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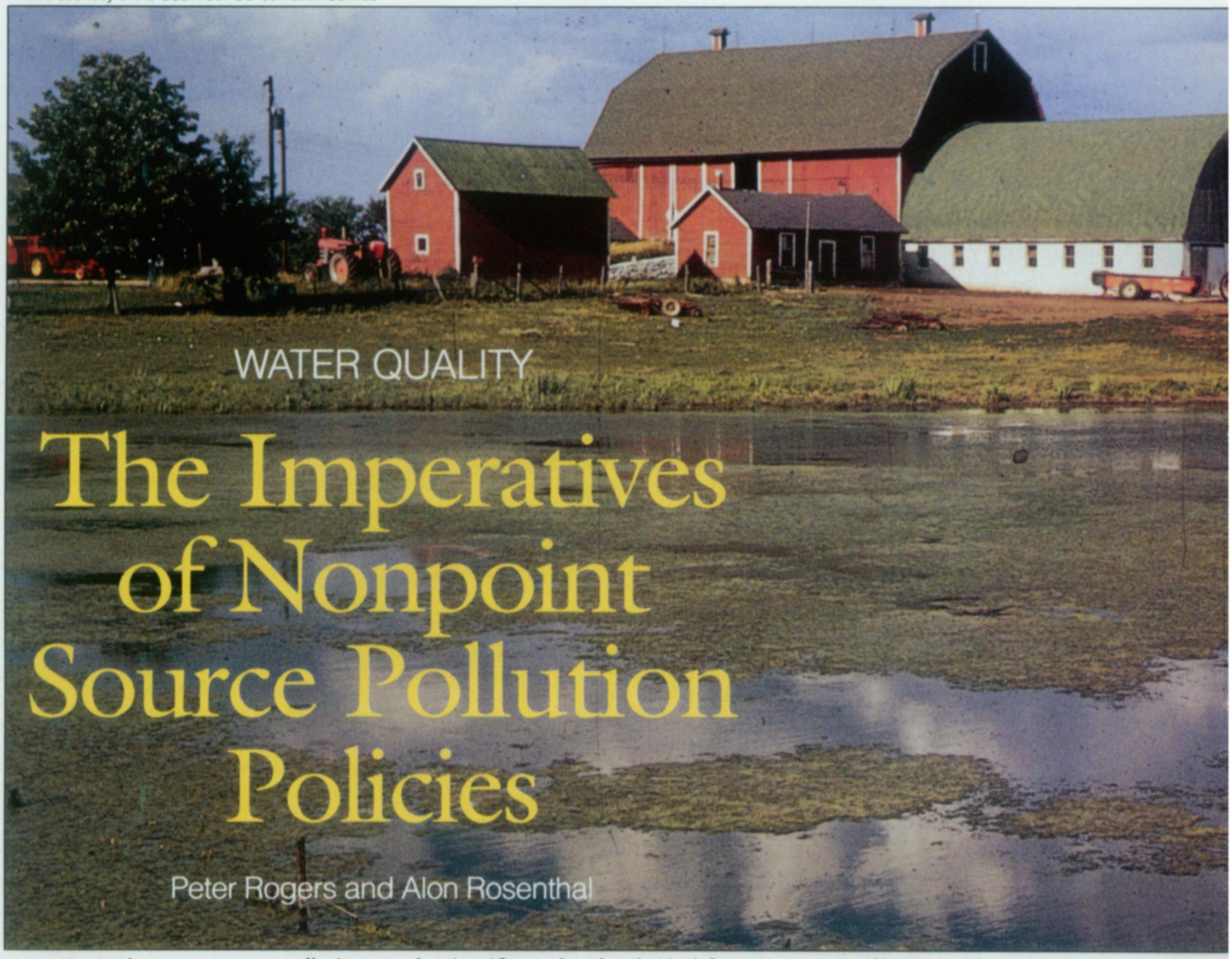

WATER QUALITY

The Imperatives of Nonpoint Source Pollution Policies

Peter Rogers and Alon Rosenthal

Nonpoint source water pollution is increasingly recognized as the primary source of surface water degradation. It is the cause for non-attainment of water quality goals in 6 out 10 regions.[1] NPS pollution is responsible for 73% of the oxygen demanding loadings, 84% of nutrients, 98% of bacteria counts, and 99% of suspended solids in the nation's waters.[2] As such, debates about water quality are presently focusing on the issue.

While much has been written about the nature of NPS water pollution and available engineering solutions, much confusion remains regarding the form which NPS abatement programs should take. Questions such as "who's in charge?", "who is responsible for the pollution?" and "what policies should be adopted to control it?" meet with widely differing opinions. While differences arise from agricultural, industrial, and environmental camps, experts believe that the technological means for controlling most NPS runoff from anthropogenic sources exist. Development of technology is no longer the paramount challenge.

Water policy, in general, should be formed from the interaction of the legal, political, fiscal, economic, ecological, scientific, and technological forces that converge on particular problem areas. Conflicts between these forces typically produce a set of prescriptions which become codified in laws and regulations for the responsible agencies. These laws and regulations, in turn, would either specify the realm of possible economic and technical choices, or mandate some particular version of them. An accompanying educational program, directed at the regulated community, often facilitates efficacious implementation.

