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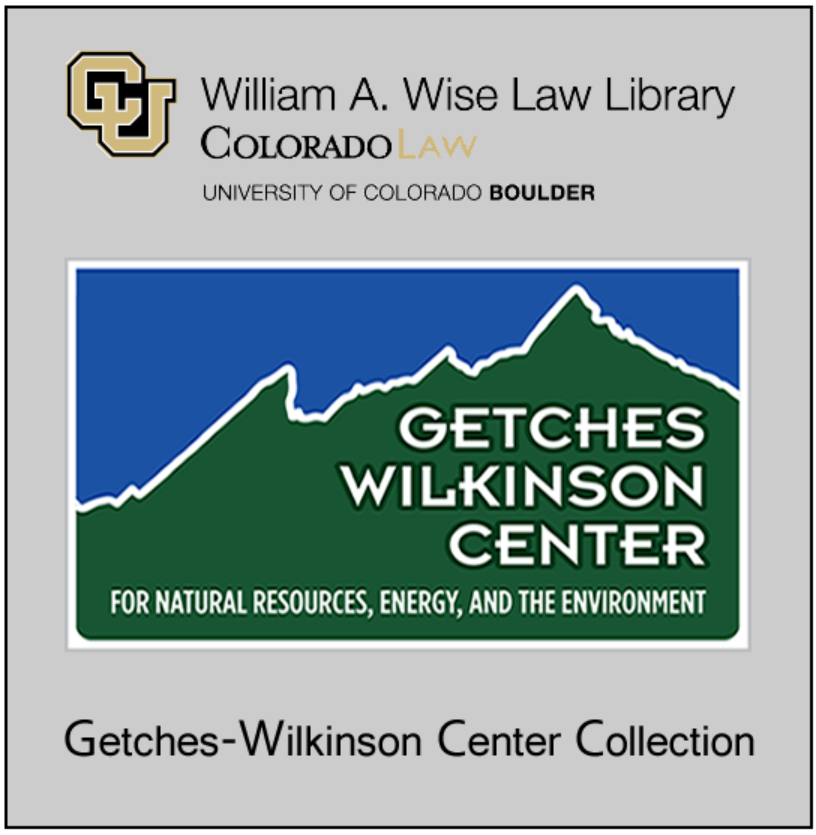

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EMERGING POLICY AND STRATEGY CHOICES FOR PROTECTION OF THE GROUNDWATER RESOURCE

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Summer Program

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I. Introduction and overview.

The volume of known groundwater in the United States is 50 times greater than annual surface flow of the entire nation. Groundwater is the source of one-quarter of the nation's domestic, agricultural, and industrial water supply. In the West, groundwater is likely to become a more important resource over the next two centuries as the useful lives of surface storage facilities come to an end and as agricultural water is transferred to cities. Despite the critical importance of this resource, the nation has no integrated cohesive policy for groundwater protection. Formulation of such a policy is complicated by the sheer number and diversity of groundwater contamination sources, the complexity of the technical issues, and our lack of knowledge about groundwater and contaminant dynamics. But this decade, and the last three years in particular, have brought a flood of legal proposals and strategies aimed at producing an integrated approach to protection of the nation's groundwater resources, treating groundwater much the same as other environmental media.

A. The groundwater resource.

Groundwater is by far the largest single source of available freshwater worldwide representing four percent of the earth's water resources. Compare river channel water at less than .01 percent. Consider that almost 96 percent of the world's water is in the oceans and icecaps. 24% of the United States' water supply is from groundwater; state use ranges from 2% (Delaware) to 86% (Kansas). Note that total use figures for the same state vary widely from source to source. See for use patterns, Pye et.al., Groundwater Contamination in the United States (U. of Penn. 1983). see also United States Geological Survey, National Water Summary, Hydrologic Events, Selected Water-Quality Trends, and Ground-Water Resources (U.S.G.S. Water-Supply Paper 2275, 1984)

B. Groundwater contamination.

1. Sources

a. Waste disposal.

(i) On site sewage disposal. Septic tanks; nitrates, phosphates, pathogens, heavy metals, system cleaners, disposal of "down the drain" chemicals.

