

Notes

A DRASTIC Approach to Controlling Groundwater Pollution

Lawrence Ng

In the late 1960's and early 1970's public disgust with the nation's brown skies and befouled water provoked widespread pollution abatement campaigns and prompted the enactment of federal air and water pollution control legislation aimed at alleviating the aesthetic and public health costs of pollution.¹ Overlooked in this flurry of environmental protection legislation was groundwater,² a hidden, long misunderstood, but vitally important and ubiquitous³ resource. Yet today, groundwater is rapidly moving to the front ranks of the nation's environmental protection priorities.⁴

The reasons for this increased interest in protecting groundwater are not difficult to discern. Groundwater provides a substantial proportion—almost twenty-four percent—of the nation's domestic, agricultural,

1. Between 1969 and 1972, Congress enacted the National Environmental Policy Act of 1969, Pub. L. No. 91-190, 83 Stat. 852 (1970); the Clean Air Act Amendments of 1970, Pub. L. No. 91-604, 84 Stat. 1676 (1970); and the Federal Water Pollution Control Act, Pub. L. No. 92-500, 86 Stat. 816 (1972).

2. Groundwater refers to subsurface water in fully saturated soils and geologic formations. *See* R. FREEZE & J. CHERRY, *GROUNDWATER* 2 (1979). This Note will use the term "groundwater," except where quoted materials use a different variation.

3. "Ground water is available in at least small amounts at nearly every point of the Earth's surface . . ." R. HEATH, *GROUND-WATER REGIONS OF THE UNITED STATES* 1 (1984) (United States Geological Survey Paper No. 2242).

4. The United States Environmental Protection Agency (EPA) suggests that groundwater "looms as a major issue for the 1980's." U.S. EPA, *GROUND-WATER PROTECTION STRATEGY* 1 (1984) [hereinafter *EPA GROUNDWATER STRATEGY*]; *see also* HOUSE COMM. ON GOVERNMENT OPERATIONS, *GROUNDWATER PROTECTION: THE QUEST FOR A NATIONAL POLICY*, H.R. DOC. NO. 1136, 98th Cong., 2d Sess. 2 (1984) (reiterating conclusion in 1980 that "ground water destruction will be one of the most serious environmental problems of the 1980's") [hereinafter *COMM. ON GOV'T OPER. REPORT*].

and industrial water.⁵ More than fifty percent of the United States population relies on groundwater for its drinking water supplies,⁶ with more than ninety-five percent of rural households dependent on groundwater as their source of drinking water.⁷ Total groundwater withdrawals in the United States have increased by more than 150% since 1950—from thirty-five billion to more than ninety billion gallons per day.⁸ Reliance on groundwater is increasing as a proportion of all fresh water used, partly due to population growth, but also because of greater per capita use.⁹ Although withdrawals from all sources of water are increasing, groundwater use is currently increasing almost twice as fast as total water use.¹⁰

Spurred by an emerging awareness of groundwater contamination and its dangers, Congress has begun to pay greater attention to the groundwater pollution problem,¹¹ and some state and local agencies are undertaking their own protection efforts.¹² These efforts, however, fail to protect the nation's groundwater resources adequately. The federal government's passive role in protecting groundwater has led to a mounting crisis of groundwater pollution and mismanagement. State programs, while sometimes employing innovative approaches to groundwater pollution control, have suffered from insufficient federal guidance and a lack of coordination in their efforts.

5. EPA GROUNDWATER STRATEGY, *supra* note 4, at 10.

6. *Id.* at 11.

7. *Id.*

8. *Ground Water Contamination and Protection: Hearings Before the Subcomm. on Toxic Substances and Environmental Oversight of the Senate Comm. on Environment and Public Works, Part I*, 99th Cong., 1st Sess. 6 (1985) (statement of Sen. Dave Durenberger) [hereinafter *Senate Groundwater Hearings I*].

9. *Ground Water Contamination: Hearings before the Subcomm. on Toxic Substances and Environmental Oversight and the Full Comm. on Environment and Public Works*, 98th Cong., 1st & 2d Sess. 72 (1984) (statement of Jack E. Ravan, Asst. Administrator of Water, EPA).

10. *Ground Water Contamination: Hearings before a Subcomm. of the Comm. on Government Operations*, 98th Cong., 1st Sess. 286 (1983) (statement of Environmental Defense Fund, Inc.).

11. Several groundwater bills have been introduced recently in Congress. In January 1987, Sen. Moynihan introduced groundwater legislation, see S. 20, 100th Cong., 1st Sess., 133 CONG. REC. S642-44 (daily ed. Jan. 12, 1987), and in February 1987, Rep. Bustamante introduced companion legislation in the House, see H.R. 963, 100th Cong., 1st Sess., 133 CONG. REC. E400-01 (daily ed. Feb. 5, 1987). Earlier this year, Sen. Durenberger presented the most highly publicized of the proposed groundwater protection bills.

Released in February 1988, Sen. Durenberger's proposed Ground Water Protection Act, see S. 2091, 100th Cong., 2d Sess., 134 CONG. REC. S1441-45 (daily ed. Feb. 25, 1988), espouses a non-degradation policy, preventing discharges to groundwater from increasing the concentration of a contaminant. The bill calls for the use of permits, water quality standards, and technology standards. The states would retain primacy in the implementation of control programs, while the federal government would be primarily responsible for funding. While EPA would outline the minimum elements of a state program, the states would be free to establish their own priorities among various program options and to focus on those sources of contamination which they deem most important. EPA recently released a much more limited groundwater protection proposal derived from its pesticide registration programs. The proposal utilizes a "differential" approach to managing pesticides, based on differences in groundwater use, value, and vulnerability. The proposal's preferred management approach contemplates individual states tailoring plans to match the specific needs of discrete regions. See *EPA, Durenberger Release Strategies with Differing Approaches to Protection*, [18 Current Developments] Env't Rep. (BNA) 2264 (Mar. 4, 1988).

12. See *infra* notes 84-90 and accompanying text.

This Note proposes that the federal government assume a leading role in addressing the nation's groundwater contamination problems and implement comprehensive federal groundwater protection legislation. Section I briefly discusses the nature of groundwater and the groundwater pollution problem. Section II describes the failure of existing federal and state regulatory mechanisms to control groundwater pollution and concludes with a call for comprehensive federal groundwater legislation. Finally, Section III argues that this comprehensive legislation, which must focus on prevention, should rely on a market-like incentive, the modified effluent charge,¹³ as its primary pollution control tool.

I. THE GROUNDWATER POLLUTION PROBLEM

Although pollution of the nation's groundwater resources has not yet reached crisis proportions, the nature of groundwater and the difficulty associated with its clean-up suggest a differentiated, prospective strategy to ensure its future integrity.

A. *The Nature of Groundwater*

Groundwater is found in aquifers, fully saturated geologic strata located beneath the water table. Aquifers are recharged with new water by infiltration of precipitation or surface water through a recharge zone—a portion of the land surface composed of permeable soils.¹⁴ Groundwater discharges to the surface in springs or into streams and lakes.¹⁵

Groundwater generally moves from zones of recharge towards zones of discharge.¹⁶ Generally, the greater the porosity of the subsurface material, the greater is its permeability, or ability to store and transmit water.¹⁷ Velocities of groundwater flow in aquifers are relatively low, typically varying from several hundred meters per year in sands and gravels to sev-

13. Effluent charges are fees that may be administratively imposed for discharge of pollutants into the air or water or onto the land. For perhaps the classic treatment of the applicability of effluent charges to the problem of pollution control, see generally A. KNEESE & C. SCHULTZE, *POLLUTION, PRICES, AND PUBLIC POLICY* (1975). For a treatment dealing more specifically with water pollution control, see A. KNEESE & B. BOWER, *MANAGING WATER QUALITY: ECONOMICS, TECHNOLOGY, INSTITUTIONS* (1968).