The site-specific nature of nonpoint sources is by now a "truism." Yet, far too often variability, such as climatic and spatial conditions, is used to derail attempts to set general guidelines to direct a national nonpoint pollution abatement policy. There have been few attempts to make a comprehensive evaluation of policy alternatives for nonpoint source controls even though research has suggested a framework for evaluating policy options.[3] The framework simply establishes or reaffirms the three Es of water policy: Efficiency, Equity, and Effectiveness. The range of policy options, from voluntarism to command and control, is comprehensive (Table 1). Given the localized nature of NPS problems, the overview, not unlike other traditional water quality evaluation criteria, may be, however, too general to be useful to those making decisions about NPS policy at the state and local level.

Other approaches, such as the three Ws and four Ps, can be used to analyze water policy. The Ws approach examines water policy by asking three questions: "Who decides on water use?", "What are the deciding mechanisms?", and "Who pays?" For NPS pollution, this approach may be again too broad. The Ps approach of Preachments, Practices, Pricing, and Politics, provides a better framework in which to analyze NPS pollution. *Preachments* characterize current NPS pollution policies; *practices* are simply best management practices (BMPs), *pricing* needs to be more than incentives to implement practices; and *politics* can not be ignored.

For all NPS pollution, there are certain inherent characteristics that must agree with the proposed policy or it will not work. The policies, therefore, must obey certain imperatives. Obviously, NPS pollution policies must be in agreement with the simple laws of physics, chemistry, biology, economics and other sciences. It is the interaction

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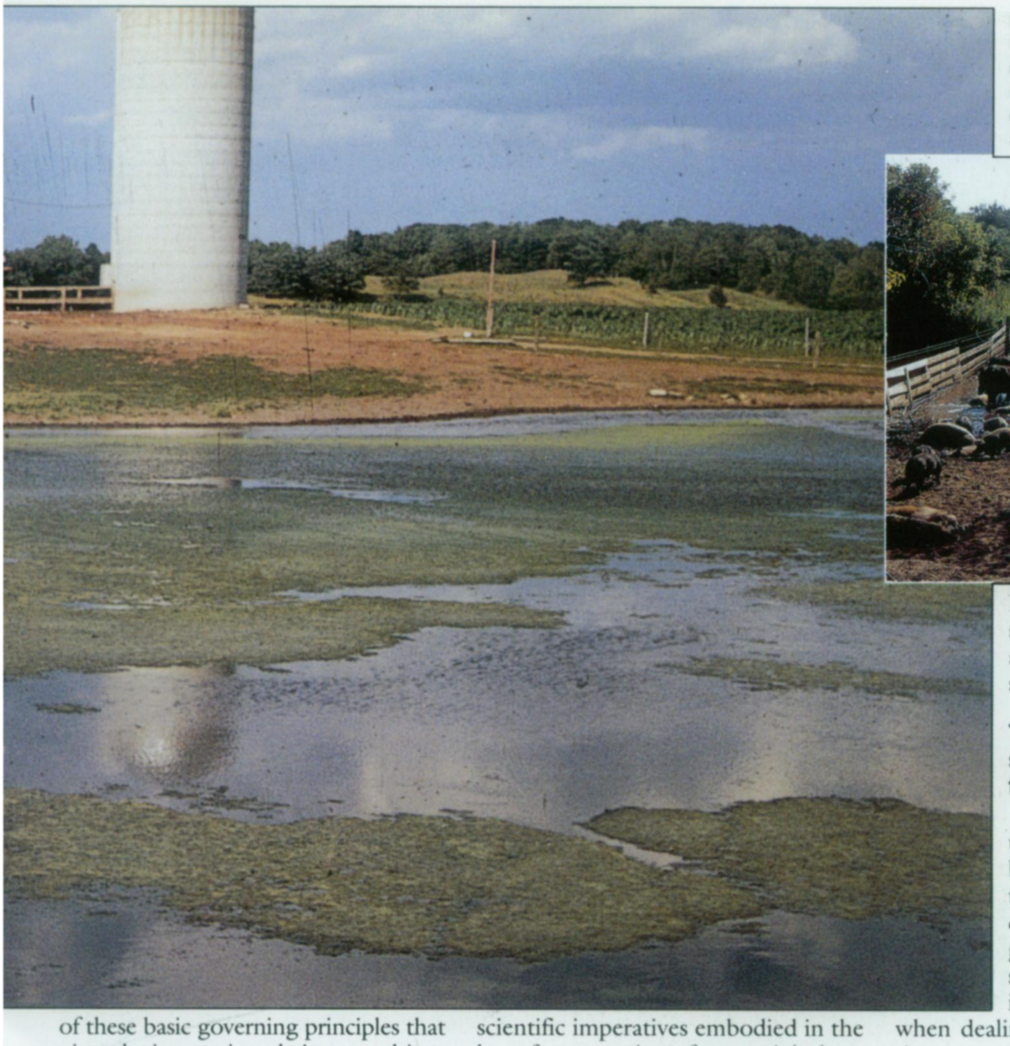

■ **Proper animal waste management (below) can effectively limit barnyard runoff and the eutrophication of adjacent ponds (left).**

of these basic governing principles that gives the imperatives their compulsion. In other words the imperatives are more focused, the governing principles are not. "Water runs downhill," is a scientific imperative but, "Water runs uphill towards money," is an economic imperative and "Water quality goes downhill if upstream and downstream users do not cooperate," is a political imperative.

