United States Environmental Protection Agency

Office of Communications, Education, and Public Affairs

Volume 17, Number 5
November/December 1991
22K-1005

EPA JOURNAL

NPS Pollution

Runoff of Rain and Snowmelt— Our Biggest Water Quality Problem

EPA JOURNAL

A Magazine on National and Global Environmental Perspectives

November/December 1991 ■ Volume 17, Number 5 22K-1005

Front Cover:
Rainstorm—runoff in the making.
Photo by David Falconer of Folio, Inc.

EPA JOURNAL
is printed on recycled paper.

From the Editor

Perhaps we should forgive the bureaucrats for the phrase, nonpoint-source pollution. Consider a shopping mall parking lot in the dead of winter. Salt has done its work; the macadam is free of snow. But the snowmelt has carried the salt, crankcase oil, and whatever else it finds to the gutter, and from there to the nearest stream.

If you're not into shopping malls, consider a several-hundred-acre farm enjoying a soaking rain: dairy cows, fields of corn protected by pesticides, a stream meandering through. You get the idea. If you fertilized your lawn last spring, you're probably a nonpoint-source (NPS) polluter.

There's the rub. Nonpoint sources are so diffuse we find it difficult to wrap our arms around the problem. I'm reminded of the early days of the magazine, when we sent photographers out to capture pollution on film. One came back with a beautiful shot of the New York City skyline. "That's carbon monoxide over Manhattan," he said. Who could say he was wrong?

According to the most recent review the states made of their lakes, 56 percent of assessed lake acres failed to fully support the uses designated for them—uses such as drinking water supply, contact recreation, and fisheries. The same can be said for 37 percent of river miles and 32 percent of estuarine square miles. By all accounts, NPS pollution was the leading cause.

The diffuseness of the sources of runoff, for that is what we're talking about, compounds the difficulty of controlling it. We can't single out, as we can with point sources, the owner of a factory outfall and slap him with a fine for violating his National Pollutant Discharge Elimination System permit. NPS pollution has to be tackled through the management of land use, a sea of troubles in itself.

In this issue of the *Journal*, we attempt to outline the dimensions of NPS water pollution and introduce you to the controversy over the problem.

John Heritage

EPA JOURNAL Subscriptions

The annual rate for subscribers in the U.S. for *EPA Journal* is $10. The charge to subscribers in foreign countries is $12.50 a year. The price of a single copy of *EPA Journal* is $3.50 in this country and $4.38 if sent to a foreign country. Prices include mail costs. Subscriptions to *EPA Journal* as well as to other federal government magazines are handled only by the U.S. Government Printing Office. To subscribe to *EPA Journal*, send a check or money order payable to the Superintendent of Documents. The requests should be mailed to:
Superintendent of Documents, GPO,
Washington, DC 20402.

Contents

EPA is charged by Congress to protect the nation's land, air, and water systems. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.

EPA JOURNAL is published by the U.S. Environmental Protection Agency. The Administrator of EPA has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget. Views expressed by authors do not necessarily reflect EPA policy. No permission necessary to reproduce contents except copyrighted photos and other materials.

Contributions and inquiries should be addressed to the Editor, EPA JOURNAL (A-107), Waterside Mall, 401 M Street, SW., Washington, D.C. 20460

Communities that Violate Air Standards Are Named

EPA has listed 98 areas of the country that violate the air quality standard for ozone, 42 that exceed the carbon monoxide standard, 71 the particulate standard, and 12 the standard for lead. EPA will update the list every year to track progress in meeting the standards. Administrator Reilly said: "New clean air programs will begin operating in designated places over the next couple of years. The effect of these measures, combined with other recent actions such as reformulated gasoline, will mean healthier air for more Americans to breathe."

The Washington Times reported: " . . . While states have considerable leeway on how to clean up the air, preferred measures are likely to be requiring cleaner-burning gasoline, tighter tailpipe emission standards, the use of alternative motor fuels for fleets, tougher vehicle inspections, required employer-sponsored rideshare programs and controls on emissions from such businesses as bakeries, dry cleaners, and breweries. Only the Los Angeles-South Coast Basin area is ranked as having "extreme" pollution, the worst category. The area has until the year 2010 to come into compliance. Areas classified as having "severe" air pollution are San Diego and Ventura County in California; the Baltimore metropolitan area; an urban stretch that includes Philadelphia and 13 surrounding counties; the Houston-Galveston-Brazoria area of Texas; New York and surrounding areas of Connecticut, Long Island, and New Jersey; the Chicago-Gary-Lake County areas of Illinois and Indiana; and Milwaukee-Racine in Wisconsin . . . . The EPA earlier this year estimated that while the overall air quality improved in the 1980s, more than 84 million people continued to live in areas where the air does not meet at least one of the federal standards . . . ."

The Washington Post commented: " . . . Four outlying suburban counties, some considered rural only a decade ago, are now so polluted by commuter traffic that the Environmental Protection Agency yesterday added them to the official Washington smog zone . . . . The clean-air law lets states require that new cars registered meet California tailpipe standards, which are tighter than federal mandates. Yesterday, a regional commission representing states from Virginia to Maine promised to ask legislatures to adopt the California standards. Representatives from nine states, including Virginia and Maryland, voted for the resolution, as did a representative from the District. Vermont, Connecticut, and Rhode Island abstained . . . . 'Cars are responsible for over half the emissions which create ozone,' Fran Du Melle, of the American Lung Association, said in a statement. 'We are encouraged to see the states act without capitulating to the auto industry's tired exaggerations about cost and technical feasibility.' Automobile industry officials, however, called the California restrictions a costly and excessive step. Some auto dealers oppose having to offer 'California cars,' because they would be required to stock two types of vehicles in a market that includes more than one state . . . . The California rules phase out sales of cars meeting less-restrictive national standards through 1999, and phases in the sale of cars with little or no emissions. By 2003, 10 percent of new cars must emit no pollution; they probably would be powered by batteries. All clean cars would carry a 100,000-mile warranty on emission-related parts, including the engine, higher than current warranties . . . ."

Areas Violating Ozone Standards

GEO Metro Wins 1992 Mileage Derby

Fuel economy estimates for 1992 model-year vehicles rank the 1,875-pound GEO Metro XFi as the most efficient car at 53 miles-per-gallon (mpg) city, and 59 mpg highway. It is the second year in a row for this subcompact to come in first. The Lamborghini DB 132/Diablo again received the lowest fuel economy rating of 9 mpg city and 14 mpg highway.

Also included in EPA's list of the top 10 high-mileage cars were various models of the Honda Civic, Suzuki Swift, and other GEO Metro models. Their fuel economy estimates ranged from 48 mpg city/55 mpg highway to 39 mpg city/43 mpg highway.

Light trucks have become a major portion of the light-duty fleet—30 percent of the fleet now, as opposed to 15 percent in 1980. Consequently, EPA tabulated separate top 10 and bottom 10 lists for them. The Suzuki Samurai 2WD received the highest fuel economy rating of 28 mpg city/29 mpg highway. The lowest rating of any vehicle in the 1992 Gas Mileage Guide is shared by three Dodge truck models: W250 Pickup 4WD, Ramcharger 4WD, and the W100/W150 Pickup 4WD, at 9 mpg city and 13 mpg highway.

By choosing a car that gets just 1 mpg more than the average for its vehicle class, consumers can save about $440 in fuel costs over the life of the car. For comparison purposes, EPA sorts vehicles into size classes by interior volume. Consumers can use the 1992 Gas Mileage Guide for comparison shopping. The

Acid Rain Emissions to Be Cut in Half

EPA has proposed market-based rules that will cut sulfur dioxide (SO_2) emissions 10 million tons a year by the end of the century. This is half the SO_2 emitted in 1980 by electric power plants, the chief source of the gas. Administrator Reilly said: "Today's proposal breaks new ground in harnessing the power of the marketplace to improve the environment. Market incentives and tradeable allowances will be used to cut acid rain emissions. The Bush administration believes that the economic incentives in this rule have significant advantages over traditional 'command and control' regulations in bringing about the most cost-effective pollution reductions possible."

The New York Times said: " . . . The proposed rules, required under revisions to the Clean Air Act that passed last year, were welcomed by environmental groups and by industry as a signal that innovation and consultation, rather than obstruction and confrontation, can guide the development of costly new environmental rules . . . . Under the proposal released today, a coal-fired utility that does better at cleaning up sulfur dioxide than the regulations require could accumulate credits for sale to another company that failed to clean up enough. In theory, companies that can clean up pollution cheaply by changing fuel or persuading their customers to conserve energy would recover some of the cost by selling their pollution rights to companies that could only clean up by adopting costlier measures, like filtering the smoke they emit. The air would be just as clean, but the costs would be lower. In effect, clean air would become a commodity with known production costs, and traded under laws of supply and demand as if a reduction in noxious emissions were a pork belly. Indeed, the futures market at the Chicago Board of Trade plans to trade the pollution allowances . . . ."

The Washington Post reported: " . . . Under the EPA plan, 110 power plants in the Midwest and Appalachian states that are the largest emitters of sulfur dioxide—the principal cause of acid rain—would be allocated pollution 'allowances' every year to begin with. Each allowance would be good for a ton of sulfur dioxide emitted. At year's end, each plant would calculate whether it had emitted as much sulfur dioxide as it had allowances to cover. A utility that cut its emissions and had leftover allowance could sell them to the highest bidder among utilities that emitted more than they were permitted. Or the allowances could be banked for later use in the event of plant expansion. A utility that emitted more than allowed but could not, or did not, buy allowances would have to pay the government $2,000 per ton of excess pollution. The EPA would hold an annual sale to keep the market fluid, offering allowances at a fixed price of $1,500, at least $500 more than the cost of cutting pollution with technology . . . ."

The Wall Street Journal said: " . . . In its proposal, EPA rejected attempts by the Energy Department to allow more utilities to qualify for a special clean-coal technology exemption that would give them four extra years to meet their cleanup deadline. However, in a dispute that won't be resolved until final rules are issued in May 1992, environmentalists were dismayed that the EPA failed to be stricter on utilities monitoring of their smokestack pollution. Overall, though, controversy has been held to a minimum, largely because the EPA held unusual advisory sessions with utilities, energy concerns, environmentalists and others in drafting the rules. Utilities . . . still contend the costs for producers and consumers will be higher than the EPA projects. The Edison Institute expects 10 percent to 15 percent rate increases in several states, and rate boosts over 20 percent at 10 particularly hard-hit utilities. EPA officials call those estimates excessive. All sides, though, agree that costs are held down by the law's emphasis on allowing utilities to choose for themselves how to cut their emissions . . . ."

The Los Angeles Times reported: " . . . The EPA estimates that the total cost of the crackdown would be less than $4 billion a year, translating to an increase of 1 percent to 1.5 percent in consumer electric bills . . . . Acid rain, so named because the acidic pollutants are emitted into the atmosphere only to return to the surface with rain and snow, has been blamed not only for severe damage. to lakes, streams, and forests in the eastern United States but in Canada as well . . . . Without being specific, Reilly suggested that the financial incentives brought to the acid rain problem will get serious consideration at EPA for incorporation in water pollution control programs . . . . He lauded 'the efforts of many people, including representatives from electric utilities, state regulatory agencies, equipment manufacturers, fuel suppliers, environmental groups and the business community . . . . I believe that the process we used set a benchmark for working together in constructive and productive ways. The child of these labors is born today and it is a healthy baby, full of promise.'"

guide should be available at all new car dealerships. The mpg ratings also appear on the window stickers of all new cars.

Fuel economy estimates are derived from EPA's vehicle emission testing program. Pre-production vehicles are tested under controlled laboratory conditions for both emissions and fuel economy. EPA has reported fuel economy comparisons since 1974.

Federal Water Standards to be set for 22 States and Territories

Surface water quality standards for as many as 105 toxic pollutants will be set by EPA for states and territories that have failed to set their own standards, according to an announcement by the Agency. Administrator Reilly said: "Many states have adopted good water quality standards for toxics—but the delay of some is forcing us to step in, to accelerate the control of the most prevalent toxic pollutants impairing surface water. I hope today's proposal will prompt states to set toxic standards while they still can under their own initiative."

Mike Brisson photo.

The Baltimore Sun reported: " . . . Nineteen states, the District of Columbia, and two territories must complete adoption of water-quality standards by February 19 or the federal government will set the standards for them . . . . EPA Administrator William K. Reilly said that by the time the three-month waiting period expires—the clock will begin ticking November 19, when the EPA publishes its standards in tentative form, subject to revision after an abbreviated 30-day period for public comment—he expects only Colorado and New Hampshire to have standards for all 105 of the toxic pollutants involved . . . . In addition to Colorado, New Hampshire, and the District of Columbia, the jurisdictions involved are Alaska, Arizona, Arkansas, California, Connecticut, Florida, Hawaii, Idaho, Kansas, Louisiana, Michigan, New Jersey, Nevada, the Northern Mariana Islands, Puerto Rico, Rhode Island, Vermont, Virginia, and Washington . . . ."

The Washington Post said: " . . . Congress required the EPA to set standards for the states to adopt by February 1990, and the agency responded with regulations for 105 pollutants, including 61 carcinogens. Among them are such well-known substances as dioxin, PCBs, lead, benzene, and asbestos. Only five states complied on time, with 26 others falling into line after the EPA indicated plans to impose its own standards. It took the agency nearly two years to follow up its threat with yesterday's action. The long-awaited announcement was propelled by new data from the states revealing 'harmful' levels of toxic substances in 28,000 miles of rivers, 3.6 million acres of lakes, 2,000 square miles of estuaries and 4,800 miles of Great Lakes shoreline, according to the EPA. Forty-four states and territories have issued advisories warning against eating local fish because of toxic pollutants concentrated in the tissue of fish . . . ."