(ii) Underground injection wells. Current estimate that 200,000 UI wells are in existence. Mining, oil and gas production, chemical production, hazardous and radioactive waste

disposal (banned May 1984, 40 CFR 144.13). EPA classifies injection wells for regulatory purposes, see generally 40 CFR Parts 124, 144, 145, and 146.

(iii) Surface impoundments. This class includes pits, ponds, lagoons, treatment basins, and pools used to store, treat or dispose of liquid, semi-solid, and solid wastes. Major users of impoundments fall into four categories: paper and allied products, petroleum and coal products, primary metals, and chemicals and allied products. see U.S. Congress, Office of Technology Assessment, Protecting the Nation's Groundwater from Contamination, at 275 (1984)

(iv) Land application of wastes. About 25% of municipal sludge generated is disposed of by some form of land application. Farmers dispose of animal wastes by land application. Some industrial waste is applied to land. see The Conservation Foundation, Groundwater Protection at 116 (1987).

(v) Sanitary landfills, open dumps, illegal dumping.

b. Materials handling and storage.

(i) Underground storage tanks. EPA estimates that there are about 1.4 million underground storage tanks (UST) at a half million facilities nationwide that qualify for regulation under the Resource Conservation and Recovery Act. Approximately 80% are constructed of unprotected steel. EPA recently stated, "[T]he nation may be facing a pervasive threat to its groundwater from leaking UST systems. If even only 10 percent of the nation's gasoline service stations have leaked or are leaking (as one company-sponsored testing program...indicated), then releases to groundwater could exist at approximately 17,500 retail gasoline stations nationally." 52 Fed. Reg. 12662, 666 (April 17, 1987). see generally U.S.E.P.A., Underground Motor Fuel Storage Tanks: A National Survey (May 1986), see also U.S.E.P.A, Summary of State Reports on Releases from Underground Storage Tanks (August 1986), see also Office of Technology Assessment, supra, at 277. Tanks exempt from federal regulation may pose a larger threat to groundwater than regulated tanks. see 17 Env. Rep. 2118 (April 17, 1987).

(ii) Materials stockpiles. Materials held in large bulk such as coal, sand, gravel, ores of copper, iron, and uranium, potash, titanium, phosphate, rock salt, and gypsum can be leached by water percolating through the mass carrying contaminants into groundwater. see OTA, supra at 277. Note that these stockpiles are not waste and do not fall under the coverage of the Resource Conservation and Recovery Act.

(iii) Materials transport and transfer. Spills, leaks and accidents. From 1973 to 1983, an average of 11,462 accidents and spills that violated safety regulations were reported each year, or 1.25 incidents per 10,000 shipments of hazardous materials. Most reported of the reported incidents were accidental releases during handling and loading, not vehicle accidents en route. see U.S. Congress, Office of Technology Assessment, Transportation of Hazardous Materials--State and Local Activities (March 1986).

c. Mining and drilling

(i) Coal mining. Majority in the East and Midwest. Mine pumping shifts groundwater depth and flow in the area of the mine. Acid from pyrites leaches into groundwater from inside mines and from overburden piles.

(ii) Other mining and mineral processing. Accumulated mining wastes are estimated to be 50 billion metric tons. For 1985, EPA estimated that five percent of the generated mining wastes exhibit corrosivity and toxicity. Another two percent are beneficiation wastes contaminated with cyanide. 21% are copper production by-products with potential to release acidic and toxic liquids to groundwater. 34% of the total contains radioactivity greater than five picocuries per gram. see U.S.E.P.A., Report to Congress: Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale (Dec. 31, 1985).

(iii) Oil, gas, and geothermal wells. Reinjection of drilling and extraction wastes such as brines. Improperly built, operated, and closed wells. OTA estimates that 525 billion gallons of brine are produced annually most of which are injected into wells. Seventeen states have reported brine related contamination incidents. see OTA, Protecting the Nation's Groundwater supra at 268.

d. Agriculture

(i) Pesticides and herbicide application. About 1.4 million pounds of pesticides are produced domestically each year and about 280 million acre-treatments are conducted annually. Corn, cotton, soybeans, and wheat account for 85% of all herbicide use and 70% of insecticide use. In 1985, 17 pesticides had been detected in 23 states. Monitoring for pesticides in groundwater is relatively recent and EPA estimates that additional monitoring will reveal more contamination. see U.S.E.P.A., Pesticides in Groundwater: Background Document (May 1986). Note that pesticide application is often in areas served by private wells for domestic supply; private wells are not covered by the Safe Drinking Water Act and can also be effected by private septic systems. Note also the potential for pesticide contamination to render agricultural groundwater unfit for transfer to metropolitan areas.