The risks associated with ignoring imperatives are most apparent with technological or scientific imperatives. For example, the conservation of mass, a basic scientific imperative, should not be ignored when establishing policy. One could ask, "Who would be so foolish to ignore such an imperative?" The answer, unfortunately, is, "We are."

Ignoring imperatives has occurred often in the water pollution business. The removal of the waste materials by physical, biological, and chemical processes from wastewater, and subsequent separation of the sludges, for instance, has been chosen as the major technical approach for wastewater treatment. Recently, many have voiced "surprise" at the alarming amounts of sludge to dispose. Careful consideration of the scientific imperatives embodied in the law of conservation of mass might have led to the choice of cheaper, and more environmentally benign, technologies. A goal, therefore, is to identify the primary technical, scientific, economic, fiscal, social, political, and institutional imperatives of NPS pollution control.

Agricultural runoff can be used to demonstrate the convergence of imperatives in NPS pollution policymaking. Generally considered the most pervasive cause of nonpoint source water quality problems,[4] agricultural runoff is the primary NPS problem in 18 states and a major problem in another 35.[1] Only five states did not see it as a problem at all.

The identification of a range of imperatives associated with a coherent NPS pollution strategy can facilitate analysis of existing area policies. More importantly, it may serve as a checklist to aid in the development of a proposal that is intended to improve the means of achieving high quality environment goals that are affordable and equitable. After describing for the various imperatives, possible examples and applications of each will be offered. For instance, what follows in the discussion of the first imperative is not a taxonomy of all NPS problems, but a discussion of what a specific examination of taxonomy should consider.

Technological and scientific imperatives for NPS pollution

In addition to fundamental physical, chemical, and biological laws which cover the bio-geo-chemical cycling of material on the globe, there are six specific scientific and technological imperatives to consider when dealing with NPS water pollution: taxonomy, measurement, predictability, laws of intervention, type of intervention, and control criteria.

Taxonomy. For NPS pollution analysis, as for any scientific phenomena, pollutants and their origins must be identified and classified.

Because NPS pollutants are produced by widely scattered polluters they tend to be widely different. Pollutant classification is not without its attendant nuances. Nutrients, for example, are sometimes lumped together in diagnosing a given NPS pollution problem. In fact, phosphate-phosphorus (PO_4-P) is readily adsorbed on soil and, therefore, primarily associated with sediment runoff, while nitrate-nitrogen ($N0_3$-N) is mostly lost with subsurface water because of its high infiltration during storms and its low adsorbtivity.[4] Beyond this, variation in amount, persistence, and location within the soil profile suggest different management practices. In non-agricultural areas, the NPS stream composition reflects the local mix of residences, commercial activities, and industry.

A key element of the taxonomy is pollutant transport, an essential in assessing the components of NPS impacts

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Table 1 - Evaluation of nonpoint source pollution control policies from a national point of view.[3]

Nonpoint control policies	Efficiency: Is policy economically feasible?	Equity: Is policy politically feasible?	Effectiveness: Is policy administratively feasible?
I. Voluntarism A. moral suasion B. technical assistance C. education	No	Yes	Yes
II. Economic incentives A. bubbles 1. point-nonpoint 2. nonpoint-nonpoint B. fees 1. inputs 2. outputs 3. effluents C. subsidies 1. by general public 2. by beneficiary 3. lump sum (non specific) 4. per reduction of pollutant 5. per technology	Yes	Yes	Yes
III. Adjustment of other government policies A. price supports B. soil banking C. financial subsidies 1. tax exempt bonds 2. below-market loans 3. export financing 4. other agricultural supports D. disaster insurance E. federal, state, local tax policies 1. depreciation guidelines 2. property taxation F. zoning G. governmental land and water programs 1. military programs 2. reclamation and stream channelization 3. access to federal lands 4. federal highway programs	Depends	Yes	Depends
IV. Direct government investment for NPS control A. purchases of green spaces B. purchases of development rights C. hardware	Depends	Yes	Yes
V. "Cross-compliance" with other government programs A. loss of entitlements B. access to greater entitlements	Depends	Yes	Yes
VI. Research	No	Yes	Yes

on a receiving water body. Even within certain homogeneous agricultural regions, the variety of transport modes (in solution in subsurface drainage, in solution in surface runoff, or in association with sediment in surface runoff) may make the control strategies for seemingly similar types of pollutants very different. One study involving six watersheds in Knoxville, Tenn. demonstrated significant decrease in runoff yields in areas underlain with less soluble carbonate rocks.[5] Surface waters which receive inflow from many areas (as opposed to one city) will have even greater diversity because of the relative role of transport on loadings.

Measurement. Pollutants that do not exit effluent pipes and that are of diverse compositions must be identified and quantified. Methodological problems must be overcome, appropriate measurement and methods strategies must be established, and appropriate models and quantity relationships must be defined.

Traditional Soil Conservation Service (SCS) criteria, such as the Universal Soil Loss Equation, are generally unsatisfactory for assessing water quality. Its use demonstrates the inappropriateness of some models. Sediment may not be the critical pollutant vector which is to be controlled in a given watershed. Indeed, in some instances, sediment deposition is seen as playing a positive role, slowing the photosynthetic/eutrophication process. While sediment control may reduce runoff of pollutants that adsorb strongly to soils, such as chlorinated hydrocarbon insecticides, it will have little effect on pollutants with low soil adsorption coefficients such as NO_3-N.[4]

Measurement also implies quantifying the impacts of the pollutants on the environment and the health and welfare of society. Finding objective criteria to appraise the cost impacts of NPS pollutant damage requires detailed knowledge of an ecosystem without a corresponding understanding of damage effect threshold levels. For example, NPS nutrient loadings act in concert with numerous other factors, such as sunlight and lake alkalinity, which may cause eutrophication and which have varying effects on lakes. Degree of damage may vary widely.