The Los Angeles Times commented: " . . . In spite of the EPA's stern rhetoric, it was unclear how aggressively enforcement of the tough federal standard will be pursued. Although the agency hopes to complete work on the new regulations and put them into effect in about 90 days, it will take five years for them to reach all polluters. Routinely, the standard will be put into force only when industries apply to renew any of the thousands of water quality permits. In urgent cases, the EPA can intervene and make the new toxic standard part of an existing permit. Possible sanctions against violators include heavy fines, government-ordered abatement, and suspension of operations. But, when states respond to the EPA nudging by completing their own standards, they may be able to get the federal agency's approval for restrictions far less stringent than those announced Wednesday. Depending on the circumstances, the one-in-a-million cancer standard announced by Reilly might be changed to one in 100,000 . . . ."

Ongoing

Paper Pulp Mills to Pay $5.8 Million in Penalties

Louisiana Pacific Corporation and the Simpson Paper Company, owners of paper pulp mills near Eureka, California, have agreed to pay $2.9 million each for illegal discharges into the Pacific Ocean. The agreements were reached in consent decrees signed by EPA, the companies, and the Surfrider Foundation. The penalties are among the largest ever levied under the Clean Water Act. In addition to the penalties, the settlements require Louisiana Pacific and Simpson to implement treatment measures or process changes to abate toxicity in the mills' 40 million gallons of daily effluent. The decrees are precedent-setting by requiring treatment systems to meet toxicity limits based upon impacts to living organisms. EPA and the Surfrider Foundation brought suit against the mills in 1989 for persistent violations of permits issued them under the Clean Water Act. The violations resulted in adverse effects on human health and marine life in Humboldt County coastal waters.

Enforcement Actions

$9.8 Million Sought for Illegal Shipment of Chemicals and Wastes

Helped by the U.S. Customs Service, EPA seeks a total of $9.8 million from administrative actions it has filed against 21 companies for illegal import or export of chemicals and hazardous wastes. A number of the cases involve shipments across the Canadian and Mexican borders. The actions were filed under three EPA statutes: hazardous waste management provisions of the Resource Conservation and Recovery Act; import provisions of the Toxic Substances Control Act; and export provisions of the Federal Insecticide, Fungicide, and Rodenticide Act.

In a related matter, on behalf of EPA, the Department of Justice filed judicial actions against two companies for importing ozone-depleting CFCs without first obtaining the consumption allowances required by the Clean Air Act.

American Cyanimid to Pay $625,000 for Violation of CAA

The American Cyanamid Company has agreed to pay a $625,000 civil penalty for failing to obtain a pre-construction permit for a stationary gas turbine at its Lederle Laboratories Division facility in Pearl River, New York. Under the Clean Air Act, a facility that has the potential to emit 250 tons per year or more of certain pollutants, including carbon monoxide, nitrous oxides, sulfur dioxide, and particulate matter under 10 microns (PM-10), must obtain a permit before beginning construction. According to the complaint filed by the federal government, the company was aware of the requirement, and had applied for a permit, but began construction before EPA issued it. In addition to the $625,000 penalty, the proposed agreement between the government and American Cyanamid includes an injunction requiring the company to comply with all provisions of the Clean Air Act at its Pearl River facility for three years. Violation of the injunction would be punishable as contempt.

First Penalty Sought for Violation of Laboratory Rules

EPA has filed a civil complaint in the amount of $260,000 against Carter Wallace, Inc. of Cranbury, New Jersey, for violations of Good Laboratory Practice regulations, which the agency had issued under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The 60-count complaint is the first complaint filed under the regulations.

The complaint charges Lambert Kay with certifying falsely that laboratory studies of two of its pesticide products were performed in accordance with the FIFRA rules. In fact, an EPA inspection of the laboratory turned up serious discrepancies. EPA also issued a Notice of Warning to AMA Laboratories, which performed the studies.

Superfund National Director Named; Reforms Announced

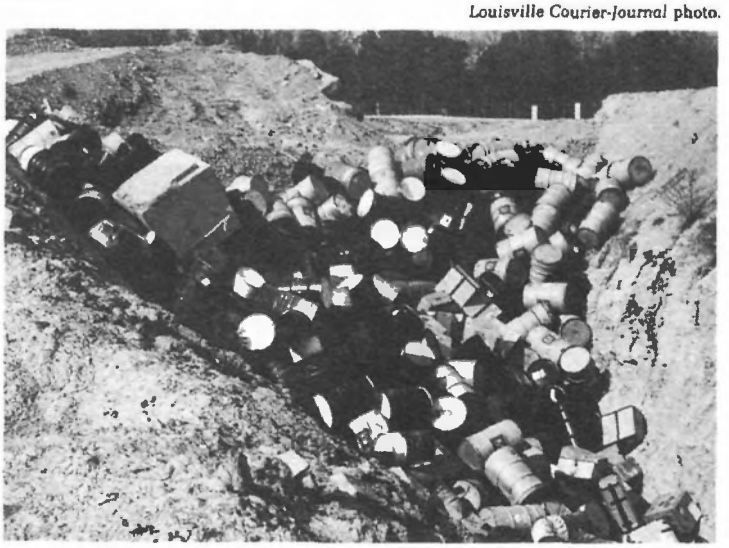
Key reforms to the Superfund program have been announced by EPA, including the appointment of a National Director and a 20- to 30-person trouble shooting team to serve as a strategic nerve center. The reforms are designed to improve program management and accountability; their objective is to triple cleanup completions by the end of 1993 and to bring the costs of management down to 20 percent or less. Richard Guimond has been named as National Director. He was recently appointed Deputy Assistant Administrator of the Office of Solid Waste and Emergency Response. (See July/August *Journal*.)

In making the announcement, Administrator Reilly said that, as a result of the enforcement-first strategy adopted two years ago, EPA had succeeded in getting private parties to increase their share of cleanups: A record number of settlements have been reached, with a threefold increase in private commitments. What remained was to accelerate the rate of cleanups and reduce the cost of managing them.

Reilly appointed a task force last June to examine the program. They found that management expenditures by some contractors, while not illegal under federal procurement regulations, appeared to be unjustified. Under the reforms, which they recommended: Internal controls of contracts will be improved; more audits will be performed; all contracts will be reexamined with an eye to eliminating unnecessary management costs; poor contract performers will be terminated. Funds are being provided from the fiscal year 1992 budget to speed audits.

The new National Director is charged with overseeing all Superfund procurements and budgeting, and with implementing measures to improve contracting and accelerate cleanups. Nevertheless, most site-specific decisions will remain with EPA's regional offices. The trouble shooting team will track progress in site cleanups and will provide an early warning system for identifying problems and their solutions.

Louisville Courier-Journal photo.



THE PROBLEM

Introducing NPS Water Pollution

We can't write permits on parking lots.

by Robert Griffin, Jr.

Sediment, animal wastes, and chemicals run off farms into our surface waters.

Mike Brisson photo.

In this period of public skepticism over government's ability to solve problems, the results of the Clean Water Act stand as a refreshing counterpoint. By many indicators, this legislation—and the programs it has generated—must be counted as a major success.

Gross pollution of the nation's rivers, lakes, and coastal waters by sewage and by industrial wastes is largely a thing of the past. Fish have returned to waters that were once depleted of life-giving oxygen. Swimming and other water-contact sports are again permitted in rivers, in lakes, and at ocean beaches that once were closed by health officials.

This success, however, is at best only a partial one. Water pollution remains a serious problem in most parts of the country. Sediment, nutrients, pathogenic organisms, and toxics still find their way into the nation's waters, where they degrade the ecosystem, pose health hazards,

(Griffin is a Washington-based science writer specializing in health and environmental issues.)

and impair the full use of water resources.

It is clear that our success in combatting the gross pollution of yesteryear—however incomplete—is largely the result of tackling the easy things first. We have, in large part, brought under control the so-called point sources of pollution.

These include municipal and industrial outfalls and other sources that are clearly identified with a well-defined location or place. Government, by requiring permits to operate such facilities, has created a mechanism whereby control technology—such as a waste treatment plant—can be mandated, and the effect of such technology can be monitored.

It is equally clear that if we are to continue the progress made over the past two decades, we must now focus on "nonpoint source" (NPS) pollution. The task of controlling NPS pollution is in many respects more difficult than controlling pollution from point sources, and requires different control strategies.

Nonpoint-source pollution—unlike pollution from point sources—is quite diffuse, both in terms of its origin and in the manner in which it enters ground and surface waters. It results from a variety of human activities that take place over a wide geographic area, perhaps many hundreds or even thousands of acres. Unlike pollutants from point sources—which enter the environment at well-defined locations and in relatively even, continuous discharges—pollutants from nonpoint sources usually find their way into surface and ground waters in sudden surges, often in large quantities, and are associated with rainfall, thunderstorms, or snowmelt.

Let's take a look at some of the most significant sources of NPS pollution, as identified in EPA's latest published *National Water Quality Inventory*:

- *Agriculture*: Between 50 to 70 percent of impaired or threatened surface waters are affected by NPS pollution from agricultural activities. Pollutants include sediments from eroded croplands and overgrazed pastures; fertilizers or nutrients, which promote excessive growth of aquatic plants and contamination of ground water by nitrate; animal waste from confined animal facilities, which contains nutrients and bacteria that can cause shellfish bed closures and fish kills; and pesticides, which can be toxic to aquatic life as well as to humans.

- *Urban runoff*: Pollutants carried by runoff from such urban artifacts as streets and roadways, commercial and industrial sites, and parking lots affect between 5 to 15 percent of surface waters. Urban runoff contains salts and oily residues from road surfaces and may include a variety of nutrients and toxics as well. Elevated temperatures—which are typical of urban runoff—can result in "thermal pollution," contributing to higher-than-normal temperatures in nearby streams, reservoirs, or lakes.

Urban runoff discharged from municipal separate storm sewers serving populations of 100,000 or more and stormwater discharges associated with industrial activity are considered point sources by Congress and are regulated under the National Pollutant Discharge Elimination System (NPDES) permit program.

- *Hydromodification*: Engineering projects, such as reservoir or dam construction, stream channelization, and flood prevention will inevitably result in changes in water flow patterns. When such changes occur, there is often an increase in sediment deposits. By modifying habitat, such projects may adversely affect aquatic life. Between 5 to 15 percent of surface waters in the United States are estimated to be affected by hydromodification.

- *Abandoned mines and other past resource-extraction operations*: Up to 10 percent of surface waters are adversely affected by acid drainage from abandoned mines, pollution from mill tailings and mining waste piles, and pollution from improperly sealed oil and gas wells. Active mines are regarded as point sources by EPA.

- *Silviculture*: Pollution associated with commercial timber cutting and other forestry operations affects up to five percent of surface waters. Erosion from deforested lands, and particularly debris from eroded surfaces of logging roads, produces large amounts of sediment which ultimately finds its way into streams and lakes. Habitat altered by logging can adversely affect a wide range of plant and animal species.

- *Construction*: New building and major land development projects, including highway construction, produce sediment and toxic materials that have been estimated to degrade up to five percent of the nation's surface waters. While pollution loadings from development and construction activities are generally localized, and of limited duration, such activities have the potential to generate levels of sediment which are typically 10 to 20 times greater than those from agricultural lands. Severe sediment loads may degrade water quality and permanently alter wildlife and fishery habitat. Construction activities disturbing five acres or more are considered point sources by Congress.

- *Land disposal*: Between one and five percent of the nation's surface waters are affected by disposal of waste on land—largely leakage from septic tanks and the spreading of sewage sludge.

In some cases, policies of federal agencies that directly affect land use may contribute inadvertently to the NPS problem.

Often, the full effect of NPS pollution cannot be measured in terms of water contamination alone: Loss of topsoil to erosion has a negative impact on agricultural productivity and can cause damage to structures, roads, and ditches. Sediment can destroy breeding grounds for fish and other wildlife. Increased levels of sediment mean increased costs for dredging harbors and treating wastewater. Resulting higher riverbeds lead to greater flooding; and reservoirs and lakes silt up more quickly than anticipated.

Although the Clean Water Act has

served the nation well in the struggle to control point-source pollution, environmental experts as well as Congress acknowledge that this landmark legislation has proved inadequate in the effort to manage pollution from nonpoint sources. The Act was amended in 1987, in part to address this deficiency.

Under the amendments, all 50 states, with guidance and technical support from EPA, have conducted surveys and developed "assessment reports" defining the nature and extent of NPS pollution within their boundaries. Based on these assessments, the states have adopted NPS management programs tailored to address the particular NPS problems in their state. EPA lends financial support to these efforts through grants earmarked for NPS pollution control.

Controlling nonpoint sources turns out to be a different animal than controlling point sources.

Point sources lend themselves to the traditional regulatory approach, what has been called a "top down" solution: Federal and state governments "at the top" establish environmental requirements that industries and municipalities must meet. Environmental agencies monitor pollution control activities "down" to the municipal or industrial plant level to insure compliance.

Under this approach, EPA defined limits—applicable nationwide—on the discharge of individual pollutants from industrial plants and sewage treatment facilities. State agencies then enforced these limits through permits issued individually to point source operators.

The responsibility for meeting these "top down" regulatory requirements is typically confined to a relatively few individuals—primarily industry executives or municipal officials. The approach does not require the active support and involvement of the general public on a day-to-day basis.

Pollution from nonpoint sources, in contrast, cannot be controlled by permits governing discharges from individual pipes or outfalls. There is simply no practical way to write a permit for every 100-acre field, or parking lot. Further, NPS pollution occurs as a direct result of the use to which land is put, and abatement strategies must accommodate the politically sensitive issue of land use planning and zoning.

Under our federal system, regulation of land use traditionally has been primarily a prerogative of local governments. Consequently, Congress has been reluctant to create a federal regulatory program that imposes "top down" controls on NPS pollution. Nevertheless, regulation of nonpoint sources clearly is feasible. The State of Wisconsin, for example, has enacted a back-up regulatory program that imposes penalties on farms that violate NPS pollution standards; individual farms that pollute in a flagrant manner may be regulated as "point sources," subject to monitoring and discharge limits.

