YEARS, 1970-1973 (EPA History Program 1993) (stating that business groups preferred state regulation to federal because "they found it easier to outmaneuver or bully state officials into not enforcing regulations").

283. HASKELL & PRICE, *supra* note 46, at 244.

284. *See* Hines, *Part I, supra* note 68, at 230-31. By 1970, at least eight states had some kind of permit program. *See Water Pollution Control in Texas*, 48 TEX. L. REV. 1029, 1057-60 (1970); L.A. Powe, Jr., *Water Pollution Control in Washington*, 43 WASH. L. REV. 425, 432 (1967).

285. *See* MELOSI, SANITARY CITY, *supra* note 81, at 329-30.

286. *See* KEHOE, *supra* note 40, at 44.

287. *See id.* at 83-84.

288. *See id.* at 45. Ohio officials claimed that municipal and industrial expenditures on water pollution control in Ohio topped $600 million during the 1950s. *See id.* at n.1.

289. *See id.* at 45.

tle, too late. In 1960, 3,500 cities and towns in the United States were still discharging the raw waste of 25 million Americans.[290] Of the approximately 7,500 communities that had sewage treatment facilities, only two-thirds were served by secondary treatment plants; the rest made do with antiquated, primary treatment systems.[291] Viewed in a more abstract way, the total effluent from both treated and untreated municipal sources in the United States in 1960 would have equaled the amount of raw sewage produced by 75 million people.[292] Despite all this sewage, municipal sources were running "a distant second to industry in the water pollution derby."[293] By 1968, eighty percent of the pollutant loading to American waters was industrial in origin, up from forty percent in 1900.[294] Of the 22 billion gallons of wastewater which American industry discharged on a daily basis in 1970, only twenty-nine percent received *any* treatment whatsoever—regardless of whether the level of treatment was adequate.[295]

The implications for water quality were appalling. In the 1960s, Lake Erie was experiencing accelerated eutrophication[296]—a process that also adversely affected a number of other American waters including Lake Tahoe, the Great South Bay on Long Island, Lake Oneida in New York, and a number of bays along the southern shore of Lake Ontario.[297] In 1968, the Buffalo River was described

290. *See* Stein, *supra* note 250, at 396-97.

291. *See* MELOSI, SANITARY CITY, *supra* note 81, at 332.

292. *See* Stein, *supra* note 250, at 396.

293. Hines, *Part I, supra* note 68, at 192.

294. *See* Melosi, *Environmental Crisis, supra* note 97, at 7. In 1963, American industry was discharging—measured solely in terms of the biological oxygen demand (BOD) of organic wastes and suspended solids—three times more waste than municipal sources, and these industrial discharges were increasing at the rate of 4.5 percent per year—three times the rate of U.S. population growth. BEATRICE HORT HOLMES, U.S. DEP'T OF AGRICULTURE, HISTORY OF FEDERAL WATER RESOURCES PROGRAMS AND POLICIES, 1961-70, at 208 (1979). Viewed from a historical perspective, the discharge of organic industrial waste had increased ten-fold during the first sixty years of the twentieth century. *See* Stein, *supra* note 250, at 398. No figures, moreover, were available in the early 1960s on the amount of inorganic wastes (mine acid, as well as wastes from metal pickling, metal finishing, chrome tanning, and so on) or synthetic chemicals dumped into U.S. waters on an annual basis. *See id.* at 399-400.

295. *See* Rodgers, *supra* note 69, at 764. This did, however, represent quite an improvement. In 1957, for instance, only 2.9 percent of the chemical manufacturing facilities in the Northeast, Middle Atlantic, and Midwest states had some form of waste treatment in place. *See* COLTEN & SKINNER, *supra* note 140, at 90.

296. *See* WILLIAM MCGUCKEN, LAKE ERIE REHABILITATED: CONTROLLING CULTURAL EUTROPHICATION, 1960S–1990S, at 44-48 (2000).

297. *See* D.F. Jackson, *Introduction* to ALGAE, MAN, AND THE ENVIRONMENT vii (D.F. Jackson ed., 1968). For more examples, see W.T. Edmondson, *Eutrophication in North*

as "a repulsive holding basin for industrial and municipal wastes under the prevalent sluggish flow conditions. It [was] devoid of oxygen and almost sterile. Oil, phenols, color, oxygen-demanding materials, iron, acid, sewage, and exotic organic compounds [we]re present in large amounts."[298] The Cuyahoga was described in equally graphic terms in 1968: "The lower Cuyahoga River and navigation channel throughout the Cleveland area is a waste treatment lagoon. At times, the river is choked with debris, oils, scums, and floating globs of organic sludge. Foul smelling gases can be seen rising from decomposing materials on the river's bottom."[299] While these two rivers were among the most polluted in the United States in the late 1960s, appalling conditions afflicted countless streams and lakes across the country.[300] For more and more Americans, water pollution was becoming intolerable.

With the rise of the "affluent society"[301] most Americans could afford to devote increasing amounts of time and resources to recreation and various outdoor pursuits. All too often, however, the trip to the beach or to one's favorite fishing spot was marred by foul, rotting algae, dead fish, or globs of oil and tar. Not surprisingly, many Americans concluded that stronger discharge requirements and stronger enforcement mechanisms were needed.[302] State regulatory agencies, however, seemed sluggish and unresponsive, una-

America, in EUTROPHICATION: CAUSES, CONSEQUENCES, CORRECTIVES 124-49 (National Academy of Sciences ed., 1969).