Prediction. A phenomenon must be predictable based upon the scientific understanding of the phenomenon. As rainfall, a fundamentally stochastic phenomenon, determines the magnitude of NPS loadings, this imperative involves uncertainty in the predicted outcomes.

The importance and difficulty associated with prediction and modeling should not be understated. Depending on the watershed, model accuracy is the success of policy projections, prioritization for best management practice cost sharing, and pollution reduction trading schemes. For example, the existence of a comprehensive data bank about Dillon Reservoir, Colo., provided for an accurate model giving the needed support to a successful innovative point/nonpoint pollution reduction

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Photo courtesy of the Denver Water Department.

trading system.[6] This is a scheme in which a point source pollution generator is allowed to increase its waste load allocation for a given pollutant when the same nonpoint pollutant is abated in the watershed. The plan involved the strategic placement of settlement ponds and percolation pits and elimination of septic tanks. The issue of BMP siting suggests a new category: technological imperatives.

The locus of intervention. Depending on the least-cost technology, NPS pollution may have to be controlled at the point of generation, either by "end-of-pipe" treatment or by a process change to eliminate waste production. *In-situ* treatment of ambient surface or groundwater, or treatment when water is withdrawn for use, however, may be better. Assuming feasibility, abating runoff close to its source is both logistically and philosophically preferable.

Traditionally, intervention of pollution control close to the production process is more cost effective than intervening further away or downstreams.[10] Thus, in this context, controlling agricultural runoff requires changes in agricultural practices that are analogous to process redesign.[7] Unlike the industrial equivalent, however, modifying practices in agriculture to control such critical pollutants as nutrients and sediments is often relatively inexpensive. Implementing established BMPs requires little "risky" technological innovations.

In contrast, on-site source abatement of urban and silviculture runoff is difficult because runoff may be too diffuse. In these instances, BMPs may produce economies of scales if conducted in selected locations, such as in gullies and waterways that contribute to the targeted surface water degradation. Locating the solution is linked to the form of the management practices—the next imperative.

Type of intervention. Often there are several ways to solve a runoff problem. No single form of control strategy has a monopoly on effectiveness.

The form of intervention is often divided into those methods which are capital intensive versus operation and management intense methods to control the pollution. This dichotomy is often defined as structural versus nonstructural BMPs. Despite their expense, structural BMPs offer the advantage of limiting the need for intense compliance monitoring. The tradeoffs inherent in choosing one or the other management approach should be clear to the policy maker before establishing policy.

Each BMP is not without its associated nuances. For example, a southwestern Illinois study concluded that conservation tillage and selected crop rotation on all cropland in the watershed provide the greatest water quality improvement for the least cost.[8] Before promoting these management practices, the study's implicit assumption of long- term participation by farmers must be accepted. Such cooperation may not be forthcoming.

Combining BMPs is often the most effective NPS pollution control.[9] In one case, phosphorus collection efficiency increased by 23% when a percolation pond was added to a settlement pond collecting the runoff from a 81-acre watershed.

■ Dillon Reservoir, Colorado, was the model for a point/nonpoint pollution reduction scheme (top); no-till farming helps minimize soil erosion and agricultural NPS pollution (above). Photo courtesy of the Conservation Technology Information Center.

Criteria for compliance. The methodological difficulties inherent in measuring and controlling nonpoint source discharges, ultimately determine the form of any regulatory or even contractual provision controlling NPS pollution. Setting a numerical performance standard for NPS pollutant control is practically impossible. Design criteria, therefore, must be clearly delineated to expedite smooth enforcement and policy evaluation.

A settling pond or a lagoon is a good example of compliance criteria complexity which is illustrated by the interaction of the technical and scientific imperatives. Each collects urban or rural runoff and either contains it completely until runoff evaporates or is reduced to an outflow of specific quantity and quality. While settling basins are usually considered to be the BMP most amenable to quantification, attempts to set fair and meaningful effluent levels have proved difficult in actual cases.

Attempts to design a NPS permit with

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quantifiable control capabilities for purposes of pollution reduction trading have been fouled by technical problems. For example, a range of probabilistic inflows to a detention basin cannot be determined adequately and, even if the data could be generated, the storm frequency affects the collected water residency time, which is the most salient factor involved in determining settlement efficiency.[10] Even in watersheds which are well characterized, such data are typically not available at the site-specific scale required. Attempts to stipulate "performance standards" in a more general "statutory context" will encounter the same difficulties.

Economic imperatives. Just because a solution is technically feasible does not mean that it needs to be used to its fullest extent. Typically there is some level of use that balances benefits and costs. Indeed, technical feasibility alone is no basis for implementation. In a typical case, the cost of reducing each 1% of fine particle sediment, nitrogen, and phosphorus by BMP in an Illinois watershed was estimated as high as $151,000. Diminishing marginal returns to the salient biological indicators should determine the marginal benefits which define the magnitude of government intervention.[8] Policies should comply with economic imperatives based on neo-classical economic model postulates that include benefit maximization, price responsiveness, externalties and finance.