The new coastal NPS legislation, section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990, requires states to develop coastal NPS programs that contain "enforceable policies and mechanisms" to assure implementation of these programs. Thus, while Congress has fallen short of dictating a particular "top down" approach to regulating NPS pollution, it is clearly calling for states to beef up their regulatory approaches to NPS control.

Control strategies for NPS pollution generally proceed from two basic principles, both involving land use practices:

Harley Schwadron. Reprinted with permission.

- First, measures can be taken to increase the ability of the land to retain water, thereby reducing runoff to streams and lakes. Common-sense ways to accomplish this include maximizing cover on cropland and other land at all times and using natural channels and drainage ditches, instead of paved ones or sewers, to transport storm water runoff, allowing the soil to absorb some pollutant-laden waters. Planting grasses or other forms of vegetation, whose root structures tend to bind the topsoil, will prevent erosion. Also, the plant tissues hold water.

- Second, the kinds and amount of pollutants swept away in runoff can be minimized. For example, citizens can be encouraged to recycle waste oil properly—not down storm drains. Prudent application of pesticides and fertilizers can reduce runoff of chemicals from farms.

Using these two basic principles, a wide variety of NPS pollution control strategies have been designed to meet the special requirements of the different categories of NPS pollution.

For example, farmers may choose to reserve steeply sloped lands, or lands near riverbeds and lake shores, for permanent pasture or woodland; they may employ so-called "reduced tillage systems" for crop cultivation—a technique which minimizes ploughing or soil disturbance, and which involves retaining grass or residues from previous crops to help hold the soil in place. Construction of terraces, contour strips, and grassed waterways are other means for reducing the velocity and volume of runoff and reducing soil erosion.

Runoff from construction areas can be minimized by disturbing the smallest possible surfaces of exposed soil for the shortest practical time—for example, by grading only one part of a construction site at a time. Sediments can be contained by erecting "skirts" of canvas or plastic sheeting around areas of exposed soil, or by laying down mulches to hold the soil until

Melting snow carries urban pollution into storm sewers. Wide World photo.

vegetation can be established. Depending upon the topography, it may be necessary to construct temporary diversions, dikes, or other structures to divert water around exposed soil surfaces.

Success in the effort to control NPS pollution undoubtedly requires finding good technical solutions to managing storm-water runoff and minimizing migration of pollutants into rivers, lakes, and ground water. But identifying technical solutions, alone, will not be sufficient. Attention must be paid to institutional arrangements and to financial incentives to correct the problem. Perhaps most importantly, it is essential to convince individuals, and society as a whole, that there is indeed a problem and a compelling need for taking action.

In some cases, policies of federal agencies that directly affect land use may contribute inadvertently to the NPS problem, and these must be examined critically with a view toward change. Such policies and programs include, for example, U.S. Department of Agriculture (USDA) farm commodity-price and income-support programs and USDA policies governing timber harvesting from the national forests.

Currently, more than two-thirds of all cropland in the United States is enrolled in USDA commodity-price/income-support programs. Farmers receive price supports according to a "base acre" formula which reflects the average crop yield over a previous five-year period. A farmer who accepts price supports may not substitute another crop on the same land unless he also has an established "base" for the substitute or rotation crop. Such artificial impediments to crop rotation, and penalties for leaving land fallow (a fallow year lowers the five-year average yield), work perversely to encourage greater reliance on agrichemicals, including synthetic fertilizers and pesticides, to overcome the ill effects of continual single-crop cultivation. Similarly, critics of USDA's Forest Service maintain that the agency's timber harvesting policies are biased toward production and do not allow sufficient consideration for environmental impacts.

It should be noted that USDA has shown greater sympathy in recent years for the environmental point of view: Clear-cutting has been reduced in the national forests; changes have been proposed to offer greater flexibility to the price support program.

There is promise in steps that are being taken to control pollution of coastal waters from nonpoint sources.

Protection of coastal waters is an especially sensitive issue. This fact is surely due to the well-recognized public health hazards, as well as insult to aesthetic sensibilities, associated with pollution of bathing beaches and commercial fishing and shellfish habitat. Just as the amendments to the Clean Water Act have focused greater attention on control of NPS pollution in general, so recent amendments to the Coastal Zone Management Act have focused specifically on the need for controlling NPS pollution in coastal areas.

Environmentalists, marine biologists, and others with an interest in protecting the nation's coastal waters express satisfaction over the prospect that states with approved coastal zone management programs must soon begin to develop Coastal Nonpoint Pollution Control Programs. In developing such programs, states must follow guidance issued jointly by EPA and the National Oceanic and Atmospheric Administration (NOAA). The guidance will describe management measures of proven value in controlling NPS pollution. These will include measures which can be employed to avoid or reduce the generation of pollutants, as well as actions which can be taken to prevent pollution from reaching ground or surface waters. A legislatively determined timetable calls for the states to complete development of their Coastal NPS programs within 30 months following issuance of the EPA/NOAA guidance, now scheduled for publication in May 1992.

The promise lies in the hope of many that successful implementation of the program by coastal states will warrant its extension to inland states, as well.

Finally, Congress has recognized that bringing NPS pollution under control will not be cheap, and it has authorized channeling substantial federal monies into the effort: A number of grants to states under the Clean Water Act may be used for either NPS program development or implementation and State Revolving Funds, capitalized by EPA, may be applied to implementation of NPS programs. In addition, many states are financing their own NPS control programs.

The effort to control NPS pollution will not be easy, nor can it be accomplished quickly. It certainly will not be inexpensive. But the price of avoiding this issue, or of continuing delay, grows daily. It is measured in terms of the nation's health, and in the degradation of our irreplaceable water resources. □

THE PROBLEM

Agricultural Chemicals: The Karst Case

In the land of sky blue waters, wells are polluted.

by John Weiss

Minnesota, land of sky blue waters, land of 10,000 lakes, land of tall pines ringing clear lakes and streams. This is the common image of the state.

But the state and its water have another side, one that presents unique beauties, and unique problems, for its people and their drinking water. That side is found in the southeastern corner, in all or parts of six or seven counties. In these counties, the glaciers never left their mark with deep topsoil and lakes.

In many places in these counties, there is little topsoil to filter pollutants from water before it gets into the sandstone or limestone that is often only several inches or several feet below the surface.

What that means is that whatever is put on the surface, be it pesticides or fertilizers, often quickly ends up in the subsurface, or ground water. It is a problem that began to surface about 15 years ago in the realization of some health experts, and in the last decade in the minds of most of the region's residents.

A short geology lesson is needed to understand the phenomenon known as karst, an area of porous, fractured rock.

According to Dr. Nancy Jannik, a professor of geology at Winona State University, rock formed at the bottom of ancient, warm seas sometime within the last 600 million years. Sands deposited there became sandstone; marine creatures became limestone; muds compacted into shale.

(Weiss is an environmental writer with the Rochester Post-Bulletin. He has covered water quality issues for 15 years.)

Being porous, the rocks contain huge amounts of water, many times more than is found in all the streams and lakes of the state, except for Lake Superior. The southeast, in other words, is a huge reservoir of ground water. It is formed in three basic layers separated by rock that lets no water through, or only lets it trickle through.

Besides being porous, the rock often is fractured, especially near the surface. Unfortunately, it is not consistent in this regard, making the study of ground water challenging and frustrating. Rock may be quite solid in one place, and badly fractured just 10 feet away. Some limestone areas have large caves that have been gouged out by underground streams.

Because the rock is porous and fractured, Jannik says, the best way to think of it is not as rock but as a sponge that may suck up any pollution. Where the pollution goes when it's under the ground is hard to predict, but it does go down, although it often takes centuries to reach lower levels.

Karst became a problem when settlers came to the region and turned much of the former prairie and woods into farms or pastures. Although there isn't a great amount of topsoil, much of the region is still heavily farmed. In flatter areas, at the top or at the base of bluffs, there are large fields of corn or soybeans, the two main cash crops. There are also large hay or alfalfa fields for cattle, another mainstay of the farming industry. Some areas, which are too rolling for planting cash corps, are used for pasture for beef or dairy cattle.

Farmers use pesticides to keep grasses and insects at bay and fertilizers to help crops grow. For years it was commonly believed that such chemicals would either remain on top of the ground or would degrade before they could reach the ground water.

But recently, drinking water samples were found to contain nitrates, nearly all of which came from fertilizers which seeped into the water. Many samples were below the 10 parts-per-million standard set for drinking water by EPA, but they still showed amounts higher than would be found naturally. Now and then, some were found in high enough doses to harm infants or young cattle. (High nitrate levels can interfere with the ability of blood to carry oxygen.)

Besides nitrates, some common pesticides, such as atrazine, have also been found in the water. What low levels of such pollutants will do over the long run isn't well known.

When the settlers came, they also drilled wells to tap the ground water. But they usually didn't bother to protect the wells. Consequently, the wells became not only a conduit for water to come up, but also for pollution to go down. In some cases, where wells were too close to feedlots or home sewage systems, people literally drank their own waste or that of their cattle.

The Minnesota Project.

When rock is dissolved by ground water, the land surface may cave in, forming sinkholes.

Still another problem, besides little topsoil or bad wells, are sinkholes, according to Laurie Hassler, who works on water protection for the Soil Conservation Service in Olmsted County, in the center of the southeast. Those holes are simply areas where the rock has been eroded from below, and the surface has caved in. They are direct links from the surface to the ground water. Olmsted County has about 800 such sinkholes; Fillmore County, to the south, is the sinkhole capital of the southeast, with several thousand.

Because they were of little use otherwise, sinkholes were often used for dumps. Included in the debris were unrinsed herbicide or insecticide containers. In the cases of two towns, sinkholes opened below sewage lagoons, allowing thousands of gallons of untreated (or semi-treated) sewage to flow into the ground water.

As farming became more developed, chemicals and fertilizers were used more, and problems became worse. Now, in large part due to chemicals, but also because of urban pollution, throughout the region the top layer of ground water is too contaminated to use for drinking or cooking, the middle layer is in good shape, and the lowest one is still good. But towns built along rivers usually don't have all three ground-water layers. They may already be using the lowest one. If that is polluted, they are out of luck. There is very little water below.

Policy makers and others in the region have begun to respond to the problem. Nine counties have formed a joint powers board through which they can work together to reduce the amount of contamination going into the water. Agricultural experts are helping farmers to use fewer chemicals, use them more effectively, and recycle pesticide containers. In the case of nitrates, studies have been made to help farmers determine just how much fertilizer they really need, so that excess fertilizer doesn't end up in drinking water. This also saves them money.

As for the sinkholes, Hassler said the region recently received a state grant to see if it's possible to divert runoff around them. It's too expensive to seal them, and the seals don't always work. However, with diking or other devices, runoff can be kept out of the sinkholes, and out of the ground water. □

Agricultural Sediment: The Case of Otter Creek

Erosion can smother fish and aquatic plants.

by David Wann and Jack Wilbur

Chinese leaders expressed it well more than 3,000 years ago: "To protect your rivers, protect your mountains." The same Earth that is a critical resource on wilderness terrain or grazing lands becomes a pollutant—sediment—when it washes into creeks and streams. Otter Creek in central Utah is a good example.

The Otter Creek watershed is a tributary to the Sevier River system, which provides municipal, industrial, and agricultural water to several thousand downstream users. Because of its deteriorating condition, Otter Creek is near the top of Utah's priority list of areas requiring immediate action. The bull's-eye is good water quality in the creek and downstream reservoir, but the target includes 240,000 acres of riparian and upland range operated by the Bureau of Land Management, the U.S. Forest Service, the state of Utah, and private owners.

The story is a familiar one, yet one that is ecologically complex.

When rangeland condition is declining, native grasses tend to be replaced by vegetation that doesn't adequately hold the soil in place. (At Otter Creek, sedges, blue gramma grass, and aspens are steadily being replaced by more shallow-rooted grasses, sagebrush, and juniper.)

The effects of wind, water, ice, and excessive grazing can combine to deposit soil in creeks and streams, which in turn changes the stream's shape, temperature, and biological capacity. Eroded soil can smother fish habitat and deplete dissolved oxygen. Many species of aquatic plants cannot thrive because of the cloudiness of the water. Downstream, reservoirs fill up with silt, reducing their storage capacity and biological vitality.

What are the causes of this chain of events? In most cases, a whole series of activities occurring both in upland pastures and streamside ("riparian") meadows. Like humans, whose major cities are located on rivers, livestock and wildlife tend to congregate along streams and creeks, especially in hot weather. When upland vegetation deteriorates, livestock rely on streamside forage even more than usual. This heavy concentration may cause trampling of the overhanging streambanks that are ideal as fish habitat, filling in the pools where fish feed. Excessive grazing also depletes the lush vegetation that typically grows on the banks of streams.

Poorly managed grazing in riparian zones often removes young tree and shrub seedlings, leaving species that are not only less palatable but also less capable of holding streamside soil in place. The removal of vegetation along the stream causes elevated water temperatures that are intolerable to fish species such as trout. And it leads to the bank erosion that makes streams wide and shallow, a condition that further raises temperatures.

Over-utilized vegetation loses its

(Wann works in the Policy Office in EPA's Region 8; recently he produced television programs on hazardous waste, transportation, and sustainable agriculture. Wilbur is a public information specialist with the Utah Department of Agriculture, specializing in nonpoint-source water pollution issues.)

vigor. The roots become less healthy and the plants may eventually die back, leaving exposed soil that is vulnerable to runoff. To be healthy, both upland and riparian areas need a mix of vegetation that provides a "pathway" for water to soak into the ground, and tenacious roots to hold streambanks together. A healthy mixture of plant species stabilizes soil so the pasture can withstand natural challenges like thunderstorms, flashfloods, and rapid snowmelts.

The decline of a watershed can happen quickly, or it can beslow and difficult to detect. But the end result is the same: a hydrological system that is literally going down the drain.

A wide variety of agencies and groups are attacking the causes of Otter Creek's malaise: The state of Utah's Departments of Environment, Agriculture, Wildlife, Parks, and Recreation are working closely with the federal Bureau of Land Management, Soil Conservation Service, Forest Service, Environmental Protection Agency, Agricultural Stabilization and Conservation Service, Utah State University Cooperative Extension Service, Piute County, Piute Soil Conservation District, and the towns of Angle, Greenwich, Koosharem, and Burville.