(ii) Fertilizers. Average annual application in the period 1980-83 was 48.3 million tons. Nitrogen fertilizer accounts for half the total applied and is responsible for most fertilizer groundwater contamination. Major impacts of nitrate contamination are not well known, but nitrate infant deaths caused by nitrate in groundwater have been reported.

(iii) Chemigation. This is a process whereby agricultural chemicals are applied with irrigation water. The process presents two paths for groundwater contaminants. First, chemigation systems can misfunction and back-syphon chemicals directly into the aquifer. Second, application of chemicals with irrigation water drives some amount of chemical directly into soil before air and sunlight have an opportunity to degrade the chemical. Undegraded chemicals then leach into groundwater. Note that federal law only regulates application of pesticides (fertilizers are not regulated) and that the Federal Insecticide, Fungicide, and Rodenticide Act permits any method of application not expressly prohibited on the label. see FIFRA, Sec. 136 (q)(ee)(3). 7 USC 136 (q)(ee)(3). The Colorado legislature proposed a bill to regulate chemigation practices in the 1987 session, but regulation was entirely limited to prevention of back syphoning. see H.B. 1024.

(iv) Livestock and poultry production. Animal wastes are rich in nitrogen and bacteria. A typical feedlot produces on the order of 23 tons of nitrogen rich compounds per year. One study suggested that the 140 millions chickens raised in Delaware annually produce more solid waste than the city of New York. W.C Liebhardt, Manure and the Nitrate Problem in *Lime and Fertilizer Conference: Delaware-Maryland Plant Food Association Proceedings* (1972). A 1968 study in Colorado of nitrate and ammonium concentrations in groundwater under feedlots and adjacent irrigated fields concluded that feedlots were a significant source of nitrate and ammonium. B.A. Stewart et at., Agriculture's Effect on Nitrate Pollution of Ground Water, *Journal of Soil and Water Conservation* (1968).

e. Miscellaneous sources.
Road deicing salt application.
Urban stormwater runoff.
Atmospheric contaminants.

II. The existing legal context for controlling groundwater contamination.

Groundwater quality law has evolved from a relatively simple matter of local land use control to an inordinately complex mixture of federal, state, and federally delegated laws that regulate 1) substance manufacture, use, storage, transport and

disposal, 2) public drinking water supply, 3) pollution clean up, 4) land use, and 5) natural resource extraction. . Notably absent from federal law is a comprehensive aquifer protection scheme. Rather, the federal approach has been largely reactive on a source and contamination cause basis. Most federal programs provide for delegation of program implementation to the states and most provide that state programs can be more protective than federal programs at the option of the states. But unlike federal air and surface water pollution law, there is no single integrated federal approach to groundwater pollution control.

A. Federal law.

See Table 1 for a list of federal statutes and associated groundwater protection activities. Note that only one of the listed laws expressly deals with protection of aquifers. Table 2 relates federal statutes with sources of contamination. The most complete treatment to date of the law of groundwater pollution control is Glicksman and Coggins, Groundwater Pollution I: The Problem and the Law, 35 Kan. L. Rev. 75 (1986). Note however, that the law is enormously complex, inconsistent, and at times contradictory. The Glicksman and Coggins article, while providing an excellent introduction to the field, is not a treatise. A complete study of the law of groundwater contamination would take in virtually the entire law of environmental pollution control. Below is a highly selective and brief discussion of federal statutes and recent amendments with ramification for groundwater pollution control.