Benefit maximization. NPS strategies must meet benefit-cost criteria applied to all other public policies. If they do not, then other political, social, or institutional imperatives must support policy. When water quality damages associated with NPS loadings are not readily quantified, policy makers must make an extra effort to characterize the aesthetic and environmental benefits in the same units used to measure control costs.

The focus of NPS pollution control, when considering policies, should not rest solely on implementing costs. This tends to understate the benefits accruing to society, or individuals, as a result of the policy. Doing this also undermines the most central of economic imperatives: net benefit maximization. Answering the question, "Do the benefits exceed the costs?", assures a balanced and exhaustive accounting of both sides of the equation. This has been a central challenge in policy analysis.

There have been isolated attempts to assess the benefits associated with some NPS pollution control policies on a national level. The benefits in these cases were typically estimated as costs avoided when using NPS controls. For instance, total national in-stream and out-of-stream damages, caused by all forms of soil erosion, cost $6.1 billion.[12] Of this amount $1.2 billion was associated with erosion from cropland. In other words, if we could control soil erosion we could achieve annual benefits of more than $6.1 billion in aggregate, and $1.2 billion in annual benefits by controlling cropland soil erosion alone. The estimated annual nationwide costs to control cropland erosion, are $3.1 billion.

It might appear that, on a national scale, cropland erosion control violates the economic imperative of benefit maximization. The assumptions of this analysis, however, are debatable. For example, adjustment of the time horizon used can drastically alter the results. Time horizon is a salient subject for discussion prior to selecting a nonpoint strategy. Even using a short term scale, which tends to accentuate costs, cropland erosion control can still be an effective solution in many cases .

Price responsiveness. The demand for environmental quality is not an absolute end in its own right, but a function of incomes, consumption of other goods and services, and the actual costs of buying or paying for the environmental quality. Agricultural BMPs, with intrinsic on site benefits, increase farmer participation. They provide an economic justification for being less expensive. This is the price responsiveness imperative.

States have easily implemented NPS controls on animal feedlots as opposed to other agricultural pollution sources, such as cropland. One reason is that manure management controls are time saving. Before manure storage measures were installed in confined feeding operations, the daily chore of manure application, which could take as long as 3 to 5 hours,[18] was required. A properly designed lagoon, can efficiently store manure, meeting both the farmer's scheduling convenience and the land's assimilative capacity. While overall demand for reduced nutrients from feedlots is no greater than from field crops, the real difference in costs manifests itself dramatically in the implementation of the policy.

Similarly, to combat the rise in fertilizer cost, effective management and application of manure can bring substantial savings. A small farm which typically uses 500 lbs/acre of fertilizer can save as much as $1500 by using animal wastes efficiently. Today, with no government regulation, almost all new feedlots are designed with some form of wastewater control system. The initial costs of the system, in some cases, is covered by subsidies farmers receive for manure storage. In contrast, implementation of field runoff control often involves substantial time and expense without the concomitant short-run benefits. For these two cases the economic imperatives work in opposite directions; but the overriding economic imperative of "price responsiveness" still holds true.

Externalities. In the presence of pervasive economic and physical externalities, affecting a wide population, it is not possible to achieve economically efficient solutions without some form of government intervention, or regulation, or both.

Although one typically thinks of

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externalities as a phenomenon arising from the self interest or myopia of private individuals, activities in the public realm may also impose external costs. Controlling NPS pollution from highway deicing illustrates the problem. It is difficult to assess the benefits of salt control because of perceptions of decreased highway safety and its cost in human life (even though solid evidence of increased safety is lacking).

The use of salt, a relatively benign chemical, and the citizens' demand for "bare pavement" are relatively recent phenomena beginning in the 1950s. Currently, 10% of the global production of salt is now spread each year on the highways of the American snowbelt. EPA estimated the total damages caused by road salting to $5 billion per year. Ten million tons of salt are used annually at cost of $25 per ton. When all of the externalities are taken into account, however, the full economic "cost" of road salt is at least $500/ton.

Unfortunately, the calcium magnesium acetate, pavement additives, urea, or calcium chloride alternatives are all quite costly and some have similar external damages. Of course, salt does not have to be used at all. Mechanical snow removal and sanding (which has some environmental side effects) are adequate and are standard in Alaska. The definition selected for feasible economic management practices, in this case, determines whether the policy almost breaks even or enjoys $5 billion a year of net benefits. The externalities can lead to large divergences between the "financial" price of $25/ton and the "economic" price of $500/ton. Making the correct management practice choice is difficult when the prices do not reflect the true economic costs.

Financing requirements. Individuals and groups face many problems financing environmental quality improvements. The major imperatives are the type and size of the debt that can be assumed, and the repayment capacity.

The financial imperatives may be difficult to distinguish from the economic ones and, unfortunately, there is often a direct conflict between them. Because costs and prices are often distorted in the economy by taxation, direct subsidy, resource scarcity, physical and economic externalities, and so on, the individual producer or consumer may not be able to respond to the correct economic signals. Following the existing financial prices could lead to producer and consumer behavior quite different from that which would be "correct" under economic pricing. It is often impossible to give the appropriate signals to the economy without some form of government intervention. Thus, an important financial imperative involves ensuring that the real costs of anthropogenic NPS pollution are identified so that

Table 2 - The imperative on nonpoint source pollution policies.