14. See R. FREEZE & J. CHERRY, *supra* note 2, at 211.

15. See *id.* at 194, 201, 226.

16. Physical flow processes are governed by a potential gradient; thus, the regional direction of groundwater flow is generally from higher to lower elevations. See Cleary, *Introduction to Groundwater Hydrology*, in *GROUNDWATER POLLUTION: ENVIRONMENTAL AND LEGAL PROBLEMS* 17-19 (C. Travis & E. Etnier eds. 1984); Whittemore, *The Mechanisms of Groundwater Pollution*, 35 U. KAN. L. REV. 346 (1987).

17. See Whittemore, *supra* note 16, at 345-46. For example, very porous materials, such as clean sands and gravels, which possess an abundance of voids between individual particles, have higher porosity and permeability than dense crystalline rock or shale formations, which contain relatively few voids.

eral meters per year in limestones, sandstones, and fractured igneous and metamorphic rocks.¹⁸

B. *The Pollution Problem*

Groundwater contamination—by organic and inorganic chemicals, radioactive elements, and microorganisms—has occurred in every state and is being detected with increasing frequency.¹⁹ Although only a very small percentage of the nation's overall groundwater resources has been found unusable because of contamination,²⁰ reports of contamination near heavily populated areas and the increasing use of groundwater²¹ elevate the issue of groundwater contamination to one of national importance. Contamination is geographically widespread, and groundwater pollutants have been linked to adverse health, economic, environmental, and social effects.²² The Office of Technology Assessment has estimated that over 200 contaminants can currently be found in the nation's groundwater.²³ In addition, the Environmental Protection Agency (EPA) has estimated that at least two-thirds of all rural households are using water containing at least one of these contaminants, and nearly one-fourth of all municipal drinking water systems show some contamination.²⁴

Groundwater contamination occurs when pollutants are discharged into an aquifer's recharge zone, into wells tapping the aquifer, or into surface streams that feed aquifers. The sources of groundwater contamination, excluding natural processes,²⁵ fall into two broad categories: (1) waste disposal methods and facilities,²⁶ and (2) non-disposal activities.²⁷ Common

18. *See id.* at 346.

19. OFFICE OF TECHNOLOGY ASSESSMENT, PROTECTING THE NATION'S GROUNDWATER FROM CONTAMINATION 5 (1984) [hereinafter OTA REPORT].

20. *See id.* It should be noted that the current state of detection technology and methods provides only a very conservative estimate of the level of groundwater contamination. *See infra* notes 30-37 and accompanying text.

21. *See supra* text accompanying notes 8-10.

22. *Senate Groundwater Hearings I*, *supra* note 8, at 74 (statement of Paula J. Stone, Office of Technology Assessment). For instance, contamination of a groundwater aquifer can render a water supply worthless, thus imposing unexpected and potentially enormous costs of obtaining substitute water supplies for human use, as well as causing adverse effects on the health of people and livestock, and significant disruptions in the economic activity of an affected region. *See* Burmaster, *The History and Extent of the Groundwater Pollution Problem*, in *GROUNDWATER POLLUTION: ENVIRONMENTAL AND LEGAL PROBLEMS*, *supra* note 16, at 51-55.

23. OTA REPORT, *supra* note 19, at 23.

24. *Ground Water Contamination and Protection: Hearings Before the Subcomm. on Toxic Substances and Environmental Oversight of the Senate Comm. on Environment and Public Works, Part II*, 99th Cong., 1st Sess. 190 (1985).

25. Groundwater may be polluted by both natural processes and human activities. Natural causes of groundwater contamination include leaching of minerals, migration of poor quality groundwater into fresh water aquifers via fault zones, excess levels of undesirable dissolved gases, salt water intrusions in coastal regions, river infiltrations, and phreatophytes (water-wasting plants). *See* J. WILSON, *GROUND WATER: A NON-TECHNICAL GUIDE* 33 (1982).

26. The types of waste disposal methods and activities that have substantially contributed to groundwater contamination include landfills, abandoned and active hazardous waste sites, surface impoundments, septic tank systems, underground injection wells, brine disposal, and land application. 1 U.S. EPA, *OVERVIEW OF STATE GROUND-WATER PROGRAM SUMMARIES* 6 (1985).

27. Non-disposal activities which have led to instances of groundwater pollution include pesticide

toxins include nitrates, heavy metals, and synthetic organic compounds.²⁸ Especially dangerous are synthetic organic compounds, since they are extremely difficult to detect and may be highly toxic even at very low concentrations.²⁹

Due to significant limitations in the mapping and monitoring of aquifers, it is difficult to determine accurately the full extent of groundwater contamination. Millions of sources of potential contamination are known to exist.³⁰ Once contaminants enter an aquifer it is hard to predict precisely how those contaminants will be dispersed throughout the body of groundwater.³¹ Contaminants generally flow in a concentric plume, following the speed and direction of groundwater flow.³² As a result of these relatively concentrated plumes of contamination, groundwater can be heavily contaminated in one portion of an aquifer, yet uncontaminated in another portion only a few hundred feet away.³³

Similarly, the heterogeneity of subsurface systems³⁴ and differences in hydraulic conductivities³⁵ between aquifer systems also lead to differing contamination dispersion patterns. Because these dispersion patterns are so difficult to predict, detecting groundwater pollution and monitoring groundwater quality are extremely difficult and expensive.³⁶ The difficul-

and fertilizer applications, animal feedlot waste seepage, chemical applications in industrial and manufacturing operations, and underground storage of liquids. *Id.* at 8.

28. See CONSERVATION FOUNDATION, STATE OF THE ENVIRONMENT: AN ASSESSMENT AT MID-DECADE 116 (1984); U.S. COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY: ANNUAL REPORT 109-10 (1984) [hereinafter CEQ REPORT].

29. COMM. ON GOV'T OPER. REPORT, *supra* note 4, at 4. Examples of dangerous synthetic organic compounds include trichloroethylene, vinyl chloride, toluene, benzene, and dioxin. Among the adverse health effects associated with such chemicals are depression of the nervous system, liver and kidney damage, lung and respiratory tract ailments, birth defects, and cancer. OTA REPORT, *supra* note 19, at 32-34.

30. These potential contamination sources include 16,000 identified closed hazardous waste sites; 1,500 active hazardous waste disposal facilities; 93,000 landfills; 181,000 surface impoundments; 1.5 to 2 million underground storage tanks; and 20 million septic tank systems, not to mention contamination from accidental spills, illegal disposals, abandoned mines and oil and gas wells, and pesticide runoff. See COMM. ON GOV'T OPER. REPORT, *supra* note 4, at 4.

31. For a general discussion of the difficulty and complexity associated with modelling contaminant transport patterns, see R. FREEZE & J. CHERRY, *supra* note 2, at 388-413.

32. *Id.* at 75-76.

33. In most instances "contaminant plumes will extend laterally only hundreds or thousands of feet from the source. In unusual circumstances where a source has been continuous over many decades, identifiable plumes are known to extend laterally 11,000 feet or more." *Senate Groundwater Hearings I*, *supra* note 8, at 71 (statement of Philip Cohen, Chief Hydrologist, United States Geological Survey).