1. Safe Drinking Water Act, 42 USC 300f et seq., as amended by Pub. L. 99-339, 99th Cong., 2d Sess. (June 19, 1986). The SDWA contains three programs for protecting aquifers and wellhead areas.

a. Underground injection control. The SDWA provides for state UIC permitting programs meeting minimum requirements of EPA regulations. 42 USC 300h, 300h-3. Note numerous exceptions for injection associated with oil and gas production. For example, Section 1421(b)(2) provides that no EPA regulation may prescribe requirements which "interfere with or impede" reinjection of brines brought to the surface in the course of oil or gas production or natural gas storage, or injection for secondary or tertiary recovery of oil and gas. The burden of proof is on EPA to show that such regulations are necessary to "assure that underground sources of drinking water will not be endangered by such injection." 42 USC 300-1(c)(1),(2).

b. Sole source aquifer protection. The SDWA provides for designation of "sole source aquifers" (SSA). An SSA is defined as "an aquifer which is the sole or principal drinking water source for an area and which, if contaminated, would create

a significant hazard to public health..." 42 USC 300h-3(e). Such a designation prohibits federal funding or assistance for any project which the EPA administrator determines may contaminate the aquifer through its recharge zone. id. The prohibition on federal funding is not absolute; the administrator may also simply decide that federal money should be used to "plan or design the project to assure that it will not so contaminate the aquifer." id. EPA recently published guidance regarding designation of SSAs. U.S.E.P.A., Sole Source Aquifer Designation, Petitioner Guidance (1987). EPA policy limits sole source aquifer designation to aquifers "needed to supply 50% or more of the drinking water for the aquifer service area, and [that] the volume of water which could be supplied by alternative sources is insufficient to replace the petitioned aquifer should it become contaminated." id. Further, EPA requires that the boundaries of the aquifer, its recharge area, and streamflow source be capable of clear delineation. 52 Fed. Reg. 6873 (March 5, 1987). These policies will probably serve to discourage SSA applications.

c. State wellhead protection programs. The 1986 amendments to the SDWA included a requirement that each state design and submit to EPA a wellhead protection program. The definition of "wellhead protection area" is broad enough to include any identifiable recharge zones. The program requires extensive planning for protection of recharge zones for aquifers that serve public drinking supply systems. States with more than 2,500 active wells must also certify to EPA that they have and are implementing a program to protect underground drinking water from contamination caused by "annular injection or surface disposal of brines associated with oil and gas production". See Pub.L. 99-339, Sec.205 (to be codified at 42 USC 300h-7(a)).

Note: This provision although essentially only a grant program may be the single most important development in federal groundwater pollution control to date. It is the first federal requirement mandating comprehensive planning to protect groundwater based on protection of recharge zones. Unfortunately, it is unlikely that either the federal government, or the states will be able to adequately fund design and long term implementation of such programs.

2. Clean Water Act, 33 USC 1251 et seq. Despite its name, the Clean Water Act (CWA) is not a particularly effective vehicle for protecting groundwater. First, it is unclear whether the CWA delegates authority to EPA to require discharge permits for disposal of wastes into groundwater. See Exxon Corp. v. Train, 554 F.2d 1310 (5th Cir. 1977) (disposal of chemical wastes to underground waters is not discharge of a pollutant to navigable waters of the United States.), compare United States Steel Corp. v. Train, 556 F.2d 822 (7th Cir. 1977) (EPA may

regulate disposal of pollutants into deep wells when regulation is undertaken in conjunction with limitations on discharges to surface water.), see also Kelley v. United States, 618 F. Supp. 1103 (W.D. Mich. 1985)(action will not lie under Sec.505 of the CWA for pollution of groundwater from toxic chemicals released into the ground.) A second problem with the CWA is that it has been only partly effective in controlling non-point sources of contamination such as fertilizer and pesticide application. The Act provides no firm regulatory scheme for controlling such pollution and delegates such regulation to the states and other law such as the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act.

a. The 1987 amendments. In early 1987 Congress amended the CWA in several ways. First, a new section was added to focus EPA and state attention on control of non-point pollution. Pub. L. No .100-4, Sec. 316, 100 Cong., 1st Sess. (1987). The new section requires states to produce reports to the EPA that identify waters that cannot attain or maintain conformity with water quality standards without additional non-point source controls. The states must then prepare management programs "for controlling pollution added from nonpoint sources to the navigable waters within the State and improving the quality of such waters". Sec. 316 (b)(1). Application of those programs to groundwater is not clear, but Sec. 316(i) provides that states may apply for grants to assist the states "in carrying out groundwater quality protection activities which the [EPA] determines will advance the State toward implementation of a comprehensive nonpoint source pollution control program".