Technical and scientific imperatives
Taxonomy
Measurement
Prediction
Locus of intervention
Type of intervention
Criteria for compliance
Economic and financial imperatives
Price response
Benefit maximization
Externalities
Financing requirement
Political and social imperatives
Equity
Irreversibilty
Statutes
Acceptance
Institutional imperatives
Agencies
Enforcement
Local participation
Inter agency collaboration
Bureaucratic survival

Tillamook Bay, Oregon. Photo Courtesy of the Department of Environmental Quality, Portland.

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they can be internalized by the generators.

The socio-political imperatives

The social and the political imperatives are the most difficult to specify because they typically concern many issues at once. In a sense they attempt to translate the economic and financial imperatives into social terms. Hence, the social and political imperatives start with the equity and those market failure issues which are not covered by the economic imperatives.

Equity. No group or individual should bear a cost disproportionate to their contribution to the environmental quality problem (marginal utility of income not equal). The levels of environmental quality chosen should be such that no additional benefit can be derived without making one group or individual worse off—*pareto feasibility*.

The question of equity is particularly salient in NPS policy because of the variability in the relative contributions of seemingly indistinguishable sources. Two neighboring farms which use identical processes to produce identical products, by virtue of location on "opposite sides of a hill," may have entirely different impacts on the receiving waters. Internalizing the externalities by requiring installment of an effective BMP will impose costs on one which the other should not have to bear. The economically efficient solution would not appear even-handed. Supplementary policies, such as cost-share monies and tax incentives, may be essential to maintain some sense of fairness from the socio-political viewpoint.

Irreversible impacts. The concern for irreversible environmental deterioration and consumption of non-renewable resources has to be protected by society at large (intergenerational impacts).

In NPS pollutant control the irreversible impact imperative is encountered most strongly in the ecological destruction of lakes and contamination of groundwater. Society needs to guard against irreversible environmental degradation which may come about because of the divergence of "economic" values of resources placed on them by the current generation and their value to future generations. The strength of the chlorine-carbon bond in many pesticides and the long regeneration period for a lake choked by eutrophication ensure that today's actions will be felt for many years. This must be included in the policy maker's calculus.

Statutes. There must be legislation and regulations; those regulations must be clear and easy to carry out.

Nonpoint source pollution has been the subject of myriad federal legislation, either directly by specific NPS medium or indirectly by effects. The specific measures in the primary environmental statutes through which Congress addresses the NPS problem are well known and widely documented. The NPDES Permitting System, reflecting the CWA's technology-based "end of the pipe" orientation imposes stringent effluent limitations on point and not nonpoint sources. Provisions which prod the states to identify and prioritize the critical watersheds affected by NPS runoff and to offer technical assistance do not constitute specific prohibitions or signals to potential NPS generators. Silviculture, mines, and construction runoff control programs conform, also, to this general model of regulation. For example, the Forest Service has established sediment control programs for public and privately owned forest lands. Likewise, the U.S. Departments of Interior and Agriculture acted to control water pollution from abandoned mines.

With five federal departments and agencies acting independently on NPS pollution and the intensity of state activities often varying widely between counties, untangling the different messages is difficult. Insofar as the great range of NPS so often precludes generalization, there is a certain logic in avoiding a monolithic legislative approach to these diverse generators. Nevertheless, the potential conflicts of interest between the primary promotional functions of the state agencies, and the responsibility for managing the externalities is self-evident. Clearly, when legislation becomes as complex as it is now, active consent and participation by the regulated community is difficult to obtain. Without voluntary compliance, the regulations become even more specific and enigmatic, exacerbating the cycle once again.

Acceptance. There must be a concurrence on the part of the people and groups being regulated that they will, by and large, obey the regulations. While it is generally assumed that the agricultural community is very hostile to certain command and control strategies,[13] the experiences in some states suggest otherwise.[14] Certainly, environmental objectives cannot be abandoned because of the perceived unwillingness of a large proportion of the intended actors to participate in a policy scheme. Nevertheless, promotional and educa-

Photo courtesy of the Street Maintenance Division, Municipality of Anchorage.

Photo courtesy the Conservation Technology Information Center.

■ **Alaska's mechanical snow removal and sanding operations have eliminated the need for road salts (above); sediment runoff is analyzed from a test area at the Milan Experimental Station, Tennessee (below).**

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tional efforts may be needed to supplement an unpopular policy at its outset.

The institutional imperatives

Maintenance of institutional and societal structure is an important imperative. Environmental quality can only be achieved through the human organizations of the state.

Agencies. Agencies and other organs of government must carry out the mandates of regulations. The cost of carrying out the regulations must be small in relation to the size of the overall problem.

As mentioned, farming produces the primary component of anthropogenic NPS water pollution. One would expect some corresponding response on the part of the agricultural agencies if for no other reason than to preempt environmental agencies from "invading their turf." The Department of Agriculture has been involved in soil conservation since 1933, but only in the last 10 years has it begun to give water quality a prominent place in its research (and to a lesser extent regulatory) agenda. Programs such as the Rural Clean Water Program or the Agricultural Conservation Program administered by the Soil Conservation Service in consultation with EPA go beyond the conventional scope of cost-sharing contracts. Since their inception such programs have been utilized to generate valuable information about the relative effectiveness of different BMPs.

Abatement of agricultural sources of nonpoint pollution will require a partnership between agricultural and environmental agencies. The relationship must be clearly delineated.[15] Mechanisms to ensure effective coordination have been recommended[3] and are essential for an efficient state strategy.