34. See R. FREEZE & J. CHERRY, *supra* note 2, at 384.

35. Hydraulic conductivity describes the ability of an aquifer to transmit a unit of water through a unit area per unit of time. The higher the conductivity, the better the aquifer transmits water. Hydraulic conductivity is a function of the porous medium and the fluid flowing through it. Thus, aquifers composed of clean sands have greater conductivity than those composed of clay. Cleary, *supra* note 16, at 19-21.

36. Monitoring groundwater is fundamentally more difficult than monitoring surface water quality, not only because it involves the digging of wells, but also because the relative lack of mixing in an aquifer means that many samples in different locations must be taken to determine accurately the

ties associated with detection and monitoring become even more acute given the inability of groundwater to cleanse itself. Unexposed to light or air, groundwater is less amenable to the biological processes that allow surface waters to break down contaminants introduced into them.³⁷ Although filtration and adsorption cleanse many contaminants from water before it reaches an aquifer, soil and rock strata are unable to break down many toxic chemicals.³⁸ Once water reaches an aquifer, very little, if any, further cleansing takes place in this "chemically reduced, abiotic, cool, and dark" environment.³⁹

Once an aquifer is polluted, therefore, it may remain polluted indefinitely, barring outside intervention, even if the source of pollution is removed. In those instances where groundwater pollution is detected, restoration of the contaminated groundwater may be attempted, but clean-up is difficult, expensive, and time-consuming.⁴⁰ In combination, the above factors present a strong argument that protection of groundwater resources should focus on prevention, rather than on clean-up, of pollution.

II. THE EXISTING LEGAL FRAMEWORK

While federal and state efforts have made important contributions to the protection of groundwater quality, these efforts have achieved only limited success in preventing groundwater contamination.⁴¹ This limitation stems from incomplete coverage and lack of coordination in existing federal and state programs.

groundwater quality for an area. Tripp & Jaffe, *Preventing Groundwater Pollution: Towards a Coordinated Strategy to Protect Critical Recharge Zones*, 3 HARV. ENVTL. L. REV. 4 (1979). Contamination is often discovered only after it has damaged a drinking water supply. See J. FREEZE & R. CHERRY, *supra* note 2, at 384.

37. See Burmaster, *supra* note 22, at 48; Teclaff & Teclaff, *Transboundary Groundwater Pollution: Survey and Trends in Treaty Law*, in INTERNATIONAL GROUNDWATER LAW 77, 80 (L. Teclaff & A. Utton eds. 1981).

38. Burmaster, *supra* note 22, at 48.

39. *Id.* Groundwater movement, unlike surface water movement, is slow and occurs under laminar flow, thus resulting in little mixing. Thus, contaminated groundwater is not diluted by the entire body of groundwater, as would occur with contaminated surface water. See R. PATRICK, E. FORD & J. QUARLES, GROUNDWATER CONTAMINATION IN THE UNITED STATES 21 (2d ed. 1987).

40. Restoration of badly contaminated aquifers to potable-quality is rarely achieved; most remedial efforts merely focus on containing groundwater contamination. The cost for clean-up and containment of a typically complex plume of contaminated groundwater ranges from \$5-10 million per site. The cost of total restoration of a badly contaminated aquifer may be orders of magnitude greater. Miller, *Protection of Groundwater Quality*, in GROUNDWATER POLLUTION: ENVIRONMENTAL AND LEGAL PROBLEMS, *supra* note 16, at 93, 117. Research currently is being directed at developing cost-effective methods of biodegrading toxic chemicals that may reach groundwater. See, e.g., *Natural Enzyme Helps Reclaim Contaminated Groundwater*, UCLA ENGINEER, Winter 1988, at 1 (discussing research involving use of cytochrome oxygenase to break down halocarbon pollutants, which endanger vast amount of nation's groundwater supply).

41. See *Focus on Prevention, Monitoring Urged in Report by Academy of Natural Sciences*, [18 Current Developments] Env't Rep. (BNA) 1789 (Nov. 27, 1987) (noting that environmental authorities are "playing catch-up" in their attempts to control groundwater pollution) (statement of Ruth Patrick, Chairperson, Environmental Assessment Council, National Academy of Sciences).

A. *The Federal Framework*

Congress has only tangentially approached the protection of groundwater.⁴² There is no comprehensive federal groundwater legislation comparable to the legislation protecting surface waters⁴³ or the marine environment,⁴⁴ nor is one federal agency or office responsible for managing the quality of the nation's groundwater.⁴⁵

Perhaps as a consequence, notable omissions from federal programs and activities include significant non-hazardous waste, non-waste, and non-point sources of contamination.⁴⁶ This uncoordinated, piecemeal federal approach fails to satisfy the complex technical, economic, and political demands of groundwater protection. The approach and application of several of the most relevant federal laws illustrate the current role of the federal government in groundwater protection and reveal significant gaps in the existing federal regulatory framework.

42. Sixteen pieces of federal legislation authorize programs and activities relevant to some aspects of groundwater. Some programs protect water resources, although not groundwater explicitly, e.g., Clean Water Act, 33 U.S.C. §§ 1251-1376 (1982 & Supp. IV 1986) (authorizes construction of sewage works and use of alternative waste treatment techniques, establishment of effluent standards, and regulation of point source discharge of pollutants); Reclamation Act, 43 U.S.C. § 390 (1982) (funds projects for restoration of underground water supplies contaminated due to natural leaching). Other programs regulate the handling of substances that could expose groundwater to contamination, e.g., Atomic Energy Act, 42 U.S.C. §§ 2011-2022 (1982 & Supp. IV 1986) (authorizes regulation of storage and disposal of radioactive wastes); Hazardous Materials Transportation Act, 49 U.S.C. app. § 1801 (1982) (requires establishment of regulations for commercial transportation of hazardous materials). Still other programs protect the environment generally, e.g., National Environmental Policy Act, 42 U.S.C. §§ 4321-4370 (1982 & Supp. IV 1986) (directs federal agencies to prepare environmental impact statements for major federal activities significantly affecting quality of human environment); Federal Land Policy and Management Act, 43 U.S.C. §§ 1701-1784 (1982) (authorizes regulation of mining operations).

43. See Clean Water Act, 33 U.S.C. §§ 1251-1376 (1982 & Supp. IV 1986). Despite the Clean Water Act's broad mandate "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters," it is unclear whether the statute's protections extend to groundwater. See *infra* notes 47-58 and accompanying text.

44. See Marine Protection, Research and Sanctuaries Act, 33 U.S.C. §§ 1401-1445 (1982 & Supp. IV 1986).

45. Although in April 1984, EPA established the Office of Ground-Water Protection, that office is responsible only for the coordination of EPA-related groundwater activities and programs. See *To Assess Progress Toward the Development of a National Groundwater Protection Program: Hearings before a Subcomm. of the Comm. on Government Operations*, 99th Cong., 1st Sess. 39 (1985) (statement of Lawrence J. Jensen, Asst. Administrator of Water, EPA). Currently, a multitude of different departments and offices administer statutory programs that affect the nation's groundwater. See *Industry, Environmental Groups Support Mandatory Cooperation Ground Water Bill*, [19 Current Developments] Env't Rep. (BNA) 70 (May 20, 1988) (statement of Sen. James Sasser).