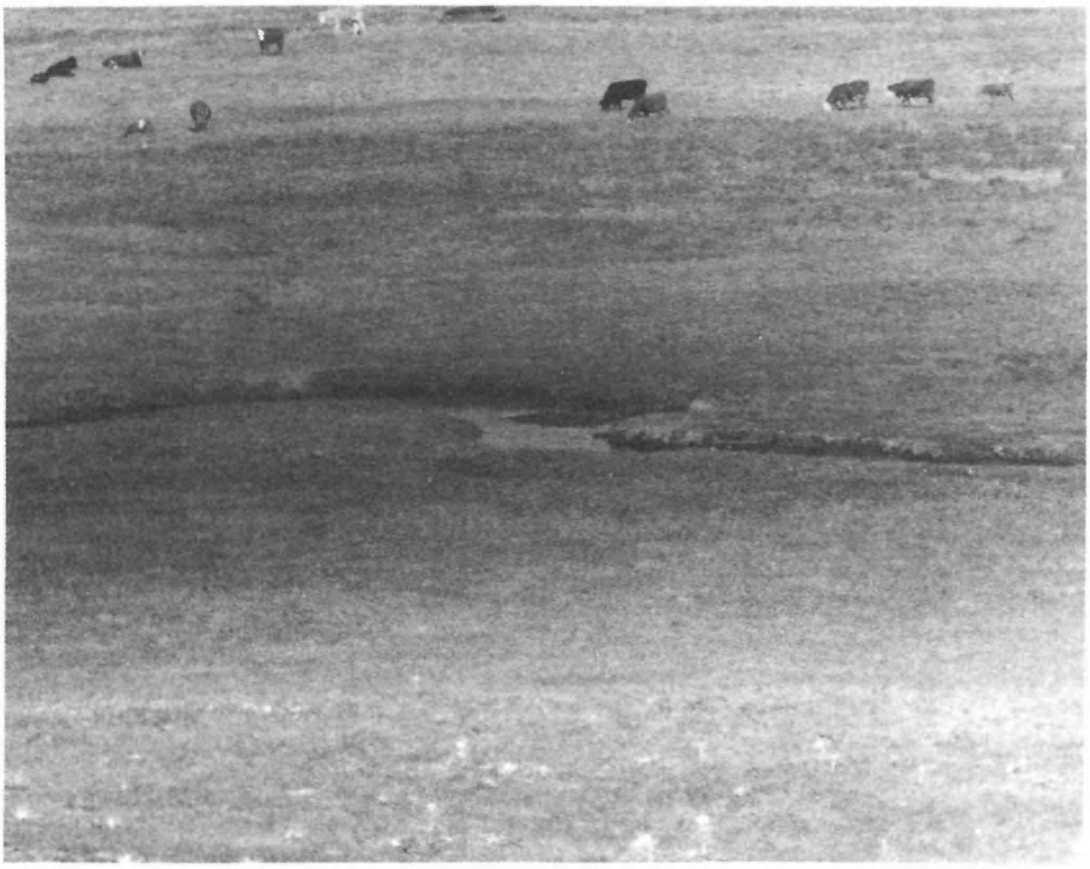
Participants in the project will perform remediations such as the exclusion of cattle from critical riparian areas, range seeding, brush management, streambank stabilization, and in-stream structures to improve fish habitat.

Range managers and ecologists have found that streamside vegetation can sometimes become so depleted that even a long "rest period" from grazing won't enable it to regenerate to a vigorous, productive state. In such cases, clearing away unproductive brush and reseeding grasses and willows is called for.

In other situations, a change in grazing patterns is enough to bring the pastures and riparian back to life. Using fencing systems that permit managed rotation of their herds, ranchers move the cattle before they can damage the grass. Gradually, the pastures gain back their vigor; water tables rise, as snowmelt and rain soak in, rather than running off.

At Otter Creek and elsewhere, the key is to devise a strategy that integrates climate, soils, vegetation, livestock, wildlife, and stream conditions into a single, living system, benefiting not only the farmer but the community. Throughout the Otter Creek watershed, for example, local business will benefit by increased sales to recreational users, hunters, and fishermen. Sometimes the benefits can range much further, as in the case of birds and fish that use a watershed and then migrate to a different region. In the rangelands of the West, riparian zones are less than three percent of the land area, but they provide habitat for 80 percent of the wildlife species.

Poor water quality in a stream such as Otter Creek can be a symptom of poor livestock management. In the past, range managers have tended to focus their attention on the maintenance of vegetation and the productivity of the livestock. Fish and wildlife managers have stressed in-stream conditions and fish populations. At Otter Creek, experts have literally found common ground: Taking care of riparian as well as upland vegetation can result in high-quality cattle, as well as "happy" fish. □



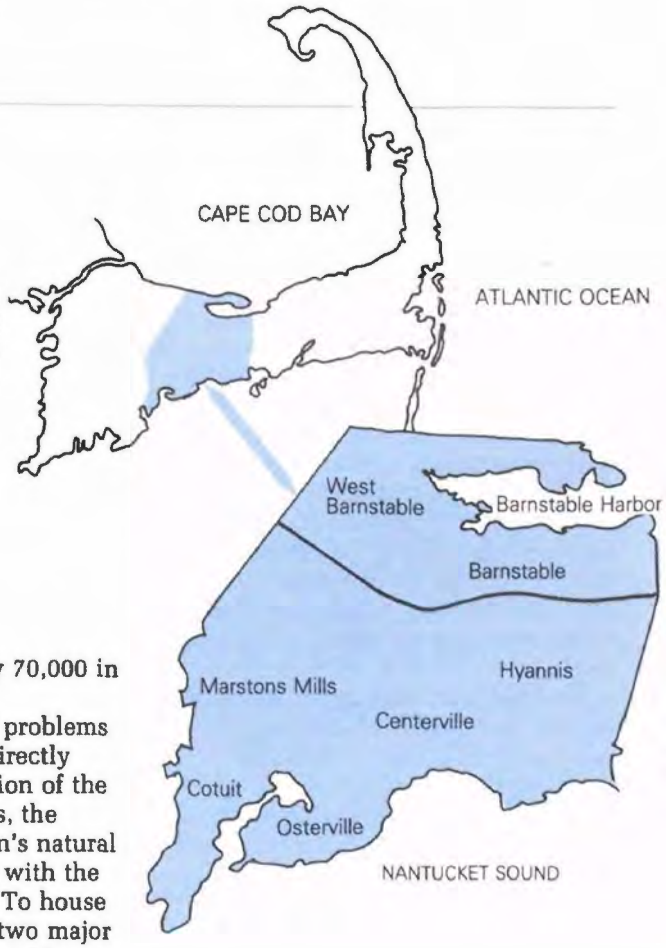
Livestock graze along Otter Creek, trampling its banks and causing erosion.

Utah Dept. of Agriculture photo.

Urban Runoff: The Example of Barnstable

The aquifer of a Cape Cod town is threatened.

by David Still II



Covering an area of 64 square miles, and with over 100 miles of shoreline, the town of Barnstable is the largest community on Cape Cod, a peninsula that juts into the Atlantic Ocean from Massachusetts. Although the town is properly called Barnstable, most people more readily identify with its urban center of Hyannis. Hyannis, however, is just one of seven villages that comprise the town.

Barnstable is 70 miles south of Boston, and it serves as a retirement and summer recreational area for Boston, the rest of New England, and parts of Canada. Most jobs are in tourism, construction, fishing, shellfish harvesting, and, more recently, light industry. Thirty-four percent of all jobs are in retailing; an additional 31 percent are in service industries.

The Cape Cod peninsula was formed during the most recent Ice Age. The ice sheet acted as a conveyor belt in depositing a thick layer of glacial till. As the ice sheet melted, runoff washed through the deposits and transported sand southward to form an out-wash plane on the south side of the Cape. Consequently, the southern half of Barnstable has extremely porous sands and gravels. The northern half is more varied, with alternating areas of clays, sand, boulders, and silts. A single large aquifer lies under the town; it is the only source of drinking water.

Barnstable has been one of the fastest growing communities in the Northeast, more than doubling its population in the last 20 years. Currently, the year-round population of 41,000 increases to nearly 70,000 in the summer.

There is a convergence of problems within Barnstable that are directly attributable to the urbanization of the town. Over the past 20 years, the demands placed on the town's natural resources have grown along with the ever-expanding population. To house this population, there were two major building booms, one ending mid-way through the 1970s and the other in 1988. Whether the building booms contributed to the population increase has been the focus of some debate. Whatever the answer, Barnstable has had a difficult time keeping pace.

Protection of the aquifer has been a major concern. Most of the ground water is still drinkable without treatment. However, some problems are emerging:

- One public supply well in the Hyannis industrial park has been shut down due to chloroform contamination; a second due to freon contamination.
- Ground water is being treated at two locations because of gasoline leakage from underground tanks.
- Elevated nitrate levels have been found in densely populated areas where septic systems are used.
- High bacterial counts have been found in some densely populated coastal areas where the water table is high and where septic systems are used.
- The ground water feeds coastal estuaries with contamination. Eighty-five percent of the nutrient loading on one Cape Cod bay came from the ground water.

Of particular concern has been the increase in the number of septic systems discharging wastewater into the ground. Only about 15 percent of residences hook into the town sewer.

When construction of the wastewater treatment plant started in the early 1970s, the thought was to build one each in the eastern and western parts of town, eventually connecting all residents to a collection system. This thinking went by the wayside because of lack of funding, and because it has since been found impractical to connect all properties to the system.

Barnstable is working to identify sewage-related problems and to target areas for improvement. At an original projected cost of $2.5 million, a facilities plan was to have identified the areas of the town where upgrading sewage collection technologies was a main priority. The plan has been scaled back significantly because of a reduction in funding by the Commonwealth of Massachusetts. Although the entire project will eventually have to be completed if Barnstable is to comply with state and federal grant requirements, the town is being allowed to stretch the upgrade over the next several years so as to lighten the financial load. The primary effort will be focused on the

(Still is a reporter for the Barnstable Patriot.)

THE PROBLEM

wastewater plant and the plume of contaminants emanating from it.

Protection of the aquifer is vital to the future of the Cape and the town of Barnstable; the quality of the town's coastal waters is also a primary concern.

Stretching the entire north-to-south span of the Cape, Barnstable has two distinct shorelines. The south side, with five separate bays and many more estuarine systems, abuts Nantucket Sound, which is warmed by the northerly flow of the Gulf stream. The north side, with its one major harbor and 5,000 acres of marshlands, outlets to the much colder waters of Cape Cod Bay.

As developers continued paving or otherwise occupying large areas of previously undisturbed land, the ability of the area to handle stormwater declined. The common method of dealing with the additional runoff was to redirect it off site or into the ground as quickly as possible, which managed the volume of water but not the quality. Water quality has become an important issue with regard to runoff.

In recent years, the town has been sensitive to water quality when correcting drainage problems close to the shore. Rather than installing outfall pipes leading directly into the water, they built gravel and rock filtration beds or created grass swales for water to drain through before discharge. But many pipes built both privately and publicly in the past are still in existence.

Water sampling conducted at various locations in the town identified no less than 50 sites where stormwater discharges needed to be treated. After closer scrutiny, 12 of the 50 were classified as high priority. The town-owned boat ramp at Scudder Lane topped this list and was selected as the location for the town's first proactive stance on treating stormwater discharge.

The Scudder Lane ramp is a popular access to Barnstable Harbor and its bountiful shellfishery, used heavily by both commercial and recreational fishermen. The housing and road development around the Scudder Lane ramp has not changed very much in the past 20 years. The homes in existence today are the same ones in existence then. Contamination caused by storm runoff has always existed, but only recently has there been an effort to curb its effects. If successful, the technology used at this site will be used as a model for other town-owned sites, as well as for shoreline protection elsewhere in the state.

To determine the extent of the contamination at Scudder Lane, water samples were taken from the harbor before, during, and after a storm. These showed bacteria counts measuring 7 to 10 parts per million (ppm) before a storm, jumping to 1,450 ppm during a storm and returning to pre-storm levels two to three days later.

The plan to reduce contamination had to take into consideration the fact that the amount of town-owned property at the site was limited. Therefore, the first step was to see if the contamination could be cut off at the source. A sanitary survey found that all four homes in the watershed had properly functioning septic systems and did not contribute to the high bacteria counts in the storm water. In the end, the sources were determined to be diverse and undetermined, leaving treatment of the stormwater itself as the only viable alternative.

Treating the runoff could have been done in a number of ways. A town-hired consultant looked into chemical and ultra-violet disinfection, and into using wetlands for filtration. However, a man-made infiltration system seemed the best solution on the basis of cost effectiveness and amount of maintenance. Moreover, such a system would use existing technology that the town could service itself.

In simplest terms, the town built a huge septic system to catch stormwater as it made its way to Barnstable Harbor. The water collects in large catch basins that discharge to leaching fields. Direct flow into the harbor is stopped. Once in the system, the water seeps into the ground and eventually resurfaces through the harbor floor. Ground soils filter out contaminants before they get to the shellfish beds.

The collection system was designed and built at a cost of $105,000, with a capacity of 19,000 gallons per storm. This is large enough to treat all runoff from typical storm events, but larger storms will inundate the system. In these cases, the majority of the contaminants will be taken into the system by the first 19,000 gallons; the overflow discharging directly into the harbor will be relatively clean.

To test the effectiveness of the ground soils as filters, three ground water monitoring wells were placed on the site: one before the system, one just after it, and another closer to the shoreline.

The final touches on the project were completed mid-way through November, and the town has not had the opportunity to fully test its effectiveness. However, early indications point to improved water quality in the immediate area.

Infiltration systems for the other areas identified in the surveys are being designed by the town's engineering department. The goal is to recapture the large shellfish areas closed because of high pollution counts. It is estimated that well over $2 million in stocks were lost to contamination in 1990.