Enforcement. There must be clearly understood penalties for non-compliance and a mechanism to enforce the law equitably and swiftly.

In the area of enforcement, the incentives for aggressive pursuit of violations are dubious when the department promotes the regulated activity.[16] To the extent that NPS enforcement activity must rely on other agencies' cooperation, it may fall victim to such dynamics. Beyond this, budgetary limitations and constraints on personnel often cripple the enforcement efforts of an NPS regulatory program. The Minnesota Pollution Control Agency, which regulates 20,000 of its 80,000 feedlots, has only six employees to write, monitor, and enforce the animal waste permit system.

Local participation. The National NPS Policy put forth by EPA in 1985 is in effect a manifesto rejecting direct regulation at the federal level. This position elevates the significance of local controls as an institutional imperative in an overall policy scheme.

The key question, in the context of local participation, generally is not addressed: "Can and will local entities move to implement the appropriate control strategy?" The unfortunate truth may well be that although local participation in NPS controls is desirable, there may not be sufficient willingness, professional staff, and independence at the local level for significant delegation of authority in the area. Minnesota, for example, has attempted to involve local units, allowing local authorities to control soil loss through an ordinance. Only one county has developed a permit system. The limited success of the program is largely attributed to the political clout of area farmers. Native pressures remain strong even when there is willing participation. Cost-sharing is by no means free of the problems inherent in locally directed programs. Clearly, state and even regional EPA oversight is crucial if local participation in permitting or enforcing command and control agricultural pollution policies is going to be cultivated.

It would be wrong, however, to disparage the potential or the desire of many local conservation districts and environmental agencies to take an active role in a nonpoint source strategy. Pennsylvania has already delegated to four counties complete authority for enforcement of their Erosion Control Plan Requirements. The authorization, made some 2 years ago, has spawned some remarkably aggressive enforcement programs. In the last 2 years, landowners responsible for NPS discharges in Bucks County have been fined more than $200,000. However most conservation districts in the state are simply not large or independent enough to undertake the responsibilities of direct regulation.

■ Shellfish harvests are now abundant in Tillamook Bay, Oregon, after local farmers helped fund a massive cleanup.

Economic institutions overseeing voluntary self-monitoring have expedited BMP implementation. For example, in Oregon a dairy association (Tillamook), in coordination with the state Department of Environmental Quality, monitors and regulates its own operators. The tons of manure produced annually by dairies pollute the Tillamook Bay and threatens the safe harvest of shellfish.[17] In one case BMPs were not properly applied; the Tillamook Association imposed economic sanctions for 6 months beyond the time in which manure management was operated correctly and the discharge was abated.[18] A two-to-ten fold decrease in fecal coliform bacteria levels in influent streams indicates progress.

To the extent that this local participation can be achieved by economic incentives — it should be done. For example, an approach that provides cost-share money to successful programs and applies non-compliance fines at the local level is the preferable approach. Local units, however, often are not responsive to such incentives. In such cases, tough guidelines must be incorporated to provide them with the political will which might be otherwise lacking.

Interagency cooperation. Cooperation between environmental agencies and the representatives of other governmental departments is essential, and many examples exist.

Collaboration with the SCS in particular has often spontaneously established cost-sharing. This should become increasingly defined and institutionalized. Management of agricultural pollution control is conducted from a pool of employees: the SCS with 13,000 employees and EPA, which oversees air, radiation, solid waste, and drinking water programs with 14,000. At the state level the imbalance is more acute. The SCS is an invaluable resource for expertise. In many states, the SCS advances solutions to an agricultural

Photo courtesy of the Department of Environmental Quality, Portland.

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discharge problem, either by providing cost share funds or by preparing an adequate discharge control plan. The SCS solutions obviously do not carry with them stipulation of fines or penalties.

Differences in orientation between agricultural and environmental agencies have sometimes caused problems, however. For example, states are dissatisfied with enforced BMPs that do not control erosion where SCS recommendations would and with water quality effectiveness. SCS practices were successful in other cases. The problem is illustrated by a model conservation district in North Carolina where BMP cost-share grants are available through the state and disbursed locally by the SCS and the conservation district. Disbursements are made on a first-come-first-serve basis without environmentally-based criteria. Grants were given without knowledge of the extent any farm's runoff contribution to the NPS problem. Moreover, cost-share decisions are not based on previous developed models, nor are benefits being evaluated because water quality is not being monitored.

The imperative of interagency cooperation involves the form of partnership. The *de facto* collaboration which is already so prevalent should be replaced with a *de jure* arrangement in which the environmental criteria by which agricultural institutions must act in their NPS control efforts are clearly defined. More important than clarifying procedural roles is the standardization of the substantive orientation and pollution reduction strategies which are to be implemented to abate nonpoint sources.

Bureaucratic survival. In any program development or implementation, it is not realistic to assume too much altruism on the part of bureaucracies. The bureaucracies will fight to maintain and extend their power and influence in every setting. These areas become complicated in the context of NPS abatement because of the competing and converging interests of non-environmental agencies on the regulated community. Beyond the obvious example of agriculture, states with large silviculture and mining operations have governmental agencies with long-established relationships and commitments to NPS generators. The underlying agendas of these agencies may be very different. Similarly, as the entanglement of federal legislation previously described suggests, the potential for differential compliance demands opens the door for jockeying and "agency shopping" by those regulated. A clear statutorily-authorized mandate for environmental agencies may be essential for directing NPS policy in the correct direction.