46. A point source is any "discernible, confined and discrete conveyance," such as a pipe, well, ditch or container, from which pollutants may be discharged. 33 U.S.C. § 1362(14). Non-point source pollution may be understood as any source of water pollution not associated with a discrete conveyance. See *National Wildlife Fed'n v. Gorsuch*, 693 F.2d 156, 165-66 & n.28 (D.C. Cir. 1982). The OTA has noted that federal and state programs generally focus on managing selected point sources of contamination, particularly those associated with hazardous wastes. Sources of potential contamination are diverse and, in addition to commonly addressed point sources associated with hazardous wastes, include sources associated with non-hazardous wastes (e.g., open dumps) and non-waste (e.g., leaks in oil pipelines). See OTA REPORT, *supra* note 19, at 7.

1. *The Clean Water Act*

The Clean Water Act (CWA) is the nation's principal and most comprehensive federal water pollution control statute. Although CWA establishes a far-reaching permit program that regulates the discharge of sources of water pollution, the Act protects groundwater only in a very limited sense. Despite a general statutory indication that Congress meant to grant EPA authority over groundwater pollution,⁴⁷ the actual extent of that authority is ambiguous and has not been clarified by judicial decision. While the planning provisions of CWA deal with groundwater,⁴⁸ the Act provides little assurance that EPA will address groundwater pollution to the extent that it regulates surface water pollution.⁴⁹

The chief uncertainty hampering the application of the Act's regulatory provisions is their limitation to "navigable waters."⁵⁰ While the Supreme Court has interpreted the term broadly,⁵¹ federal case law has been equivocal over whether CWA allows regulation of groundwater. In *United States Steel Corp. v. Train*,⁵² the Seventh Circuit determined that EPA could regulate groundwater and waste discharge into deep wells, at least "when the regulation is undertaken in conjunction with limitations on . . . discharges into surface waters."⁵³ By contrast, the Fifth Circuit, in *Exxon v. Train*,⁵⁴ held that EPA did not possess authority to limit well injection of wastes because CWA required permits only for discharges

47. As one of its original mandates, the Act directs EPA to "develop comprehensive programs for preventing, reducing, or eliminating the pollution of the navigable waters and ground waters" 33 U.S.C. § 1252(a).

48. Section 1252(a) of the Act describes a planning provision calling for the development of programs to control water pollution. *Id.*

49. Nowhere does CWA confirm that EPA shall address groundwater pollution through mechanisms similar to the National Pollution Discharge Elimination System (NPDES), the primary permit authority granted to EPA and the primary vehicle for regulation of surface water pollution.

50. See 33 U.S.C. § 1342(a)(5) ("The Administrator shall authorize a State, which he determines has the capability of administering a permit program which will carry out the objectives of this chapter to issue permits for discharges into the navigable waters within the jurisdiction of such State.").

51. Although use of the term "navigable waters" would appear to preclude an extension of the Act to protect groundwater, the Act defines "navigable waters" as "waters of the United States," a definition that does not necessarily exclude groundwater from its coverage. 33 U.S.C. § 1362(7). In *United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121 (1985), the Court addressed the meaning of "waters of the United States" under CWA and its application to "wetlands," which the Army Corps of Engineers' regulations had included within the scope of "waters of the United States." The Court held that the Corps' exercise of jurisdiction under CWA extended to wetlands, since defining "waters of the United States" to encompass all wetlands adjacent to other bodies of regulated water was rationally related to the goals of CWA. *Id.* at 139.

While sanctioning the Corps' judgment of the extent of its jurisdiction, the Court did not conclusively decide Congress' intent with respect to groundwater. Although *Riverside* may understandably be read to imply that the entire hydrologic system may be regulated as "waters of the United States," this does not lead to the conclusion that groundwater in particular may be regulated. The *Riverside* holding suggests only that groundwater may be regulated incident to regulation of surface water pollution. Such a reading fairly comports with the result reached by the court in *United States Steel Corp. v. Train*, 556 F.2d 822 (7th Cir. 1977). See also *infra* text accompanying notes 53-54.

52. 556 F.2d 822 (7th Cir. 1977).

53. *Id.* at 852.

54. 554 F.2d 1310 (5th Cir. 1977).

into "navigable" waters. The court viewed the failure of Congress to include groundwater in the 1972 amendment to CWA as an indication that Congress did not intend EPA to have such authority.⁵⁵

In any case, EPA failed in *Exxon* to press its authority to regulate subsurface disposal that could affect groundwater. In fact, the agency disclaimed "jurisdiction and authority to regulate subsurface disposal directly,"⁵⁶ conceding that groundwater is not part of the "navigable waters" of the United States and, thus, that deep well injection does not constitute "discharge of a pollutant" under CWA. Because EPA has accepted the *Exxon* decision as "controlling in light of the Safe Drinking Water Act's coverage of underground waters,"⁵⁷ it is unlikely that the agency will attempt in the future to assert authority over groundwater discharges. Most of CWA's principal provisions have not been applied to groundwater at all. Nor do the new groundwater provisions established by the 1987 amendments grant EPA authority to regulate groundwater pollution directly; they merely vest EPA with authority to administer government grant programs to encourage the control of groundwater pollution.⁵⁸ Unless EPA is given greater latitude by courts or decides to press its statutory authority aggressively, it appears that CWA has only limited value in preventing groundwater contamination and will fail to provide the impetus for a federal groundwater protection effort.

2. *The Safe Drinking Water Act*

Although the primary purpose of the Safe Drinking Water Act⁵⁹ (SDWA) and its amendments is the establishment of state programs to regulate "public water systems,"⁶⁰ the Act also contains five federal mechanisms for protecting drinking water. First, section 300g-1 authorizes EPA to establish maximum contaminant level goals and promulgate national primary drinking water regulations for various contaminants. Second, section 300h-3(e), known as the Gonzalez Amendment, provides a triggering device for the protection of those aquifers that are determined to be the "sole or principal drinking water source" for a given region. For those aquifers designated as "sole source" aquifers, no federally assisted projects may be undertaken that would create a significant hazard to public health by contaminating the aquifer through its recharge zone.

A third mechanism under SDWA is the Underground Injection Control

55. *Id.* at 1322.

56. *Id.* at 1319 (quoting EPA Brief).

57. 2 W. RODGERS, JR., ENVIRONMENTAL LAW: AIR & WATER 115 (1986) (citing Memorandum from EPA General Counsel to Region II Director, Water Div., May 29, 1979).

58. See Water Quality Act of 1987, Pub. L. No. 100-4, § 316, 101 Stat. 7 (1987).

59. 42 U.S.C. §§ 300f-300j-11 (1982 & Supp. IV 1986).

60. Public water systems are those serving at least 15 service connections or at least 25 individuals. *Id.* § 300f-4.

(UIC) Program.⁶¹ This program employs a permit system to prevent underground injection of contaminants into supplies for existing or reasonably foreseeable public water systems if the contaminants prevent those systems from complying with national drinking water standards or adversely affect human health. The fourth and fifth mechanisms, added to SDWA by the 1986 amendments, are two grant programs, the State Wellhead Protection Program⁶² and the Critical Aquifer Protection Area (CAPA) Demonstration Program.⁶³ Under each program, states may submit to EPA program proposals for protecting the relevant resource from contaminants that may have any adverse effect on human health. If a submitted proposal is approved, EPA may provide supporting funds for implementation.