Stopping the direct discharge of stormwater into coastal waters is key to reducing contamination, but it is just one of the problems Barnstable has to come to grips with in terms of eliminating coastal pollution. Other sources, such as wastewater discharges from boats, failing septic systems on coastal properties, and wildlife pollution also contribute to the problem. Before they can be addressed, the town will need additional manpower, as well as a reliable source of funding. □

Logging: The Washington State Situation

As stream habitat is altered, the small fry are leaving.

by Stephen Ralph

In Washington State, especially on the wetter western slopes of the Cascade and Olympic mountains, the preferred mode of timber harvesting is clear-cut logging. During this operation, trees are completely removed from the landscape, and everything not of commercial value—limbs, root wads, shrubs, dead or diseased trees—are either piled and left on site or burned. Once clear-cutting has occurred, an area is planted and left to regrow to commercial size for 40 to 120 years, depending upon the conditions at the growing site and the demands of the market place. The growing and harvest cycle then begins anew.

Many of the extensive timberland areas of the state have been harvested in this way two or three times in succession. In the process, old growth forests of spruce, hemlock, fir, and cedar have been converted to tree plantations for growing the most commercially valuable species. Except on federal timber lands, there are no limits on the size of clear-cuts, even in a basin already substantially cut over. In some areas, square mile after square mile of clear-cuts punctuate the landscape.

Timber harvesting in Washington state is big business. The forest products industry pumps $8 billion into Washington's economy annually. The predominant land use on nearly 42 percent (18 million acres) of the area is (or recently was) commercial production of timber and related forest products.

Probably, most current timber harvesting results in little or no impact on water resources. But timber harvesting and road building in some steep, unstable watersheds have had a significant impact on the survival of the region's once abundant fisheries resource by altering the fundamental character of stream habitat that salmon depend upon. The magnitude and extent of these impacts are difficult to assess because of the sheer size of the area. In some places, impacts from logging done as long ago as 60 years have left an indelible mark on the stream habitat.

Extensive removal of forest vegetation within a basin changes the volume of water that runs off the slopes of the watershed. Without the complex of trees, shrubs, and mosses that act like a sponge, water runs off the hillslope more quickly. Snow that accumulates in clear-cuts melts faster than a comparable amount falling in mature timber stands, especially during frequent winter warm spells brought by Pacific Ocean windstorms known locally as "chinooks." The streams found within these basins have to carry a larger volume of water during more frequent periods of the year than normally.

Logging in steep unstable areas can weaken the thin soils held in place by root balls of mature trees. Hills having thin unstable soils can become further weakened when roads built along their slopes interrupt the runoff of rain and melting snow and channel it. Areas below culverts become supersaturated with water, which can cause large areas of the slope to slide downhill, carrying logging debris, rocks, soil, and whatever else is in the path into the stream channel. When the amount of sediment entering the stream is excessive, spawning beds are silted over, and pools used by juvenile salmon are filled. When excessive sedimentation is coupled with large storm events that yield intense periods

Adult salmon returning to natal stream. They have become genetically fine tuned to their birthplace.

George B. Kelez photo. U.S. Fish & Wildlife Service.

(Ralph is on the research staff at the Center for Streamside Studies at the University of Washington.)

of rainfall, the capacity of the channel to convey the flood level flows is severely reduced. The results can include extensive stream bank erosion and the altering of habitat features such as pools and riffles.

The most significant result of timber harvesting within the riparian zone relates to the removal of big trees that border streams. In the old growth condition, trees fall into the stream and form deep pools, store gravel moving downstream, and provide a buffer to the impacts of large flood flows. Streams no longer shaded by riparian trees are subjected to increased warming from sunlight. Temperatures within the stream can reach sublethal levels for adult and juvenile salmon and trout alike.

Enter the salmon, the quintessential icon of Washington State. Salmon and their cousins, the trout, need access to streams having clean water and clean gravel to successfully complete their complex life cycle. Salmon are a major export in international trade, and they contribute nearly a billion dollars annually to the economy through commercial, sport fishing, and their secondary markets. Although salmon stocks native to our rivers were once abundant beyond imagination, their future status is at best uncertain due to a list of challenges that include not only timber harvesting, but overfishing, urban sprawl, hydropower dams, and agriculture—all related to society's sometimes contradictory expectations for resource production and conservation stewardship.

Seven species of Pacific salmon and sea-run trout return to the freshwater rivers and streams of Washington. Over the millennia, they have evolved a pattern of life that takes advantage of the best that both rivers and oceans have to offer. Salmon eggs, deposited in nests built by adult fish in the gravels of cool water rivers, hatch tiny juvenile fish called fry. When the fry have grown to the size of an index finger, they begin their long journey downstream and out to marine waters, where they graze and grow for two to four years.

At maturity, adult salmon return from their oceanic pastures to their natal streams. They employ an amazing sense of navigation to make this journey, that can be measured in the thousands of miles. Those that escape the armada of the fishing fleet and sport fishermen will fight the rain-swollen rivers to ascend to the same reach from which they emerged as juvenile fish. After a spawning pair builds their nests in the gravel beds of rivers and streams, thousands of eggs are deposited, fertilized by the male, and covered with gravel to protect the eggs during development. The cycle repeats itself as it has done for thousands of years. Over the ages, stocks of salmon returning to a particular river have evolved to become genetically "fine tuned" to the unique characteristics provided by that stream. Their unique life history makes salmon susceptible to changes in rivers that can break the critical fresh-water link that ensures their survival.

The standard approach to protecting the fish is to impose stricter controls on timber harvesting. The problem with this approach in the past is that it hasn't allowed flexibility to adjust "rules" to the conditions found at a particular site. In Washington, regulations governing logging were imposed for the first time in the early 1970s. Environmental groups, Indian tribes, state agencies, and timber companies, warring for years over tighter restrictions, reached an interim agreement in 1987 on a set of rules that did allow some flexibility. These rules impose "best management practices" (BMPs) that are presumed to give a reasonably good chance of minimizing impacts on water resources. They include leaving a certain number of trees along streams, placing culverts of the proper diameter under logging roads where they cross streams, and restricting harvesting and road construction in areas with unstable soils or geology.

All parties to this issue sincerely want to employ effective strategies that will afford protection to water quality. However, because of the differing environmental conditions found from one site to another, it seems unlikely that a BMP applied to one area will always give the same desired protection when applied to another. To compound the matter, timber harvest permits are routinely assessed without a critical understanding of what the conditions are like in the entire watershed. Cumulative impacts from past logging and roading are largely ignored when approval is given to add yet another 200-acre clearcut to the landscape. □

Abandoned Mines: Report from West Virginia

Abandoned coal mines still drain acid into streams.

by Lyle Bennett

The first recorded mention of coal in West Virginia was by John Peter Salley, who, in 1742, found coal on a river which he subsequently named the Coal River. At the beginning of the 19th century, the only people using West Virginia coal were crossroad blacksmiths and the pioneers whose cabins happened to be situated near an outcrop.

By 1840, mining operations were open in eight of the Virginia counties which later became part of West Virginia. By the end of the Civil War, in the northern part of the state, the Baltimore and Ohio Railroad provided an overland outlet to the east and the west. Over the next several decades, as the transportation network improved, coal mining developed into the state's predominant industry; it remains so today. In 1990, West Virginia was the nation's third largest coal-producing state, with an annual tonnage of 170,692,238.

More than two-thirds of the "mountain" state's 24,282 square miles lie within the Appalachian bituminous area. West Virginia is acknowledged as having the most valuable fuel deposits in the United States. The coal lies in 10 fields; the fields entail 39 of the state's 55 counties.

(Bennett is Nonpoint-Source Program Leader with the West Virginia Division of Natural Resources.)

Coal mining is, and probably will continue to be, the major conomic force in the state. Unfortunately, coal mining has left behind thousands of abandoned mines, which collectively form the number one nonpoint water pollution source in West Virginia.

Abandoned mines contribute to widespread water quality problems. Where topsoil and vegetation have been removed from the surface, fractured rock is exposed to oxidation and leaching. Various elements dissolve and flow into streams along with sediment. Erosion of disturbed soil from abandoned surface mines or refuse piles creates turbidity, sedimentation, and siltation, which can lead to stream cloggings, loss of fish spawning gravels, or removal and compaction of stream bottoms. Studies indicate that sediment loads from uncontrolled surface mines may be up to 2,000 times greater than runoff from undisturbed forests.

Drainage from underground mine openings or runoff seeping through refuse piles or surface mine spoil may alter water chemically. The results can be devastating for aquatic life, water supplies, recreation, and agricultural and industrial usage.

Most chemical pollution results from the oxidation of sulfide minerals. The reactions lower the pH of the runoff, creating acid mine drainage (AMD). Solids dissolved in AMD may contain significant quantities of iron, aluminum, calcium, magnesium, manganese, copper, zinc, and other heavy metals. Acid mine drainage has been the most serious water pollution problem plaguing West Virginia during the 20th century.

Prior to the 1960s, with no laws in place to protect water quality, many coal mine operators ignored the effects pollution was having on rivers and streams. Federal studies conducted during the 1960s found that 3,100 miles of streams were impacted by mine drainage.

Information gathered in the 1980s indicates that little improvement has been made. The data, incorporated into the West Virginia Nonpoint Source Assessment in 1989, show that 96 of the state's 315 watersheds are impacted by drainage from abandoned coal mines. According to this information, 2,852 miles of streams currently are affected.

With the advent of the Federal Clean Water Act in 1972, several miles of streams improved in quality, as active coal mining operations were forced to treat discharges before they left the site. As beneficial as this law has been in regulating *active* mine operations however, it was not designed to address the problem of drainage from already *abandoned* mines, nor was it intended to prevent problems arising from newly abandoned operations.

In 1977, the Surface Mining Control and Reclamation Act (SMCRA) became law. Under this law, to qualify for reclamation funds, each state had to inventory its abandoned mine lands. By December 1990, the 13th year of SMCRA, $115 million had been spent to reclaim 417 areas in West Virginia. However, 394 new problem areas have been created since the law was passed. Currently, there are 4,000 areas in the state's inventory.

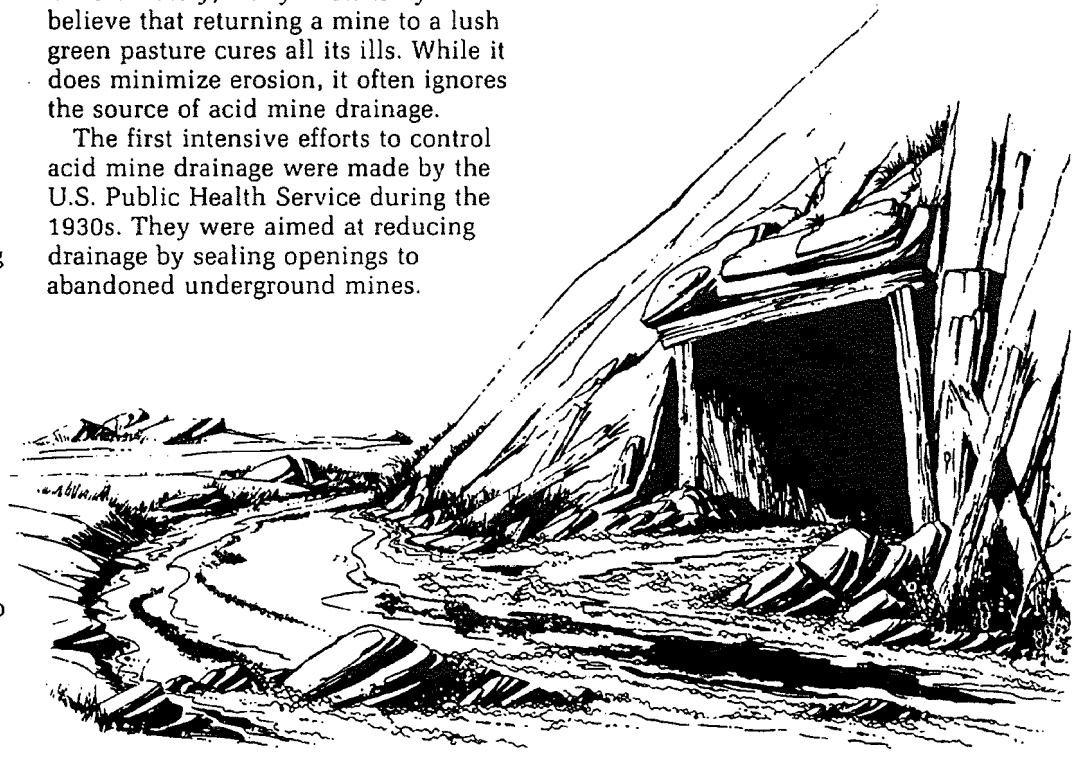
During the past 50 years, great strides have been made in reducing the problem of erosion through regrading and revegetating of abandoned strip mines. This aspect of reclamation should be nearly 100-percent effective when using current technologies. Unfortunately, many mistakenly believe that returning a mine to a lush green pasture cures all its ills. While it does minimize erosion, it often ignores the source of acid mine drainage.

The first intensive efforts to control acid mine drainage were made by the U.S. Public Health Service during the 1930s. They were aimed at reducing drainage by sealing openings to abandoned underground mines. Reductions in pollutant levels were remarkable, considering the technologies available. Mines sealed through this effort originally contributed an acid load of 402,787 tons per year. After sealing, 261,800 tons per year, or 65 percent, were removed. The sealing program was based on the theory that eliminating most of the oxygen and reducing the available water would prevent the formation of acid. The theory remains the basic principle used today.

Numerous research and demonstration projects have been carried out since the 1930s Sealing Program. They range from the simplistic to the exotic. The dilemma of controlling acid drainage after a mine is abandoned, however, still confronts government agencies and industry.

The research has shown that each mine discharge exhibits different characteristics. What works in one situation will not necessarily work in another. In West Virginia, the primary focus is on correcting pollution problems through natural processes.