3. The source control statutes. Most federal law attempts to protect groundwater only indirectly through regulation of substance production, manufacture, transportation, use, storage, and disposal. See generally, Bonine and McGarity, The Law of Environmental Protection (West 1984)

a. Resource Conservation and Recovery Act. 42 USC 6901 et seq. as amended by Superfund Amendments and Reauthorization Act of 1986, Pub. L. No. 99-499, Sec. 205. (1986). The 1986 amendments provided for a program for controlling leaking underground storage tanks, including tanks containing petroleum products. EPA's proposed underground tank regulations were published April 17, 1987. See 52 Fed. Reg. 12662. For a clear and elementary explanation of RCRA see U.S.E.P.A., RCRA Orientation Manual (EPA/530-SW-86-001 1986). Respecting EPA's implementation of RCRA see U.S. General Accounting Office, Hazardous Waste: EPA Has Made Limited Progress in Determining the Wastes to be Regulated, (GAO/RCED-87-27 Dec. 1986).

b. Federal Insecticide, Fungicide, and Rodenticide Act. 7 USC 136 et. seq. see infra.

c. Toxic Substances Control Act.15 USC 2601 et seq.

d. Uranium Mill Tailings Radiation Control Act Pub. L. No. 95-604, 42 USC 7911 et seq. as amended by Pub. L. No. 97-415 (1983). See American Mining Congress v. Thomas, 772 F.2d 617 (active sites case), 772 F.2d 640 (inactive sites case) (10th Cir. 1985).

B. State law. Despite the large federal presence in environmental protection, the states bear primary responsibility to protect groundwater. One study of state and local strategies found four reasons for state primacy in groundwater protection: 1) states have well developed law governing use and allocation of groundwater, 2) the diversity of groundwater resources and multiple sources of groundwater contamination make uniform or comprehensive federal control impractical, 3) land use controls, which are critical to groundwater protection, have traditionally been the province of state and local governments pursuant to their police power, and 4) as delegates of federal programs, the states have local expertise in implementing federal laws affecting groundwater. See Henderson et al.,Groundwater: Strategies for State Action (Environmental Law Institute 1985). The last several years have brought a spate of new programs by some states designed to aggressively protect groundwater. See National Academy Press, Ground Water Quality Protection: State and Local Strategies (1986). See also, Office of Technology Assessment, Protecting the Nation's Groundwater from Contamination (1984). Some of those programs are discussed in the next section.

III. The evolving legal context for groundwater pollution control.

A. Federal proposals.

1. EPA 1984 groundwater strategy. Because there is no single federal statute dealing with protection of groundwater, and because EPA is the agency charged with implementation of most environmental programs, the agency proposed groundwater protection strategies in 1980 and again in 1984. For a history of the 1980 strategy see Pye et al., (Groundwater Contamination in the United States 189-203 (1983). The 1984 strategy proposed four major elements;

--EPA will encourage states to make use of existing grant programs to develop groundwater protection programs and strategies.

--EPA will begin to deal with unaddressed sources of groundwater contamination.

--EPA will study the need for further regulation of land disposal facilities.

--EPA will adopt an aquifer classification system for use in EPA administered programs.