However, federal actors and private entities receiving federal assistance are unaffected by the Gonzalez Amendment,⁶⁴ and the UIC Program is restricted in the type of pollutants⁶⁵ and the manner of disposal it regulates.⁶⁶ SDWA as a whole addresses only public water supply systems, thereby leaving unregulated a significant portion of household use⁶⁷ and virtually all agricultural and industrial applications.⁶⁸

Aside from these loopholes, SDWA's regulatory strategy is likely to fail to control those circumstances it does contemplate. The reasons for this failure suggest the two central deficiencies of the present regime. First, SDWA standards anticipate the cleanup of contamination rather than its prevention. Instead of regulating groundwater in its original environment, or at the point where water is collected for treatment or blending prior to distribution, SDWA attempts to redeem groundwater at the tap.⁶⁹ The manifold difficulties of detecting⁷⁰ and neutralizing⁷¹ contaminants once introduced into the groundwater supply suggest emphasis instead on con-

61. *Id.* § 300h.

62. *Id.* § 300h-7.

63. *Id.* § 300h-6.

64. See 40 C.F.R. §§ 149.101(g), 149.102(a) (1987) (project of federal government or federal licensee is unaffected by Gonzalez Amendment).

65. See 42 U.S.C. § 300h(d)(1). The program regulates "fluids," not the more general category of "pollutants," which the CWA is intended to control.

66. With respect to the UIC Program, an "underground injection" means the "subsurface emplacement of fluids by well injection" and does not include surface disposal or disposal in a hole wider than it is deep, such as a lagoon or pond. *Id.*; 40 C.F.R. § 146.3 (1987).

67. The SDWA leaves outside its reach an estimated 12 to 14 million private wells, serving perhaps as much as 25% of the United States population. *Senate Groundwater Hearings I, supra* note 8, at 52.

68. In 1980, approximately two-thirds of all groundwater withdrawals were used for irrigation. See CEQ REPORT, *supra* note 28, at 99.

69. See 42 U.S.C. § 300f(3) ("maximum contaminant levels" established by SDWA apply to "water which is delivered to any user of a public water system.") (emphasis added). Under SDWA, contaminated groundwater may be drawn from an aquifer, treated to meet SDWA standards, and then distributed to public water systems.

70. See *supra* notes 30-35 and accompanying text; text accompanying note 29.

71. Many neutralization methods, including biological degradation, chemical detoxification, and *in situ* physical treatment, are currently in experimental stages of development. They are also time-consuming and expensive. See R. PATRICK, E. FORD & J. QUARLES, *supra* note 39, at 276-80.

tamination prevention. Second, notwithstanding its federal trappings, SDWA cedes substantial control over groundwater pollution to the states. For example, under the newly promulgated grant programs, states may choose, with little risk of federal interference, whether to protect wellhead areas or critical aquifers and how that protection will be accomplished.⁷²

3. *The Resource Conservation and Recovery Act*

The Resource Conservation and Recovery Act⁷³ (RCRA) was designed to protect the environment, including groundwater, from the disposal of solid and hazardous wastes.⁷⁴ With respect to solid waste management, RCRA makes no provision for direct federal regulation, primarily limiting the federal role to the establishment of nonbinding guidelines for state management plans and the review of those plans which are submitted.⁷⁵ The federal government's presence is much more prominent with respect to the management of hazardous waste-related activities.⁷⁶ As part of this program, EPA has promulgated a number of standards and regulations to protect the integrity of groundwater.⁷⁷ Almost all facilities must install monitoring wells and test the groundwater regularly for toxic leachates which might have escaped from the facility.⁷⁸ If monitoring reveals that the level of any hazardous substance exceeds groundwater protection standards specified by EPA, the facility operator must take corrective action within a reasonable amount of time.⁷⁹

RCRA's "cradle-to-grave" control of hazardous waste provides a valuable federal tool for the prospective control of an enormous threat to groundwater. However, it does not provide a comprehensive mechanism for enforcing precise groundwater quality standards.⁸⁰ Moreover, like other federal statutory programs, RCRA simply is not designed to deal with many of the substances and activities that contribute to groundwater pollution.⁸¹

72. Under the two newly promulgated grant programs, state participation is entirely voluntary and extremely flexible in terms of the types of programs states may develop. If a state does not develop a program, no federal program is imposed in its place. See 42 U.S.C. § 300h-6 to -7.

73. 42 U.S.C. §§ 6901-6991i (1982 & Supp. IV 1986).

74. Under RCRA, "solid waste" generally refers to any garbage, refuse, or sludge from waste treatment plants, and other discarded material. 42 U.S.C. § 6903(27). "Hazardous waste" generally refers to solid wastes or a combination thereof that may significantly contribute to an increase in mortality or serious illness, or pose a substantial present or potential hazard to human health or the environment when improperly disposed of or managed. *Id.* § 6903(5).

75. *Id.* §§ 6942, 6947.

76. See *id.* §§ 6921-6925 (requiring establishment of federal regulations for waste generators, transporters, and operators of facilities that handle substances listed by EPA as hazardous wastes).

77. See, e.g., 40 C.F.R. § 264.97-.99 (1987) (general groundwater monitoring requirements).

78. *Id.*

79. *Id.* § 264.100.

80. For guidelines regarding concentration limits, see *id.* § 264.94.

81. Under RCRA, "disposal" is defined as "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may enter the environment or be emitted

B. *State Efforts*

Prior to World War II, pollution control was largely left to states and localities.⁸² State power to abate water pollution stemmed from the public nuisance action and common law riparian rights theory. Under the common law relating to water, "it was thought quite adequate to treat groundwater either as part of the land . . . or as a commodity, susceptible of ownership through the act of capturing it by sinking a well."⁸³ The conception of groundwater as property helps explain the traditional deference of the federal government to the states in the area of groundwater regulation.

Recently, states have been devoting increasing attention to groundwater protection activities, including the development of groundwater protection plans, the implementation of aquifer mapping programs, the control of discharges to groundwater, and the setting of groundwater standards.⁸⁴ All fifty states now possess some legislative authority for dealing with groundwater quality.⁸⁵

Unfortunately, the network of state regulations mirrors the lack of coordination found at the federal level. While thirty-eight states have some form of standards for groundwater contamination,⁸⁶ the sophistication of these standards varies widely. The sharpest distinction is between states with limits on contaminant concentrations and those preferring general prohibitions on environmental degradation.⁸⁷ Significant variations occur even within these categories.⁸⁸ While this variability is due in part to the quantity and quality of local groundwater and to varying groundwater use, it suggests that, although states may be able to manage groundwater for their own use, they may be less capable of creating a comprehensive framework for the protection of groundwater.⁸⁹ Acknowledging the dis-

into the air or discharged into any waters, including ground waters." 42 U.S.C. § 6903(3). Unfortunately, RCRA does not reach many significant activities causing groundwater pollution because they fall outside the Act's definition of "disposal." For instance, RCRA does not cover application of pesticides or deicing salts, two well-known causes of contamination. See R. FREEZE & J. CHERRY, *supra* note 2, at 83-88.

82. F. ANDERSEN, D. MANDELKER & A. TARLOCK, *ENVIRONMENTAL PROTECTION: LAW AND POLICY* 338 (1984).

83. Utton, *The Development of International Groundwater Law*, in *INTERNATIONAL GROUNDWATER LAW*, *supra* note 37, at 1, 4 (quoting Teclaff, *Abstraction and Use of Water: A Comparison of Legal Regimes*, U.N. Doc. ST/ECH 154 at 57 (1972)).