Recent years have seen numerous



man-made wetlands installed to act as filters to collect and absorb the materials found in acid mine drainage. More advanced wetlands incorporate alkaline recharge zones to neutralize the acid. Modifications of the mine sealing theory have been demonstrated as well. They involve sealing the underground mine and piping the water to an alkaline leach bed. Here, the water trickles from a series of perforated pipes through 5 to 10 feet of limestone before discharge. The process provides both oxygen reduction and neutralization. Metals drop out, and pH levels increase to within water quality standards.

Other abatement systems treat water through a combination of trenches and wetlands. The trenches are filled with alkaline material, which reduces the acidity of the water and adds alkalinity in the absence of oxygen. Outlets for the trenches lead to man-made wetlands, where the water is cleansed of metals before discharging into a stream.

Although all these reclamation practices have merit, unless acid drainage from abandoned coal mines is addressed on a watershed basis, it will continue to cause serious water pollution problems in West Virginia.

As part of the West Virginia Nonpoint Source Program, the Middle Fork River Watershed has been chosen from the state's inventory and established as a National Pilot Demonstration Watershed Project. The project is designed to develop a more effective and coordinated federal/state approach to resolving acid drainage problems from abandoned coal mines through the use of innovative reclamation practices.

Without a doubt, acid mine drainage will continue to be an environmental challenge in the current decade. West Virginia will continue to seek long-term solutions based on pollution prevention. But long-term solutions will also require changes in behavior. In the Middle Fork River Pilot Demonstration Watershed Project, state and federal agencies are proving they can get away from traditional roles and work as a team. The prognosis for curing acid mine drainage will improve when duplication of efforts are eliminated, and funding sources are grouped. □

Construction: The Whitemarsh Case

Only the blacknose dace will live in Whitemarsh Run.

by Karl Blankenship

One Saturday afternoon in the early 1970s, Richard Klein was hiking along a neighborhood stream, Whitemarsh Run, when he noticed a thick ribbon of mud pouring into it from a tributary. He turned to investigate. "I came across a hill that was totally cleared," he recalled. "In fact, the bulldozers were still running over it."

The bulldozers were preparing the site for a town house development. They had exposed springs, which were eroding ruts in the slope. Mud oozed into a small stream at the foot of the embankment.

For years, scenes like this were all too common in the Whitemarsh Run watershed, a 17-square mile area just east of Baltimore. It is the largest—and most heavily developed—tributary of the Bird River, a three-mile long estuary that connects several small waterways to the Chesapeake Bay. Once a rural area where farms and forests covered the rolling hills, the Whitemarsh Run watershed underwent intense construction as Baltimore sprawled across its borders.

The construction boom that poured countless tons of "mud pollution" into the stream was the latest wave of degradation. For centuries, farming activities had contributed sediment to the waterway; in latter years, the area was mined for sand and gravel. Then, in the 1960s, the construction boom began. Acres of land were laid bare by the bulldozer at a time when controls on sediment runoff were not required.

(Blankenship is a free-lance writer and Editor of the Bay Journal, a publication of the Alliance for the Chesapeake Bay.)

In the past few decades, the watershed has become home to two expressways, subdivisions, town houses, shopping centers, and all the usual accompaniments of modern suburbs. Sediment runoff from these activities has been as deadly as an oil spill, choking aquatic life out of the stream, causing flooding, and perhaps altering habitat forever.

Klein, who grew up in the area, founded Community & Environmental Defense Services, which helps citizens to make sure that developers minimize impacts during construction. He recalled that the streambed at times was totally obscured in a field of dirt, bulldozers plowing where fish once swam. "There used to be three ponds where we would catch tadpoles and frogs when I was a kid," he said. "They were silted in. They were 100 feet from the stream, but they got filled in when the stream would flood its banks and carry sediment into them."

Klein is building a grassroots movement to watchdog construction sites with the slogan "save a stream for a century"—a slogan stemming from the premise that it takes a century for a stream to recover from construction activity. Indeed, in the case of Whitemarsh Run, recovery is years and probably millions of dollars away. Baltimore County is in the midst of a year-long study to determine what it will take to restore the watershed. Its problems are many.

The building boom brought new and bigger roads. Often, engineers forced the stream through narrow concrete culverts below the pavement. When sediment-laden water funneled through, it had the impact of a sandblaster: On the downstream side

Karl Blankenship photo.

Maryland now has tough runoff control laws, but past damage remains. Fast flowing water through this culvert eroded the streambank.

of the culvert, it literally scoured away the streambed. Not only were the streambed and banks destabilized, a barrier to fish was created when the bed was eroded below the level of the culvert. In one place, the bed dropped almost four feet. Migratory fish couldn't swim upstream.

In parts of the watershed, stream channels were bulldozed, moved and straightened. More like a canal than natural waterway, the channel that was left had no natural fish habitat, such as pools, or hiding places from predators.

In 1986, the state graded the watershed as "fair", the next-to-lowest mark on its four-point rating system. Fair meant it suffered intermittent "severe degradation" or "moderate continued degradation." Also, "few if any sensitive species occur" and those that do are "pollution tolerant."

"I distinctly remember about a dozen different species, and I watched them decline," Klein said. "All that we have left is the blacknose dace, which is about the most urban-tolerant species that we have."

Elsewhere, tree cover, which helped moderate water temperature for fish and secure banks from further erosion, was removed. Sand bars popped up in the stream channel where there had been none before. Before they could be secured by vegetation, they would wash away to another location. As the channel filled, some downstream areas began to flood.

In the Bird River estuary, submerged aquatic vegetation—vital habitat for fish and other aquatic species—was wiped out. "I would think at the minimum, there's a couple of feet of sediment on the bottom of that estuary that wasn't there 50 years ago," said Roger Copp, of the consulting firm Dames & Moore, which is studying the watershed for the county. That amount of sediment would amount to about 2 million cubic yards, he said, not counting material that has been carried into the Chesapeake Bay.

Things are changing. Today, Maryland has some of the toughest runoff control laws in the nation. Among them: Builders must install controls around the perimeter of a site within seven days of starting construction, and almost all other areas of the site must be stabilized with seed, mulch or other material, within 14 days.

During a recent drive through the watershed, for example, Klein found a highway construction site where the steep slopes were covered with mulch to prevent erosion. Lines of sediment fences lined a small stream in the valley. These controls, Klein said, would make a "dramatic difference" in controlling runoff. But even the best controls are not 100 percent effective.

Thomas Vidmar, Chief of Baltimore County's Bureau of Engineering Services, estimated that such controls are, ideally, 70 to 75 percent effective in trapping sediment. "Once you start dramatically changing the land use, you start to have an effect that controls can't fully mitigate," Vidmar said. "When you have an active construction site, you're going to get erosion."

These programs require heavy enforcement to be effective. In 1990, Klein did a random survey of construction sites for the Chesapeake Bay Foundation, a Maryland-based environmental group, and found "adequate" controls at only 42 percent of the Maryland sites inspected—though enforcement in Baltimore County tended to be much better.

Even if controls were perfect, Whitemarsh Run's problems would not be resolved. Much sediment remains in the stream, and the problems caused by new developments are compounded by post-construction impacts of earlier developments. With much of the watershed now paved, uncontrolled stormwater runoff is flushed into Whitemarsh Run at such rapid rates that it gouges out the streambed. Whereas it once carried sediment that came primarily from adjacent construction sites, it now carries large sediment loads from its own banks.

"Was it worse in the '60s and '70s when the construction boom was getting underway? Is it worse now? It's really not documented," said Robert Ryan, who is project manager for the county's Bird River study. "Before, we had all the uncontrolled sediment but not as much stormwater."

Whitemarsh Run comprises 60 percent of the Bird River watershed. Part of the restoration will include dredging the sediment out of Bird River, itself, to make it more useable for recreational boaters. Officials recognize that dredging won't solve the sediment problem, unless the upstream issues are addressed. That would require, among other things, costly projects to install stormwater control devices, such as settling ponds, in areas developed when such measures were not mandated. The total tab easily runs into millions of dollars, Ryan said.

Restoration of Whitemarsh Run will require efforts to stabilize eroding streambanks, reforestation, and improving fish habitat. The completed restoration plan will include ways for local people—for whom much of the construction was done—to take part, such as streamside trash collection efforts. Klein believes the public can get involved even further. On that day he found the bulldozers scraping the surface off the hill, he took it upon himself to confront the foreman. "He said he would look into it. I didn't expect much."

Klein, dressed in a T-shirt and cutoffs, didn't figure he'd made much of an impression and didn't expect much. But the next day he learned what one person could do: Walking along Whitemarsh Run, he again came across the tributary, but this time there was only a trickle of mud flowing through it. "I looked up that hillside, and there was this great big sediment pond." □

THE ISSUES AND THE POLICY

View from EPA

by William K. Reilly

Mostly, it will be local building and land use decisions.

Douglas T. Kuzmiak photo.

Jug Bay, a freshwater tidal marsh on the Patuxent River, is a Chesapeake Bay National Estuarine Research Reserve.

(Reilly is Administrator of EPA.)

Consider the following:

- In 1986, The Conservation Foundation reported that every year, almost 5 tons of soil erode off each acre of farmland in the United States, carrying fertilizers, herbicides, and insecticides into the nation's waterways.

- EPA estimates that each year, do-it-yourself auto mechanics pour down storm drains or send to landfills about 180 million gallons of used motor oil—the equivalent of more than 16 Exxon *Valdez* oil spills. Some of this oil finds its way into drinking water sources and other water bodies.

- Beneath Los Angeles, more than 1,000 miles of storm drains collect runoff from city streets, dumping it in coastal bays. The Natural Resources Defense Council estimates that in 1989 eight inches of rain washed 150,000 pounds of lead, 500,000 pounds of zinc, and 11,000 pounds of cadmium into Santa Monica Bay alone.

- More than one million tons of nutrients each year make their way into the Gulf of Mexico. Nutrients, EPA believes, are responsible for the increase in the size and frequency of the Gulf's so-called "dead zone" at the mouth of the Mississippi River, which drains two-thirds of the continental United States.

These alarming statistics share a common denominator: They are all examples of nonpoint-source pollution—pollution that does not comes from distinct, identifiable "point" sources (such as a sewage treatment or industrial plant discharge pipe). Nonpoint-source pollution is runoff from rainwater or snow melt that picks up along the way soil, animal wastes, fertilizers, pesticides, used oil, toxic substances, and street debris. It comes from farms, cities, forests, mining operations, and construction sites. And it carries contaminants into nearby surface or underground waterways—sometimes washing directly into lakes and streams, sometimes entering storm and sanitary sewer systems, where from EPA's regulatory perspective it becomes a point source. However it reaches our waterways, it originates, nonetheless, as nonpoint-source pollution. And almost always, it is subtle, it is diffuse, it is difficult to visualize.

Unlike dramatic scenes from an earlier era of belching smokestacks spewing black clouds skyward or sewer pipes disgorging viscous, green ooze seaward, nonpoint-source pollution conjures up no vivid images in the mind's eye. Unlike the mere mention of oil spills or beach closings or toxic waste dumps, nonpoint-source pollution fails to inflame or incite to action. Yet this "pointless" pollution is one of the most serious remaining threats to our nation's water quality—and its cumulative effects from many small sources and individual actions *are* visible and disturbing: algal blooms that choke lakes and aquatic life, fish kills, fishing bans, silt-covered spawning habitat along riverbeds.

Yet this "pointless" pollution is one of the most serious remaining threats to our nation's water quality . . . .

A preview of EPA's 1990 *National Water Quality Report to Congress* shows that nonpoint-source pollution is the main reason lakes and rivers fail to meet clean water standards for fishing, swimming, and drinking. Agricultural runoff was by far the most extensive source of pollution, responsible for impairing about 60 percent of the degraded rivers and a like percentage of degraded lakes studied. Extraction activities, along with dams, levees, and other hydrologic modifications were also significant contributors, as were storm sewers and urban runoff.

Clearly, the problem is enormous. Yet because this type of pollution is so hard to pinpoint and because almost *everybody* contributes to the problem, it largely defies traditional command-and-control regulatory approaches that have brought so much success in curbing pollution from specific plants or pipes over the past 20 years.

Incidentally, let me underscore the significant progress we have made in this area—progress that has revealed the previously obscured threat of nonpoint-source pollution. Since 1972, the federal government has spent over $50 billion to upgrade and construct municipal sewage treatment plants. By 1988, EPA reported that almost 90 percent of all municipal sewage treatment plants and a slightly higher percentage of major industrial facilities met federal and state water pollution control requirements.

With the exception of EPA's programs to control pollution from urban and industrial stormwater pipes and from combined sanitary/stormwater overflows through more traditional permitting programs, tackling nonpoint-source pollution poses different challenges and requires new solutions.

I see three hurdles ahead in curbing nonpoint source pollution.

First, a national regulatory program similar to that to control point sources simply won't work. The challenge is, in part, one of promoting changes in longstanding habits and practices—at home, at work, in our communities, on farms, in mining, forestry, and construction operations. Education is key to influencing changes in lifestyles and behaviors to prevent this type of pollution. Nonpoint-source pollution is everyone's problem. It is the responsibility of farmers to grow their crops and graze their animals in ways that protect nearby streams and ground water. It is the responsibility of those who harvest timber to do so in ways that prevent soil runoff. It is the responsibility of backyard mechanics to take used motor oil to collection or recycling centers. It's the responsibility of homeowners to apply lawn care chemicals and fertilizers carefully and

safely if and when needed. It's the responsibility of car owners to keep their vehicles maintained so they don't leak oil or grease onto the roadway.

Farmers and other landowners, in particular, are understandably wary of intrusive government programs. No effective solutions will work without the whole-hearted involvement of farmers, whose stake in conservation is greater than that of virtually all others, whose very livelihood depends on productive soils and healthy natural systems. Their trust, and their interests, need to be protected.