U.S.E.P.A., Ground-Water Protection Strategy (1984)

The last element is the most important. EPA proposes to classify aquifers by quality and use and offer each class differential protection primarily through facility and disposal siting decisions. The strategy proposes three aquifer classes, 1) Special groundwater, 2) Groundwater currently and potentially a source for drinking water, and 3) Groundwater not a source of drinking water. The scheme would establish a "classification review area" deliniated by a two-mile radius from the boundaries of a "facility" or "activity" affecting groundwater. See EPA, Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy (Final draft Dec. 1986). The comment period on the proposal closed March 2, 1987 and brought critical commentary from the states, industry, and environmental organizations. The states stressed supremacy of state control over groundwater and expressed concern that EPA's proposal would nullify state non-degradation policies in Class III aquifers. There was also concern that some existing state classification systems are preferable to EPA's. Industry predictably criticized the proposal as too restrictive; the National Agricultural Chemicals Association urged that "shallow groundwater", which may hold agricultural chemicals, be excluded from Class II designation. Environmentalists criticized the site-by-site designation scheme and endorsed an "anticipatory classification system" in which groundwater would be classified outside the context of site specific land use proposals. See Plethora of Issues Raised in Comments on EPA Groundwater Classification Proposal, 17 Env. Rep. Curr. Events. 1888 (March 13, 1987).

2. Legislative proposals. No major groundwater legislation has been introduced as of April 29, 1987. However, Senator Durenberger's office reports that four bills are under review prior to introduction:

--A comprehensive groundwater protection bill.

--A groundwater research bill. (S 513)

--Legislation to conform the conservation reserve title of the Food Security Act with wellhead protection provisions of the Safe Drinking Water Act.

--A bill to address pesticides in drinking water.

The draft pesticide contamination bill contains three interesting features. First, the bill defines 'pesticide' to include inert ingredients and the metabolites and degradation products of such ingredients. Inert ingredients are not required to be revealed on pesticide labeling pursuant to FIFRA. Second, the bill has a low regulatory trigger threshold. Any pesticide detected at three or more groundwater monitoring points is conclusively determined to "have the potential to leach into groundwater" and becomes subject to regulatory requirements. Third, the bill uses as a regulatory trigger detection of a pesticide in concentrations only a fraction of health based standard. This approach acknowledges the unique properties of groundwater; once contaminated to the health based threshold the water is useless; better to regulate when the concentration is only a fraction of the standard.

3. New state initiatives. With increasing awareness of the groundwater contamination problem the states are beginning to take the lead in enacting programs. The states are in a unique position to integrate all facets of contamination prevention, however, such programs are not cheap. Without substantial federal financial assistance it is questionable whether the relatively less wealthy states will be able or willing to enact and implement comprehensive programs.

a. Wisconsin. 1983 Wisconsin Act 410. A valuable feature of Wisconsin's new groundwater protection law is the use of two-tiered water quality standards consisting of "enforcement standards" and lower "preventative action limits". Preventative action limits are designed to provide a warning level indicating that investigation and regulation may be necessary.

b. Arizona. 1986 Ariz. Sess. Laws Ch. 368. Arizona enacted a comprehensive groundwater quality law in 1986. The law classifies all groundwater in the state as drinking water subject to protection as such unless certain specific findings are made in a proceeding to change such designation. A monitoring program is required including a requirement for maintenance of a statewide data base of groundwater and soil samples. The program also includes extensive "Aquifer Protection Permit" program for a wide variety of contamination sources including surface impoundments, solid waste disposal facilities, injection wells, mine tailings and ponds, land treatment facilities, septic tank systems with capacities greater than 2000 gallons per day,

groundwater recharge projects, sewage or sludge ponds and wastewater treatment facilities, and facilities which add a pollutant to a salt dome formation, salt bed formation, dry well, or underground cave or mine. The law also contains a separate provision for dealing with groundwater pesticide contamination. Registration of any carcinogenic, mutagenic, or teratogenic pesticide found in groundwater, eight feet below the surface, below the root zone, or below the soil microbial zone must be cancelled. A pesticide not falling into one of the above categories, but detected as above must be cancelled unless there is no alternative product available in the state and an economic hardship would be created by cancellation. This program is patterned after California's 1985 Pesticide Contamination Prevention Act, 1985 Cal Stats. c.1289 Sec. 1., codified at Cal. Agric. Code Sec. 13141 et seq..