84. U.S. GENERAL ACCOUNTING OFFICE, *GROUNDWATER QUALITY: STATE ACTIVITIES TO GUARD AGAINST CONTAMINANTS 26-27* (1988) [hereinafter GAO REPORT].

85. Fourteen of the fifty states rely on specific groundwater legislation, while the remainder derive authority under general water-quality legislation. *Id.* at 22-23.

86. *Id.* at 34-35.

87. More formally, numerical standards specify maximum contaminant concentrations. Narrative standards specify a general level of quality to be achieved, such as "no discharge of any substance or material deleterious to fish, plant life, or bird life." *Id.* at 43.

88. Currently, there are 1,019 numerical standards in 21 states covering 260 contaminants. Yet, one state set standards for as few as 14 contaminants, while another set them for as many as 190. *Id.* at 45.

89. Economic interests may stifle progress and partially account for the differing levels of state

parity in state standards, most state officials responsible for groundwater have expressed the desire for increased consistency of standards across state lines.⁹⁰

C. *Pollution Control and Federal Power*

Despite the manifest efforts at both the federal and state levels to address groundwater pollution, the Office of Technology Assessment has concluded that “[t]here is no explicitly comprehensive national legislative mandate to protect groundwater from contamination.”⁹¹ Although states should not be stymied in the development of innovative approaches to groundwater protection, the lack of clear guidelines prevents states from optimizing their individual efforts.⁹² Moreover, the interstate nature of the groundwater problem requires an aggressive federal response. Aquifer systems frequently straddle several states,⁹³ and groundwater interacts heavily with surface water which itself may span boundaries.⁹⁴

A comprehensive response to these interstate issues is certainly appropriate under the modern interpretation of Congress’ commerce power.⁹⁵ Since the Supreme Court’s decision in *Wickard v. Filburn*,⁹⁶ Congress’ power to regulate commerce extends both to interstate and intrastate activities that in the aggregate may have a substantial impact on interstate commerce. Groundwater pollution, which could undoubtedly “affect” in-

groundwater protection efforts. *See Federal Effort to Clean Up, Prevent Ground Water Contamination Said Needed*, [18 Current Developments] Env’t Rep. (BNA) 1269-70 (Aug. 28, 1987) (statement of Velma Smith, Director, Ground Water Project, Environmental Policy Institute) (“The Midwest has farming. Virginia has . . . coal mining. Texas and Louisiana have oil and gas. Every state will have an Achilles heel, one pollution point that’s difficult to deal with. The only way to force action in these areas in states is to have federal action.”).

90. GAO REPORT, *supra* note 84, at 98.

91. OTA REPORT, *supra* note 19, at 63.

92. *See Thomas Says a Groundwater Protection Bill May Be Needed to Divide Federal, State Duties*, [18 Current Developments] Env’t Rep. (BNA) 438 (May 22, 1987) (statement of Lee M. Thomas, EPA Administrator) (calling for increased federal presence in groundwater protection efforts and noting that “current ‘piecemeal’ approach to groundwater protection” fails to define state and federal roles and provide “an overall sense of policy direction”).

93. For example, the Ogallala Aquifer, a major source of groundwater in the High Plains region, extends from southern South Dakota to northwestern Texas, transecting portions of land in six other states—Nebraska, Wyoming, Colorado, Kansas, Oklahoma, and New Mexico. R. PATRICK, E. FORD & J. QUARLES, *supra* note 39, at 33.

94. The global hydrologic cycle consists of the movement of water between the oceans and other surface water, the atmosphere, and the land. Although groundwater constitutes only four percent of the volume of water in the worldwide hydrologic cycle, it has been estimated that 30% of the stream flow in the United States derives from groundwater that emerges as seepage. *Id.* at 21. During certain times of drought, much of the stream flow in the low-flow months may be due to groundwater. U.S. WATER RESOURCES COUNCIL, 2 THE NATION’S WATER RESOURCES: 1975-2000, IV-18 (1978).

95. Today the Supreme Court interprets the commerce clause as a plenary grant of power, and no longer views the Tenth Amendment as a reservation of certain subjects for state regulation. *See Hodel v. Virginia Surface Mining & Reclamation Ass’n*, 452 U.S. 264, 276-77 (1981) (“Commerce Clause is a grant of plenary authority to Congress.”); *see also Garcia v. San Antonio Metro. Transit Auth.*, 469 U.S. 528, 549 (1985) (Court lacks “license to employ freestanding conceptions of state sovereignty when measuring congressional authority under the Commerce Clause.”).

96. 317 U.S. 111 (1942) (cumulative effect of private wheat growing by many farmers would affect price of grain, thus “affecting” interstate commerce).

terstate commerce,⁹⁷ clearly seems to meet this test.⁹⁸ Analogous decisions recognizing Congress' power to control other types of pollution provide additional support for the conclusion that a sufficient constitutional basis exists for comprehensive federal groundwater protection legislation.⁹⁹

III. A PROPOSED EFFLUENT CHARGE SYSTEM

The current regulatory framework reflects an imperfect approach for dealing with the diverse problems of groundwater contamination. Although a network of federal laws provides for the prevention of groundwater contamination, it does not focus on groundwater, but rather on a narrow range of polluting activities. The states' efforts, while focusing more directly on groundwater, also fail to provide an adequate framework; their approaches are inconsistent and fragmentary.

Because of the difficulty and expense of detecting and restoring groundwater once it has been contaminated,¹⁰⁰ a federal protection effort should focus on prevention. Additionally, the special nature of groundwater pollution suggests that traditional approaches for controlling and preventing surface water pollution, namely the use of effluent and ambient standards, may be ineffective.¹⁰¹ Finally, because of the site-specific nature of groundwater pollution and the special interests states may have with respect to groundwater,¹⁰² national groundwater legislation should continue to be responsive to state concerns.

97. Groundwater, apart from its own status as a saleable commodity, is a source of water supply for industries operating in interstate commerce, such as agriculture and food processing, and affects surface water ecosystems which may produce commodities sold in interstate commerce.

98. Another basis for federal regulation of groundwater may be concern for health and welfare. In *United States v. Ashland Oil & Transp. Co.*, 504 F.2d 1317 (6th Cir. 1974), the court held that Congress had the constitutional authority to enact the Federal Water Pollution Control Act Amendments of 1972, by which the federal government took over much of the direct regulation of surface water pollution, because "Congress was convinced that uncontrolled pollution of the nation's waterways is a threat to the health and welfare of the country, as well as a threat to . . . interstate commerce." 504 F.2d at 1325.

99. The federal courts have determined that the commerce clause empowers Congress to legislate in virtually all areas of pollution control because pollution affects interstate commerce. *See, e.g.*, *Hodel v. Virginia Surface Mining & Reclamation Ass'n*, 452 U.S. 264, 282 (1981) (Surface Mining Control and Reclamation Act of 1977 regulations within congressional commerce clause authority to protect interstate commerce); *Leslie Salt Co. v. Froehlke*, 403 F. Supp. 1292 (N.D. Cal. 1974) (Federal Water Pollution Control Act within Congress' commerce clause powers to combat pollution of nation's waters), *aff'd in pertinent part*, 578 F.2d 742 (9th Cir. 1978).

100. *See supra* Section I(B).

101. *See Note, State and Federal Land Use Regulation: An Application to Groundwater and Nonpoint Source Pollution Control*, 95 YALE L.J. 1433, 1436 & n.24 (noting difficulty of effectively using effluent and ambient standards to regulate discharges to groundwater). Effluent standards are uniform standards applied to the quality of discharges into receiving waters. Ambient standards regulate the quality of receiving waters. Pollutants sources are regulated to the extent necessary to maintain the ambient standards.