298. U.S. DEP'T OF INTERIOR, FWPCA LAKE ERIE REPORT: A PLAN FOR WATER POLLUTION CONTROL 50 (Aug. 1968).

299. Reitze, *Lake Erie, supra* note 278, at 7 (quoting a statement of George Harlow, Director of the Lake Erie Program Office of the Federal Water Pollution Control Administration).

300. *See, e.g.*, DONALD E. CARR, DEATH OF THE SWEET WATERS 127-80 (1966) (discussing dozens of grim situations nationwide); Thomas E. Christman, *Water Pollution and Expanding Production in the Steel, Chemical, and Petroleum Industries, in* ENVIRONMENTAL SIDE EFFECTS OF RISING INDUSTRIAL OUTPUT 45, 77-82 (Alfred J. Van Tassel ed., 1970) (summarizing water quality problems in New York, New Jersey, Indiana, Illinois, California, and Rhode Island). Even at Niagara Falls, tourists were forced to cover their noses to ward off the stench coming from the sewage and industrial waste discharged to the Niagara River. *See* KEHOE, *supra* note 40, at 94.

301. This term was coined by John Kenneth Galbraith to describe the post-war American economy. JOHN KENNETH GALBRAITH, THE AFFLUENT SOCIETY (1969).

302. *See* KEHOE, *supra* note 40, at 52-53 (referring to calls for action made not only by the traditional conservation groups, but by good government groups such as the League of Women Voters and new single-issue groups that focused on water pollution or particular rivers and lakes). Membership in the major environmental organizations grew rapidly during the 1960s. Membership in the Sierra Club, for instance, jumped from 20,000 in 1959 to 113,000 in 1970, while membership in the National Wildlife Federation rose from 271,000 in 1966 to 540,000 in 1970. *See* SALE, *supra* note 59, at 23.

ble or unwilling to do what was necessary to correct these problems.[303] Some of their officials seemed almost eager to turn themselves into caricatures of complacency. For example, amid national headlines about the sorry condition of Lake Erie in 1965, the chairman of the Ohio Water Pollution Control Board in 1965 not only asserted that the lake was in relatively good shape, but accused extremists of having blown the water pollution problems of Lake Erie out of proportion.[304] Not to be outdone, the chairman of the North Carolina State Stream Sanitation Committee proudly declared in 1966 that "[w]e have never had a case in court. We go the first mile, the second mile, and then sometimes the third mile."[305]

The federal government, in contrast, appeared to be more aggressive in the 1960s. The federal water pollution control program was growing quickly, and a number of liberal Democrats in Congress were trying to expand the federal role in combating water pollution. Many concerned and disgruntled Americans citizens began turning to the federal government for help.

IV. Conclusion

The United States experienced a remarkable transformation during the first century and a half of its history—a transition from a rural society to an urban one, from an agrarian economy to an industrial power. During that time, local and state governments had to contend with all the consequences of rapid change, including a number of new health and environmental challenges. It is not surprising that these governments responded to the growing problem of water pollution with a series of short-term solutions. Many of the problems associated with urban water quality, for example, appeared amenable at first glance to quick, though often expensive, technological fixes.

Unfortunately, such quick fixes often failed to produce lasting solutions. Faced with ever-increasing levels of water pollution from both municipal and industrial sources, state governments developed a number of regulatory approaches to try to control water pollution. Occasionally, these regulatory approaches were quite innovative—the first uniform effluent limitations, for instance, as

303. *See* Haskell & Price, *supra* note 46, 243; Andrews, *supra* note 26, at 232-33.

304. *See* Kehoe, *supra* note 40, at 64. For years, in fact, the Ohio agency had been defending the water quality in Lake Erie despite mounting evidence to the contrary—perplexing many concerned citizens in the process. *See id.* at 61.

305. David Zwick & Marcy Benstock, Water Wasteland 258 (1971).

well as water quality standards and discharge permits. The new regulatory devices, however, failed to fulfill their promise. Faced with powerful, concentrated opposition from industry as well as from many municipalities, the states were reluctant to apply them comprehensively. Furthermore, regardless of which regulatory mechanism a state employed—innovative or more traditional—state water pollution control agencies were generally unwilling to take vigorous enforcement action, preferring informal cooperation and voluntary compliance. The public's tolerance for this incremental and largely ineffective approach to pollution control was wearing thin by the 1960s.

The pace of federal activity, therefore, accelerated between 1961 and 1970. The Federal Water Pollution Control Act of 1948[306] (the slender reed that it was) was amended four times,[307] and by 1970 the Refuse Act of 1899[308] had been rediscovered as an enforcement tool that could be used against industrial dischargers.[309] The nation's overall approach to water pollution, however, remained disjointed, and the nation's water quality continued to decline. By 1972, the country was searching for a dramatically different approach, one that was informed by prior experience, not limited by it—an approach to regulation which eschewed short-term answers in favor of long-term, comprehensive strategies. In short, the time was ripe for an extraordinary new statute: The Clean Water Act of 1972. The evolution of this federal response will be developed in the second installment of this article.

306. Pub. L. No. 80-845, 62 Stat. 1155 (1948).

307. Federal Water Pollution Control Act Amendments of 1961, Pub. L. No. 87-88, 75 Stat. 498; Water Quality Act of 1965, Pub. L. No. 89-234, 79 Stat. 903; Clean Water Restoration Act of 1966, Pub. L. No. 89-753, 80 Stat. 1246; Water Quality Improvement Act of 1970, Pub. L. No. 91-224, 84 Stat. 91.

308. Rivers and Harbors (Refuse) Act of 1899, § 13 (Codified at 33 U.S.C. § 407 (2000)).

309. *See* Rodgers, *supra* note 69, at 767-69.