c. Colorado. Where Arizona, Wisconsin, and other states have enacted comprehensive groundwater protection laws, Colorado may be typical of states trying to protect groundwater without comprehensive integrated programs. Like many states, Colorado has numerous unrelated regulatory programs that protect groundwater. In early 1987 the Water Quality Control Commission promulgated basic groundwater quality standards that it used to establish five classifications for groundwater. 5 C.C.R 1002-8-3.11.0. At that time the Commission was uncertain of how to implement the standards and later proposed four alternative implementation strategies including 1) site-by-site classification prior to authorizing a proposed activity with the potential to contaminate groundwater, 2) regional or large area classification, 3) classification of the entire state as domestic-use quality, and 4) a requirement that regulated entities provide information about the groundwater underlying a proposed facility or activity. A public hearing was held April 6, 1987 on the matter. On April 10 the Colorado Mining Association and AMAX Inc. sued the Water Quality Control Commission asserting numerous boilerplate deficiencies in the groundwater quality standards regulations. The legislature has made no move to resolve the matter.

IV. Major policy and strategy choices.

The States, Congress, and EPA are all involved in initiatives to control contamination of the nation's groundwater resources. Within the last 24 months no less than four book length groundwater strategy documents have been published. It is clear that control of groundwater contamination is a blossoming environmental issue that will ultimately involve numerous political choices. Professors Glicksman and Coggins suggest the following basic issues that must be resolved before detailed strategies can be addressed.

A. Prevention or cleanup? On this point there seems to be general agreement; prevention is preferable. But for groundwater pollution prevention is especially preferable because cleanup of the medium is expensive if not impossible.

B. Degree of protection: Non-degradation or some other standard? A non-degradation standard may be intellectually attractive but is it good policy? Should already polluted groundwaters be furthur polluted to accommodate economic needs? Should classification schemes allow some degradation of selected aquifers?

C. General standards or aquifer classification? If non-degradation is not chosen then decisions must be made regarding degree of degradation and purity that is acceptable for each class of aquifer. How detailed should these classifications be?

D. Water quality standards, what role? Groundwater is not a self-cleansing medium as are surface water and air. A health based surface water quality standard, if exceeded can trigger controls on pollution input; eventually the water will dilute and flush the pollutant. But once groundwater is polluted beyond a health based standard it will likely stay polluted. Should groundwater quality standards be used as regulatory triggers or as bases for classification of aquifers? Or both?

E. General or targeted regulation? Should regulation be comprehensive and regulate all activities with a remote possibility of contaminating groundwater? Should the most serious threats be addressed first? Or should legislatures address all sources at one time?

F. Should regulation be economic or "command and control" or a combination?

G. What level of government, federal, state, or local should take primary responsibility for groundwater protection? There is a consensus among non-government strategists that the states are in the best position to do the job. The states are in a unique position to implement and improve on federal law, and fill the gaps left by federal law. Note that the states were the largest single group of commenters to EPA's proposed groundwater strategy and a consistent concern was a fear that EPA might displace state programs.

F. How to pay for programs? If the states are in the best position to design and implement comprehensive groundwater protection programs, how will they pay for them given unequal financial resources? Should groundwater users pay by the gallon?

V. Conclusion

Groundwater is a uniquely difficult resource to protect from contamination. Contamination sources are numerous, geographically and characteristically diverse, and in some cases economically beneficial, e.g., fertilizers. The basic force of gravity drives pollutants into groundwater. There is no coherent legal framework for groundwater pollution control, nor is such a framework likely to evolve unless the states individually produce and implement comprehensive legal programs. Only an integrated system of land use controls, source controls, and source reduction can protect groundwater. Legally, the states are uniquely situated to integrate those elements. But the states must clear two high hurdles to implement comprehensive groundwater protection programs. First, the states must answer tough political questions; how extensive should land use control be to protect groundwater?; how tough on industry should source control and reduction be?; should the state firmly regulate agricultural practices such as fertilizer and pesticide application?. Next, the states have to fund their programs. Funding also involves political choices, and some states will simply not be able to adequately fund comprehensive programs. Lurking in the background are federal proposals such as the EPA 1984 groundwater protection strategy and draft legislation. The shape of the federal presence in groundwater protection is unclear and will probably be determined largely by the success or failure of the states to implement groundwater protection programs. Eventually, some form of federal/state partnership will emerge. How the law of groundwater protection evolves remains very much an open question.