102. *See supra* note 89.

A. *The Proposed Groundwater Pollution Control Approach*

Comprehensive groundwater protection legislation should rely on a modified effluent charge system, combining effluent charges¹⁰³ and minimum standards to create continuing economic incentives for pollution abatement and to reduce the current complexity and inconsistency of groundwater pollution control efforts.¹⁰⁴ Under this approach, all dischargers, including municipalities, would be required to pay for the right to discharge or dispose of the wide variety of waste that can potentially pollute groundwater.¹⁰⁵ Prior to discharge, all waste would be treated according to federally imposed minimum standards. Dischargers not adhering to the waste treatment standards would be subject to fines or other penalties.

Effluent charges would be based on both the damage unit value of a particular discharge and the vulnerability of groundwater to contamination in the area of discharge. Those discharges more likely to degrade groundwater quality would be assessed higher damage unit values than more benign discharges. Similarly, a discharge of waste into an area highly vulnerable to groundwater contamination would incur a greater effluent charge than a like discharge in a less vulnerable area.¹⁰⁶

The basis for assessing the vulnerability of groundwater to contamination should be DRASTIC, a methodology that allows the pollution poten-

103. See *supra* note 13.

104. Under a modified effluent charge system, each source of pollution would be assessed a charge on every unit of pollutant likely to be discharged into groundwater. Faced with these charges, polluters would respond rationally by reducing their pollution as long as it is cheaper to do so than to pay the charges.

Approaches incorporating effluent charges to control pollution have been implemented in a number of countries, including West Germany, Canada, and France. See C. REESE, DEREGULATION AND ENVIRONMENTAL QUALITY 413 (1983) (table). West Germany administers its effluent charges through the *Genossenschaften* (river-basin water quality management associations) and the Waste Water Charges Act. The Act calls for the Länder to levy charges on any direct discharge into rivers. *Id.* at 150-56. Canada's charge system, which is limited to several municipalities, has as its objective the compensation of municipalities for the marginal cost of wastewater treatment of industrial discharges. The discharge of industrial wastewater in excess of a minimum level triggers charges systematically related to the amount and type of waste discharged. *Id.* at 58-59.

105. For example, as applied to non-point sources of contamination, such as the application of pesticides, the proposed approach would work in the following manner: A farmer wishing to apply pesticides to her fields would obtain a permit describing the types and amounts of pesticides to be used, as well as the location of the fields to which they will be applied. Based on those three parameters described on the permit, an effluent charge would be assessed against the farmer.

The charge would not reflect actual groundwater contamination; rather, the farmer would be charged according to the likelihood of such contamination. To reduce the cost of agricultural pesticide application, the farmer's various strategies might include the development and use of "safer" chemicals, the use of integrated pest management techniques, or an altered output level or mix of produce. The charge system would use a permitting process similar to the NPDES program authorized by CWA. See 42 U.S.C. § 1342 (1982). The applicant for an NPDES permit must provide EPA or the relevant state agency extensive and precise data on the quantity and content of the wastes to be discharged under the permit. Permits identify the permissible discharges of each of the substances and require appropriate self-monitoring to assure that limits are not exceeded, or, if they are, reported.

106. Effluent charge systems imposing uniform charges have been criticized for not recognizing the differing impact a given discharge may have on different areas of the environment. See Russell, *What Can We Get From Effluent Charges?*, 5 POL'Y ANALYSIS 155, 164-68 (1979).

tial of any given land area to be systematically evaluated.¹⁰⁷ DRASTIC consists of two major elements: (1) the designation of mappable units, termed hydrogeologic settings,¹⁰⁸ and (2) the superimposition of a relative ranking scheme for certain hydrogeologic parameters. The most crucial factors in determining groundwater pollution potential—those described by the acronym, DRASTIC—consist of depth to water, recharge, aquifer media, soil media, topography, impact of the vadose zone, and conductivity of the aquifer.¹⁰⁹ The DRASTIC relative ranking scheme uses a combination of weights and ratings to produce a numerical value, called the DRASTIC Index, which allows for the ranking of areas according to groundwater contamination vulnerability.¹¹⁰ The system optimizes the use of existing data, thus minimizing the need for costly and time-consuming geologic and hydrologic surveys,¹¹¹ and provides an evaluation which can be used to direct resources, waste disposal, and land use activities.

The proposed charge system would be overseen by a single federal groundwater agency responsible for promulgating and administering groundwater protection regulations, standards, and fees.¹¹² Federally cre-

107. See generally L. ALLER, T. BENNET, J. LEHR & R. PETTY, DRASTIC: A STANDARDIZED SYSTEM FOR EVALUATING GROUND WATER POLLUTION POTENTIAL USING HYDROGEOLOGIC SETTINGS (1985) (Robert S. Kerr Environmental Research Laboratory, U.S. EPA) [hereinafter DRASTIC]. Florida is currently integrating DRASTIC into its groundwater protection efforts. The Florida Department of Environmental Regulation contemplates using DRASTIC to ensure consistency and continuity in evaluating discharge applications. Telephone interview with Randy Merchant, Environmental Specialist, Florida Department of Environmental Regulation (Dec. 1, 1988). The state's regulatory scheme, however, does not combine DRASTIC with effluent charges. *Id.*

108. A hydrogeologic setting is a composite description of all the major geologic and hydrologic factors which affect groundwater movement within a given area. It defines a mappable unit with common hydrogeologic characteristics and, consequently, common vulnerability to contamination by introduced pollutants. DRASTIC, *supra* note 107, at 5.

109. "Depth to water" refers to the distance from the land surface to the water surface in an aquifer. "Recharge" is a measure of the amount of water per unit area of land which penetrates the ground surface and reaches the water table. "Aquifer media" refers to the geologic material forming the aquifer. "Soil media" describes the uppermost portion of the vadose zone. "Topography" refers to the slope and slope variability of the land surface overlying an aquifer. "Impact of the vadose zone" describes the ability of the unsaturated material lying just above the water table to break down chemicals and other pollutants. "Conductivity" refers to the ability of an aquifer to transmit water, which in turn controls the rate of groundwater flow under a given hydraulic gradient. *Id.* at 15-20.

110. Each DRASTIC factor is assigned a relative weight from 1 (least significant) to 5 (most significant) to describe its relative importance. Further, each DRASTIC factor has been categorized into ranges or significant media types which have an impact on pollution potential. The range for each DRASTIC factor has been assigned a rating, varying from 1 to 10, that describes the relative significance of each range with respect to pollution potential. Thus, the equation for determining the pollution potential or DRASTIC Index (DI) is:

$$D_r D_w + R_r R_w + A_r A_w + S_r S_w + T_r T_w + I_r I_w + C_r C_w = DI$$

where r = rating, w = weight. *Id.* at 8.

111. For example, depth to water can be determined by referring to well logs; recharge can be determined through water resource reports and National Weather Service precipitation data; and aquifer media, soil media, and topography can be determined by referring to USGS survey reports and topographic maps.

112. This agency would be similar to the EPA's Office of Ground-Water Protection. However, instead of being limited to overseeing groundwater programs originating from a single agency or department, the agency envisioned by this Note would possess sufficiently broad authority and jurisdiction to enable it to oversee a coordinated national groundwater protection effort.

ated task forces comprised of federal, state, and industry officials¹¹³ would assist the federal groundwater agency in establishing appropriate waste treatment and disposal standards. These standards would provide uniform, nationwide guidance regarding the management of potential groundwater contaminants.