Second, addressing nonpoint-source pollution effectively may require attention to land use planning. States and localities often find they can't protect water quality without planning for protection of their watersheds—and that means planning for growth. That, of course, is properly a matter for state and local governments, not the federal government. We at the federal level can provide information on how various communities have successfully addressed these challenges—accommodating growth and development in a manner that protects valuable wetlands and habitats and avoids creating nonpoint-source pollution that threatens the health of aquatic ecosystems.

Local enforcement officials need to be alert to prevent runoff from construction sites and ensure that homes and businesses don't unlawfully connect sanitary sewer lines to systems designed to collect only stormwater. State and local governments can require catch basins, buffer strips, and other management practices. The federal government has the responsibility to provide basic scientific information, incentives, technical expertise, and limited funding to state governments to develop effective programs. Research, information, education, technical assistance—all are reasonable federal roles. But it is local building and land use decisions more than anything else that will help cut nonpoint-source pollution.

Farmers and other landowners, in particular, are understandably wary of intrusive government programs.

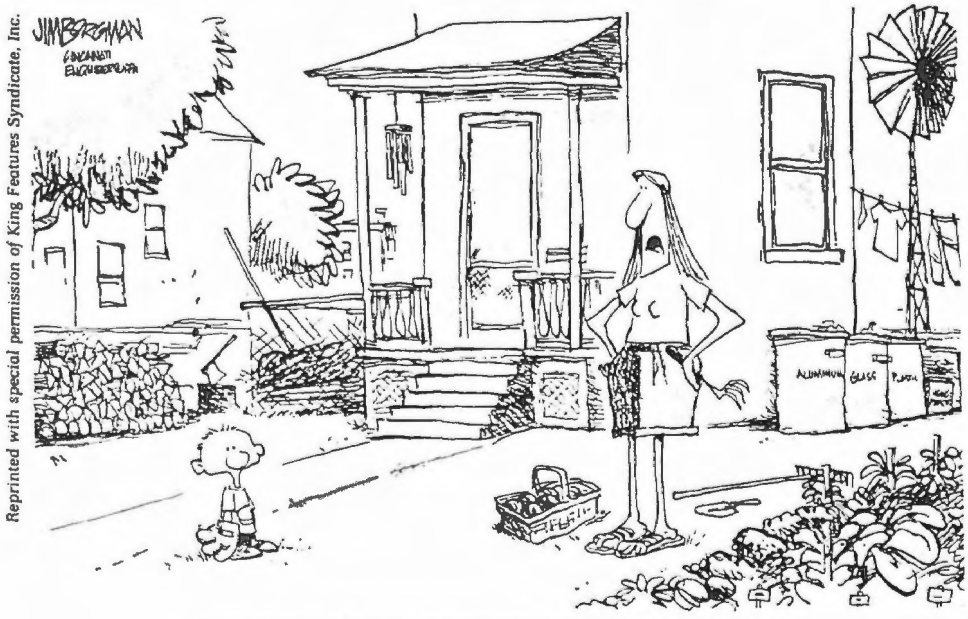
Third, in some instances—like our incipient efforts to regulate urban stormwater—the costs to control nonpoint-source pollution through traditional approaches are potentially enormous: tens of billions of dollars. I might add that on the stormwater permitting front, the Agency is hearing from states, municipalities, and industries alarmed at the cost and complexity of implementing statutory requirements to regulate stormwater as a point source. With all the concurrent demands on local governments for an entire array of environmental improvements, not to mention other worthy needs, financing nonpoint-source controls is a real challenge.

Not withstanding these constraints, a number of promising activities are underway. One is an agricultural pollution prevention strategy that EPA and the U.S. Department of Agriculture (USDA) are developing together.

This strategy holds great promise—in large measure because it promotes voluntary programs for American farmers, who have an intimate dependence on soil productivity and water quality. It is farmers' cooperation in joining with government agencies, extension services, and universities, and their willingness to apply environmentally sound practices in working the land and grazing their animals, that will make this project succeed and also create a model for other nonpoint-source programs.

In many cases, the agricultural pollution prevention strategy will seek to promote better management practices:

- Maintaining unplowed strips of grass and vegetation or natural wetland areas along stream banks to prevent soil and water runoff into the streams
- Instituting management practices that prevent livestock waste from entering waterways



"I DON'T WANT YOU PLAYING WITH THAT LITTLE JONES BOY.... WHY, HIS FAMILY DOESN'T EVEN COMPOST!"

Street debris is one of many sources of nonpoint pollution.

Steve Delaney photo.

- Ensuring the efficient use of pesticides and careful application of them under weather conditions that prevent their migrating into nearby creeks and rivers
- Accurately determining fertilizer needs
- Developing new practices and reviving traditional ones like crop rotation that interrupt destructive insects' life cycles to reduce the need for pesticides.

USDA Soil Conservation Service has a distinguished history of providing practical, on-site guidance and assistance to farmers. The new strategy capitalizes on that success to provide even greater training and information on the importance of protecting aquatic resources and habitat, as well as appropriate pollution prevention practices—practices that can benefit farmers by cutting costs while maintaining productivity.

Another way EPA is elevating attention to nonpoint-source pollution prevention is through our geographic initiatives. These projects—involving the Great Lakes, the Gulf of Mexico, Chesapeake Bay, the National Estuary Program, and a growing number of watersheds—focus on the overall health of the entire ecosystems, identifying and targeting for measurable progress the primary sources of pollution. In these geographic initiatives, we bring all our programmatic expertise and resources to bear—air and water quality programs, waste site cleanup, permitting, enforcement, and research, to name a few. Although problems differ from watershed to watershed, in virtually all these initiatives, curbing and preventing nonpoint-source pollution is high on the priority list. These projects seek to bring federal, state, and local governments, farmers, business and industry, civic organizations, and academic institutions together to improve and protect valuable watersheds and productive natural resources.

When people recognize the impact of their activities on productive resources and ecosystems, they often are receptive to the call for stewardship. This appeal can help alter behavior. For example, farming practices along the Susquehanna River in Pennsylvania—miles upstream from the Chesapeake Bay—have a profound impact on the health of the bay. The bay program's nutrient management program, pioneered in Pennsylvania, is a national model. Already, the bay states—Pennsylvania, Maryland, and Virginia—have almost 115,000 acres under nutrient management plans and have cut potential pollutants by nearly 7.6 million pounds.

The Chesapeake Bay program is the oldest of its kind in the nation—and serves as a bellwether for the rest of the country. Although the program has experienced considerable success, it still faces real challenges to restore the bay.

During my recent tenure as Chairman of the Chesapeake Executive Council, I commissioned an independent panel report on nonpoint-source pollution. The panel sounded a note of caution, concluding that existing programs were insufficient to meet the bay program's goal of 40-percent nutrient reduction by the year 2000. It recommended augmenting voluntary programs with the use of regulatory authority.

I believe we can achieve many of our goals more quickly, and more efficiently, through voluntary means. But we must recognize that, where voluntary initiatives fail, protecting the ecological and economic productivity of the resource may require states and local governments to adopt stronger measures.

In the Everglades, for example, the Bush Administration is proud of a recent action to protect this unique ecosystem. The Department of Justice, with Interior Department and EPA

participation, secured this past year a landmark settlement. The State of Florida and the South Florida Water Management District agreed to clean up polluted, nutrient-laden water before it flows into the Everglades, where it has choked the native sawgrasses and stimulated the growth of cattails and other plants, altering the habitat so vital to many of the plants and animals that live there. Under the agreement, Florida will create a buffer zone and a marsh to filter water before it enters the Everglades. The action will reduce up to 70 percent of the phosphorus from vegetable and sugar cane fields that now enters one of the most vulnerable of our magnificent national parks.

If we in the Bush Administration occasionally carry a stick, we are pleased to distribute carrots as well.

If we in the Bush Administration occasionally carry a stick, we are pleased to distribute carrots as well. EPA is in the forefront of providing grants to states to implement established nonpoint-source programs. In a new grant program begun in fiscal year 1990, we are awarding $140 million to support approved state nonpoint-source programs through fiscal year 1992. This program embodies the Agency's new emphasis on targeting our resources where they can reduce the greatest environmental risks from this type of pollution. All the money is going to implementation, not planning (with the exception of newer ground water programs), in a competitive process that emphasizes real environmental progress. The grants are enabling states and localities to get clearly defined programs with measurable objectives up and running. It is the involvement of the states—closer to the citizens and their local governments—that make these projects work.

In Montana, the Water Quality Bureau, with EPA funding, has begun a project to restore a productive fishery in Ninemile Creek. In Idaho, USDA is working with state and local entities to restore trout spawning habitat in Rock Creek. And the State of Wisconsin offers a superb example of a long-running nonpoint-source program begun in 1978 that now involves 51 priority watersheds. (See story on page 51.) The state program—one of the most successful in the nation—works in part because of the voluntary cooperation of landowners working with field staff who know the particular problems. It involves extensive outreach and citizen participation.

Providing yet another opportunity to help cut nonpoint-source pollution are the Geographic Information Systems. The systems contain data about watersheds that are useful to set priorities for nonpoint-source initiatives, to help identify streams that can be used as benchmarks for setting appropriate water quality standards, and to measure progress. They also have a very positive secondary outcome: They help bring together a variety of agencies on a common mission.

Over the past decade, all those concerned about protecting the productive natural systems of the United States have begun to recognize the immensity of the nonpoint-source problem and the challenges it poses. We are learning what makes for good pollution prevention programs, how to make sound, risk-based decisions with respect to solving the most serious problems in the most cost-effective ways. Good projects are on the ground, underway, providing living laboratories to test a variety of innovative solutions.

We at EPA have committed ourselves on several concurrent paths to step up the pace with which we address this problem. We cannot do it alone: Preventing nonpoint source pollution and restoring our waterways to health will require the dedication of every American. I am confident that as more and more people come to understand the nature of the problem and their central role in solving it, the American spirit of ingenuity, coupled with an emerging ethic of stewardship for this great land, will prevail. □

View from USDA

Farms only five miles apart may need different solutions.

by James R. Moseley

What do you get when you put a NASA space scientist, a soil scientist, and a Mississippi catfish farmer in the same room? You get an example of how American farmers and ranchers are working diligently to protect and improve our nation's water supply.

Truman Roberts, a catfish farmer from southern Mississippi, wanted to find a better way to filter nutrients and waste from his catfish ponds. He turned to a scientist from NASA who had been using plant roots to filter and treat wastewater generated during space travel and to a Soil Conservation Service (SCS) scientist, who knew how to build a filtering system that would accommodate the local Mississippi soil and water conditions. Together, working with Roberts, they constructed a wetland to serve as a catfish pond filtering system.

Roberts and the scientists agree the filter works. The wetland system has improved water quality, increased fish production, improved fish flavor, reduced disease, increased wildlife habitat, and saved ground water, money, and energy. It's been so successful he is planning to build four more to take care of his entire 60 acres of catfish ponds.

This is just one illustration of the innovations the U.S. Department of Agriculture (USDA) and agricultural producers are using to improve the quality of our nation's water. It's also a good example of how farmers and ranchers are voluntarily incorporating soil and water resource management practices into their operations.

Agricultural producers share the nation's concern for the quality of our natural resources. No other segment of our society has a more direct and dependent relationship with the environment than farmers and ranchers. Producers understand they have a special responsibility to protect our water supply from pollution that may occur because of particular agricultural production practices. Farmers and ranchers have not gone out and deliberately damaged the environment for the sake of improving their farm income. If environmental damage has occurred, it has happened because of lack of knowledge of the problem and counterproductive U.S. farm policy.

Although ground-water contamination from agricultural chemicals and fertilizers is not a serious health threat, when the USDA and the industry hear of an agricultural water quality problem, it's taken seriously.

USDA and its agencies (Agricultural

Tim McCabe photo, Soil Conservation Service.

Analyzing soil for nitrogen content helps determine the amount of fertilizer needed.

(Moseley is Assistant Secretary of Agriculture for Natural Resources and Environment.)

THE ISSUES AND THE POLICY

Stabilization and Conservation Service, Soil Conservation Service, Agricultural Research Service, Cooperative State Research Service, and the Extension Service), working in partnership with agricultural producers, are aggressively attacking water quality issues through research, education, technical assistance, and cost-sharing programs.

The major purpose of USDA's water quality programs is to provide producers with the information necessary to voluntarily adopt improved, environmentally sound management practices that do not sacrifice farm profitability. Two key principles guide the Department in developing these programs: Conduct state-of-the-art scientific research and develop effective farm policy and programs that can practically be used by farmers and ranchers.

Agricultural nonpoint-source pollution is best treated by modifying farm practices that may potentially threaten natural resources. USDA research efforts for managing nonpoint problems are focused on "source reduction." Regardless of what the "source" is—chemical applications, fertilizers, or animal waste—USDA research strategies center on developing and improving cost-effective crop and animal production technologies that reduce the contamination source.