Table 1

Summary of Federal Programs and Activities Related to the Protection of Groundwater Quality

Statutes	Investigations/detection				Correction		Prevention				
	Inventories of sources[a]	Ambient groundwater monitoring	Groundwater monitoring related to sources[a]	Water supply monitoring	Federally funded remedial actions	Regulatory requirements for sources[a]	Regulate chemical production	Standards for new/existing sources[a]	Aquifer protection [1]	Standards	Other[b]
Atomic Energy Act			X		X	X		X		X	
Clean Water Act	X	X	X		X			X		X	X
Coastal Zone Management Act											X
Comprehensive Environmental Response, Compensation, and Liability Act	X		X		X						
Federal Insecticide, Fungicide, and Rodenticide Act			X				X	X			
Federal Land Policy and Management Act (and associated mining laws)			X					X			
Hazardous Liquid Pipeline Safety Act	X							X			
Hazardous Materials Transportation Act	X							X			
National Environmental Policy Act											X
Reclamation Act					X						
Resource Conservation and Recovery Act	X		X			X		X			
Safe Drinking Water Act	X		X					X	X	X	
Surface Mining Control and Reclamation Act			X		X			X			
Toxic Substances Control Act			X				X	X			
Uranium Mill Tailings Radiation Control Act			X		X	X		X			
Water Research and Development Act											X

[a]Programs and activities under this heading relate directly to specific sources of groundwater contamination. Table 13 summarizes the sources addressed by the statutes.
[b]This category includes activities such as research and development and grants to the States to develop groundwater-related programs.

SOURCE: Office of Technology Assessment.

From: U.S. Congress, Office of Technology Assessment, Protecting the Nation's Groundwater from Contamination (1984)

1.  = Note an almost complete lack of federal programs designed to protect aquifers.

Table 2

Relationship Between Sources of Contamination and Federal Statutes[a]

Sources	Federal statutes															
	AEA	CWA	CZMA	CERCLA	FIFRA	FLPMA	HLPSA	HMTA	NEPA[b]	RA	RCRA	SDWA	SMCRA	TSCA	UMTRCA	WRDA[c]
Category I																
Subsurface percolation		E										A				
Injection wells (waste)				F								A				
Injection wells (non-waste)												A				
Land application		D		F							A					
Category II																
Landfills				F							A, B			A		
Open dumps (including illegal dumping)				F							B					
Residential (or local) disposal					C											
Surface impoundments				F		A					A		A			
Waste tailings						A									A	
Waste piles				F		A					A		A			
Materials stockpiles					C											
Graveyards																
Animal burial																
Aboveground storage tanks		A		F							A			A		
Underground storage tanks		A		F							A			A		
Containers				F	C						A			A		
Open burning/detonation sites				F	C						A					
Radioactive disposal sites	A														A, F	
Category III																
Pipelines				F			A									
Materials transport/transfer operations				F				A								
Category IV																
Irrigation practices		C, E														
Pesticide applications		C, E			A											
Fertilizer applications		C, E														
Animal feeding operations		C, E														
Deicing salts applications																
Urban runoff		C, E														
Percolation of atmospheric pollutants																
Mining and mine drainage		C, E				A							A, F			
Category V																
Production wells						A						A				
Other wells (non-waste)						A										
Construction excavation		C, E														
Category VI																
Groundwater-surface water interactions		C, E														
Natural leaching										F						
Salt-water intrusion/brackish water upconing		C, E	E													

[a]Key: A = Requires compliance with specified Federal requirements (some programs in this group may be implemented by States if they meet certain Federal criteria)
B = Authorizes funding of optional State programs that address specific sources.
C = Establishes Best Management Practices (BMPs) or recommended procedures for certain sources.
D = Establishes Federal criteria that must be met in order to receive funds for specific projects related to a source of contamination.
E = Establishes a grnt program to States (funds may be used at the State or local level to address contaminants or sources).
F = Funds Federal cleanup of contaminated groundwater and associated sources.

[b]NEPA does not apply to any particular source. The environmental impacts of projects involving the use of Federal funds may be subject to Federal agency review.

[c]WRDA does not apply to any particular source. The act provides research funds to States. Projects may focus on particular sources.

SOURCE: Office of Technology Assessment

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