The federal government, through the proposed federal groundwater agency, should provide funding to the states to implement the modified effluent charge system as well as ongoing technical assistance on pollution abatement methods and contaminant sources. States should possess primary responsibility for enforcement within their own boundaries and should issue discharge permits and collect effluent charge revenues, a portion of which they should be allowed to keep. The states should be allowed to set stricter standards if necessary to achieve particular quality goals in certain bodies of groundwater.¹¹⁴

Regional offices of the proposed groundwater agency, organized according to the various aquifer system regions of the United States, would oversee the implementation and enforcement efforts of the states. If a state overlies more than one aquifer system, then several regional offices would review groundwater protection efforts in that state. Such an administrative framework would lead to greater nationwide uniformity and coordination in groundwater protection efforts.

B. *Impact of the Proposed Approach*

The proposed modified effluent charge system would create strong economic incentives to reduce pollution. To the extent that the polluter can render its discharges more benign through its waste treatment techniques or other methods, or can avoid discharging waste into those areas overlying aquifers most susceptible to contamination, it can reduce the magnitude of the effluent charge imposed upon it.

113. Other countries, particularly Great Britain, Japan, France, and the Federal Republic of Germany, rely to a much greater extent than does the United States on government-industry consensus in shaping environmental policy. See generally C. ENLOE, *THE POLITICS OF POLLUTION IN A COMPARATIVE PERSPECTIVE* 221-316 (1975) (Great Britain and Japan); C. REESE, *supra* note 104, at 87-193 (Federal Republic of Germany and France). Where federal legislation would displace to some extent the traditional responsibility of states to regulate groundwater, the proposed task forces would safeguard states against a total loss of control over groundwater and lessen state and industry resistance to a federal groundwater protection scheme. Although participation "will not always generate consensus on regulatory goals and means[,] . . . consensus need not be the aim; in some situations involvement in lawmaking can produce a greater acceptability of the regulatory process and consequently lead a firm to conclude that resulting regulations manifest characteristics of acceptable law: clarity, fairness and rationality." J. DiMENTO, *ENVIRONMENTAL LAW AND AMERICAN BUSINESS: DILEMMAS OF COMPLIANCE* 108 (1986). For a discussion of successes in recent EPA demonstrations testing the negotiated rulemaking concept, see Susskind & McMahon, *The Theory and Practice of Negotiated Rulemaking*, 3 *YALE J. ON REG.* 133 (1985) (noting that "negotiated rulemaking appears to hold great promise for remedying the crisis of regulatory legitimacy.").

114. Other federal pollution control schemes, such as CWA and RCRA, already afford states the flexibility to set stricter standards. See 33 U.S.C. § 1370 (1982) (CWA); 42 U.S.C. § 6929 (Supp. IV 1986) (RCRA).

This scheme, which forces the polluter to confront the costs of its pollution more directly, is attractive for its fairness and economic efficiency. Currently, there exists a divergence between the social and private costs of activities which contribute to groundwater pollution. Groundwater polluters are able to "pass on" the costs of pollution to society without being forced to pay for and, therefore, to reflect those costs in the prices they charge for their goods. The proposed system would minimize these "externalities" by forcing the polluter to "internalize"—at least partially—the costs of its pollution.

The difficulty of assessing the actual impact of a pollution discharge on groundwater quality raises the problem of setting appropriate charge fees. The level of groundwater quality induced by any given fee is uncertain.¹¹⁵ What is important in the proposed scheme, however, is the creation of incentives to avoid potential contamination of groundwater. The purpose of combining effluent charges and minimum standards is to achieve marginal improvements in groundwater quality, rather than to develop an "ideal" system in which charge levels and damages perfectly correspond.

Under a pure standards approach, a discharger has no incentive to reduce pollution further once it has achieved the effluent limitation specified by regulation. In fact, there might be a positive incentive not to do so since the additional reduction might impose a cost on the discharger that it cannot "pass on." Because an effluent charge would be imposed on every unit of pollution dischargers have not removed, they would have a continuing incentive to develop less costly ways of achieving still further reductions.¹¹⁶ The proposed charge system would also create a more effective administrative regime to control groundwater pollution. A charge system combined with minimum waste treatment standards would allow greater flexibility in treatment techniques than would standards alone. The use of a charge system may also provide state and federal agencies responsible for the collection of the charges with a pool of revenues that could be used to maintain the charge system and provide funding for supplemental groundwater pollution abatement.¹¹⁷

115. The problem of estimating damages caused by pollutants is no different than that posed by setting standards. Setting appropriate standards requires knowledge of the damages, and at least enough knowledge to place rough bounds on their monetary value. For an overview of the targeting problem in environmental regulation, see generally A. NICHOLS, *TARGETING ECONOMIC INCENTIVES FOR ENVIRONMENTAL PROTECTION* 69-82 (1984).

116. Even detractors of the effluent charge system admit that it provides the clear advantage of forcing innovation. See Russell, *supra* note 106, at 178.

117. The People's Republic of China, which imposes a charge on emissions in excess of permit limitations, recycles the revenues it receives from the charges into a fund to underwrite pollution control expenditures by industry. Stewart, *Economics, Environment, and the Limits of Legal Control*, 9 HARV. ENVTL. L. REV. 1, 12 n.31 (1985) (citing J. Gresser, *The Principle of Multiple Use in Chinese Environmental Law* (unpublished manuscript on file with author)). France uses its charge revenues in a similar manner. The country's six Basin Finance Agencies, which exact effluent charges on a regional basis, disburse the charge revenues they collect to finance community projects, make loans, and grant subsidies in furtherance of pollution abatement programs. C. REESE, *supra* note 104,

The charge system would create bureaucratic incentives to develop precise measurement systems and sharpen enforcement practices. Under the proposed system, state administrative agencies would be rewarded with a share of those revenues generated by their enforcement of the charge system.¹¹⁸ Under a standards approach, no such incentives exist. If a standards approach included the power to fine those violating the standards and gave the enforcing agency a share of the fine revenues, an incentive for greater agency enforcement might be created; such an approach, however, would still lack a continuing incentive for the polluter to mitigate the damage caused by its discharges. Also, under a standards approach, the agency could only collect revenues to the extent that violators are caught. Under the charge system, revenues are generated whenever a discharge occurs, even if there is no actual violation of the standard. The total incentives for agency enforcement under the charge system thus seem to be greater.

IV. CONCLUSION

Groundwater contamination is an environmental issue of the greatest importance, but current federal and state efforts to protect groundwater describe a patchwork of activities and programs that is not adequate to the task. The proposed modified effluent charge approach would establish a coordinated framework for national groundwater protection efforts to increase incentives for groundwater pollution prevention. While some discharges may never affect groundwater, the use of the proposed effluent charge system would create a continuing incentive for dischargers to develop low-cost abatement strategies. The proposed approach is a pragmatic one, founded on the pressing need to prevent the practically irreversible destruction of crucial groundwater resources.

at 96.

118. In effect, the state would assume the role of a "quasi-public, quasi-private" enforcement agency. For a discussion of the potential benefits of private enforcement of pollution control policy, see Cohen & Rubin, *Private Enforcement of Public Policy*, 3 *YALE J. ON REG.* 167, 181-93 (1985).