Putting the imperatives together

A framework for policy evaluation can be developed from these important imperatives (Table 2). While a proposed NPS policy may not follow each imperative, a chosen policy should observe them prior to implementation. For example, imperatives affected by intervention, such as management practices, should consider each of the four economic, political, social, and institutional imperatives. Table 1 demonstrates how policy options may be evaluated using the economic, political, and institutional imperatives. This categorization assumes the technical imperatives are obeyed. Yet, many of the policy options are rated low on economic feasibility and high on administrative feasibility and vice-versa. The logic is simple and obvious; many of the policies implying government spending require little or no administrative intervention once implemented. This is attractive to institutional imperatives and not economic ones. The political feasibility falls between the economic and institutional imperatives.

Implementation of imperatives

Although environmental regulation has increasingly become woven into the nation's political and legal landscape, the basis for federal intervention in water pollution policy is the Commerce Clause of the U.S. Constitution and its allowances for interstate trade. Its use as a basis for mandating NPS pollution control may be dubious; however, there is a strong political mandate to push for improved environmental quality, not just for maintaining the status quo. For example, the 1987 amendments to the Clean Water Act, exemplifying this mandate, were passed almost unanimously over a presidential veto—a vote of 86 to 14 in the Senate and 401 to 26 in the House.

Despite legislative attempts to alter the national regulatory orientation, NPS pollution remains largely controlled on a voluntary basis. In 1985, a Federal/State/Local Nonpoint Source Task Force, however, recommended a limited role for the federal government in combatting the nonpoint pollution problem which included a commitment to financial and technical assistance and research and development. To lead the federal effort, EPA will promote adoption of NPS management programs directed at achieving water quality goals; assist with program development; and promote provision of incentives where needed. By amending the CWA in 1987, Congress appears to have concurred with this view and has continued reliance on states to formulate NPS programs.

Clearly, past EPA strategies, particularly the targeting of critical watersheds, are useful tools in the intelligent regulation of NPS pollution problems. Given the vast diversity in climatic conditions and sources of NPS pollution problems, as well as the varying degrees of enforcement capabilities, there must be room for differing approaches toward regulating nonpoint sources. However, the control technology and effectiveness of agricultural BMPs are well established today. Regulatory activity, therefore, should begin to focus on diffusion of technology rather than research development. These imperatives set a framework for a policy that will expedite this diffusion. Given the increasing recognition of the domination of the ongoing degradation of the nation's surface waters by nonpoint source pollution, they must be confronted if we wish to continue to improve water quality. ■

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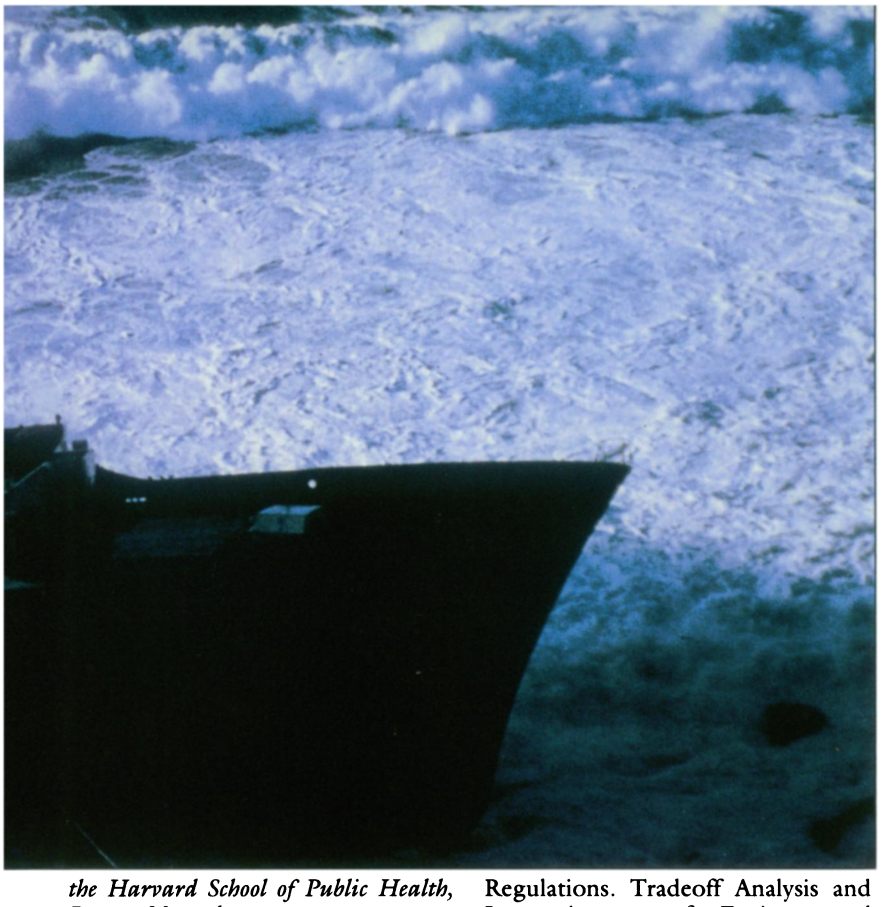

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■ **Storm damage.**

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