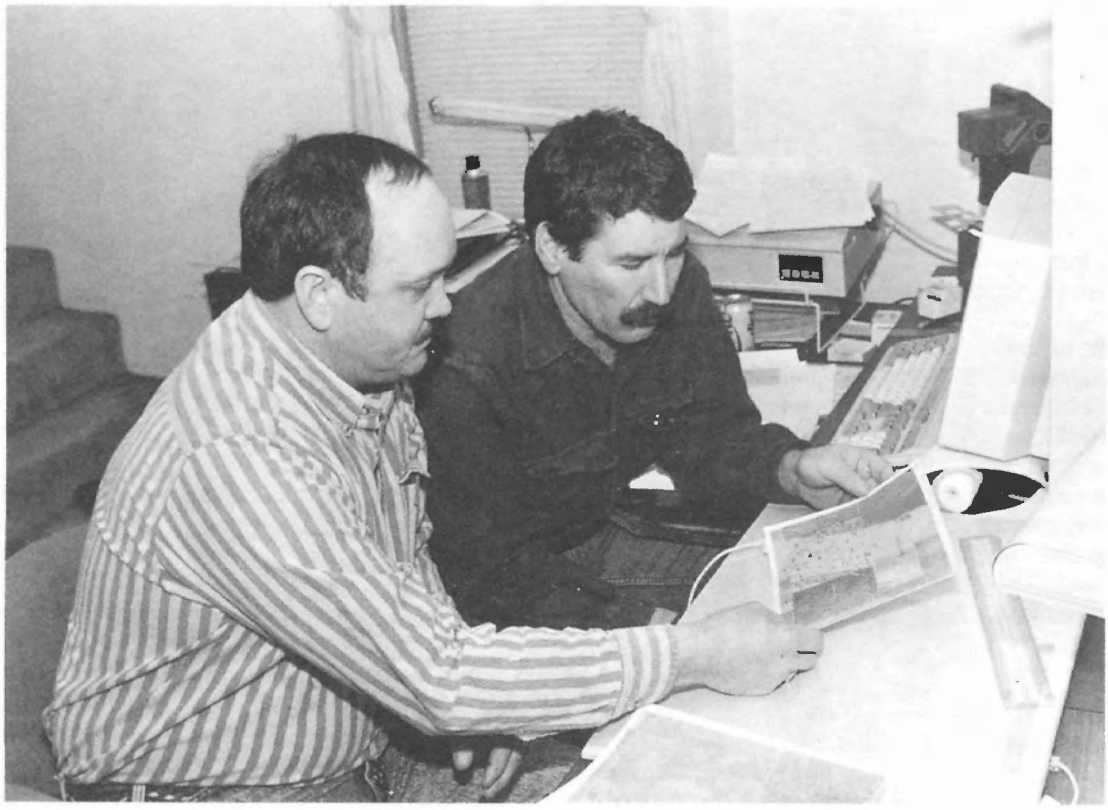
Significant progress is being made in reducing potential agricultural contamination sources. One promising development in controlling agricultural nutrients from entering ground and surface water is nutrient management programs.

Precise measurement of nutrient content and prescription application is becoming standard operating procedure on farms all across the country. In managing animal waste and fertilizer applications, farmers are paying special attention to calibration rates in an effort to apply only what is required of a crop for growth in specific crop cycle. This is especially important with nitrogen because excess free nitrogen unused by a crop can move off site or into ground water.

In the Chesapeake basin three-state area (Pennsylvania, Virginia, and Maryland), over 114,000 acres are currently covered by nutrient management plans. Since the statewide management plans have been incorporated into the farming operations, 1,797 tons of nitrogen and 2,006 tons of phosphorus have been prevented from entering the bay. Fertilizer sales in the three bay states have decreased by 24 percent, while nationally sale of fertilizers have dropped by 16 percent.

New technology is being developed that will measure soil productivity and calibrate fertilizer rates at the point of application according to the soil's productivity. This technological breakthrough will increase nutrient consumption by the crops and reduce the potential for leaching or runoff of the plant food.

Computers, electronics, and satellites are being integrated into farm equipment for more precise measuring of inputs. In Missouri, three grower cooperatives are experimenting on 10,000 acres of cropland with truck-mounted computers, lasers, infrared photography, and soil tests to precisely apply only the amount of nutrients and herbicides needed as the truck moves across the field. Very little or no excess chemicals remain for leaching to ground water or leaving the field in surface runoff.



Missouri farmers are experimenting with computer-generated soil sampling grids to determine precise fertilizer mixtures. In the field, a computer aboard a fertilizer truck will help ensure the desired mixture is distributed properly.

SCS photo.

"Prescription farming" is so popular with the local Missouri farmers that they have more than 30,000 additional acres ready for application as soon as the experiment is completed. Sixty more experimental truck-mounted systems are operating on more than 500,000 acres across the country.

U.S. farm policy also plays a major role in determining what type of agricultural practices producers use in their business. These production practices can have significant impact on water quality.

Congress recognized this policy-practice interrelation and forged a new era in American agricultural policy in the 1985 and 1990 Farm Bills. For the first time in the history of U.S. farm policy, farmers had to meet environmental standards in order to qualify for farm program benefits.

Under the Conservation Reserve Program (CRP), highly erodible land is being planted to grasses and trees, reducing chemical use and the potential for chemical leaching and sedimentation from soil erosion.

Since the first signup in 1986, farmers have enrolled approximately 35.6 million acres in the program, and the expected water quality benefits are significant. A reduction in soil loss of 655 million tons annually resulted in a 210-million-ton annual reduction in sediment loadings to water bodies. The CRP also will reduce herbicide and pesticide usage by an estimated 61 million pounds annually, and a 2.4 million tons annual reduction in fertilizer use.

A key component of most conservation compliance plans is conservation tillage and crop residue management. USDA scientists know that conservation tillage can provide a significant impact on improving water quality in our streams and lakes. The concept is simple: Keep the water on the land and you reduce the opportunity to move soil and nutrients to the drainage system.

Conservation tillage systems can also provide producers with an economic advantage. In my own personal experience as a farmer in Indiana, we cut our cost of production by 18 cents per bushel when we switched from a traditional tillage method to a ridge-tillage system. We not only improved our soil and water resources with the new tillage system, but improved crop yields as well.

When both conservation compliance and the CRP are fully implemented, SCS estimates the cropland erosion rate in the United States will be reduced by 45 to 50 percent, providing significant water quality benefits.

The challenge in the future for USDA, the agriculture industry, and policy makers will be to continue to find ways to integrate environmental and agricultural goals in policy and programs that enhance our nation's environmental and economic opportunities.

At a CWA hearing held this past summer, the first question asked by a committee member to the agriculture industry witnesses was, "Tell us why agriculture should not be regulated?"

The upcoming reauthorization of the Clean Water Act (CWA) is the next major challenge for policy makers to try to integrate these environmental and economic goals. Nonpoint-source contamination from agriculture will be a main issue in this reauthorization process. At a CWA hearing held this past summer, the first question asked by a committee member to the agriculture industry witnesses was, "Tell us why agriculture should not be regulated?"

There are two main schools of thought on how to deal with agricultural nonpoint sources of contamination. One emphasizes the adoption of regulations on the use of contaminants. The other focuses on the voluntary adoption by farmers of production practices that are both environmentally sound and cost-effective for producers.

USDA's 130 years' experience working with farmers and ranchers supports the philosophy that voluntary action through education is more effective than regulation in addressing our environmental issues. Prohibiting the use of certain chemicals and policing and fining polluters is not the best way to deal with water quality concerns, particularly in a diversified industry such as agriculture.

Effective water quality management practices are dynamic for every farm and ranch in this country. Two farms located within five miles of each other can have dramatically different water quality plans. The goals of these plans are the same, but the conditions on each farm demand different solutions.

Regulations undermine agriculture's flexibility in determining production options. And flexibility is critical to agriculture's economic stability. Regulations will increase the cost of agricultural production and put farm operators who cannot absorb the added costs out of business.

American producers are committed to taking care of the water quality problems attributed to agriculture. A recent study in Big Spring Basin in Iowa reiterates USDA's long standing philosophy that a voluntary cooperative approach between government agencies and farmers can produce effective results. On a volunteer basis, through education and demonstrations conducted in cooperation with USDA, 200 farmers cut their nitrogen use from 174 pounds per acre in 1981 to 138 pounds per acre in 1989. Corn yields were not adversely affected.

American agriculture is the most productive in the world, not because of government intervention, but rather because the partnership between the USDA and American agriculture was allowed to flourish. USDA provides the research, technology, and education and producers apply this knowledge to the land. That same system, given the opportunity, can solve our environmental needs as well. □

THE ISSUES AND THE POLICY

View from OMB

Must farmers prevent pollution to escape regulation?

by Susan Offutt

Agriculture is the remaining major unregulated source of environmental, primarily water, pollutants. The nation's water resources include underground aquifers as well as lakes, rivers, and the oceans. Agriculture is a significant non-point source of ground water contamination, presenting a thorny problem for the design of public measures to prevent pollution.

Historically, environmental policies tackled point-source pollution of surface waters before dealing with nonpoint-source problems for several reasons: Cause and effect are more easily observable, solutions are therefore most easily found, and enforcement is possible. Ground-water problems, in contrast, are hard to detect, and individual sources of aquifer contamination hard to identify.

Two years ago, the federal government launched an initiative to protect water resources from contamination by fertilizers and pesticides without jeopardizing the economic vitality of U.S. agriculture. Federal agencies, including USDA and EPA, are designing water quality programs to accommodate both the immediate need to halt contamination, particularly of ground water, and the future need to alter farming practices that may threaten the environment. The premise of this initiative is that, ultimately, farmers must be responsible for changing production practices to avoid contaminating ground and surface waters. Federal and state resources will be available, however, to provide information and technical assistance to farmers so that environmentally sensitive techniques can be implemented at minimum cost.

This initiative reflects the belief that the most sensible approach to preventing water quality degradation for farming and for society is to rely on the farm community itself to devise and implement a pollution-control program. Within this framework, research and education develop and promote use of environmentally benign production practices. The very real threat of federal or state regulation would seem to be a strong incentive for the agricultural community to embrace this strategy.

This tack recognizes that federal regulation would be greatly complicated by geographic variations in physical environment that determine whether contamination actually does occur and with what severity. An effective regulatory solution (one that accommodates all site-specific factors in prescribing best management practices) would be very expensive to implement. An ineffective regulatory solution, on the other hand, could be wasteful and inefficient if use of chemicals and nutrients were unnecessarily proscribed.

The challenge to the efficacy of the voluntary approach is formidable, however. Research and development must design a set of management practices that farmers will continue to use even as commodity and input prices vary. Recent experience with conservation tillage instructs caution in this respect. An important lesson in designing and evaluating environmentally sensitive practices is to be mindful of the presence of coincidentally favorable price relationships. During the 1980s, low commodity prices may have indirectly provided environmental benefits by reducing the incentive to apply pesticides and fertilizers in order to increase yields. Low output prices may in large measure explain the apparent success of "low input" agriculture (although surely many farmers' attitudes have changed, as well).

Beyond the not inconsiderable problems with sensitivity to commodity and input price changes, what barriers might there be to permanent adoption of environmentally sensitive practices? First, the question of diversification away from chemical-intensive crops, at least to allow for rotations, is critical. While diversification in cropping patterns is currently economically feasible in some areas of the country, it is not clear this is true everywhere. The economic forces (political and technological) that make specialization profitable need to be better understood and recognized in designing new multi-output systems.

Ironically enough, another barrier to ground-water quality protection may be soil conservation. As was learned with conservation tillage, in some instances inhibiting runoff of chemicals and nutrients leads to their percolation through the soil and perhaps into ground water. What if acceptance of higher erosion rates is the price of saving ground water from contamination? How can institutional prejudice against such an outcome be overcome? Research can determine whether or not there is a tradeoff between surface- and ground-water quality. The more fundamental need is to recognize and accept that, no matter what, agriculture disturbs the natural environment. The issue is how much disturbance society is willing to accept, not whether it will accept any at all.

It is difficult to be sanguine about the prospect of immediate mitigation of threats to water quality because

(Offutt is Agriculture Branch Chief in the Natural Resources Division of the U.S. Office of Management and Budget.)

Runoff from a farm after a rainstorm. A federal initiative seeks to protect water resources without stifling agricultural production.

F. M. Stone photo. Soil Conservation Service.

basic farm production technology is still dependent on fertilizers and chemicals. In the future, ensuring against surface- and ground- water contamination will require a truly alternative agriculture. Plants that fix their own nitrogen, repel insects, and outcompete weeds would obviate the need for farmers to apply nutrients and pest toxins. In this respect, advances in biotechnology could make very real contributions. The short-term question of coping with contamination persists, however, because society will not wait for science to deliver on these promises. Because ground-water contamination is very slow to dissipate and very difficult (and expensive) to ameliorate, there is no time to lose.

To society at large and to farmers, a program of research and education aimed at water quality protection has a number of advantages over compulsory regulation. For farmers, education and voluntary compliance offer at least a partial cost-share through subsidization of the development of new farming practices and of the dissemination of related information. Farmers enjoy maximum flexibility when they may choose the practices that not only meet environmental objectives but also the needs of their own enterprises. And, very importantly, voluntary programs are most in the spirit of farm policy over the past 50 years. For society, allowing farmers maximum flexibility also promotes efficiency in resource use because the site-specific nature of water contamination problems also dictates site-specific solutions.

The apparent mutual advantages of this framework notwithstanding, the real question is: Will it work? Will the farm community embrace the preservation of surface- and ground-water quality as part of its stewardship of natural resources? Or will it hold out for compensation and perhaps ultimately be compelled to accommodate environmental concerns? As a clue to the answer, consider the provisions of the 1990 Farm Bill, enacted since the start of the initiative to encourage voluntary change.

Although it reaffirms the importance of research, extension education, and technical assistance, the Farm Bill also authorizes monetary incentives as a means of lessening the impact of farming on water quality. First, to maintain eligibility for commodity subsidies, farmers must be in compliance with a set of strictures governing practices intended to reduce soil erosion. Second, federal payments to retire farmland (either through annual rental payments or permanent easements) address environmental side effects by halting farming. Third, federal funds may be provided as an incentive to adopt an environmentally sensitive farm plan or as a cost-share to promote a particular practice.

To the extent that the Farm Bill provides for financial assistance to farmers, its impact will be constrained

by the scarcity of federal funds. The problem is one of too many acres chasing too few dollars with too little effect.

There are 423 million acres of cropland in the United States. Of these, 135 million are subject to conservation compliance. In fiscal year 1992, the Soil Conservation Service will devote $432 million to providing technical assistance in helping farmers prepare to meet the 1995 compliance deadline. Conservation compliance may well increase the costs of farming even as commodity program benefits decline. At some point, a farmer may decide participation is not worth it, and the environmental "hook" will have been lost.

Another 37 million acres will be retired under the Conservation and Wetlands Reserves at a 1992 cost of $2 billion in rental payments and easement purchases. These reserves will eventually cost $20 billion, all aimed at retiring roughly 10 percent of all cropland. An additional 9 million acres will be treated in fiscal year 1992 using $203 million in cost-share funds available through USDA for adoption of practices that may or may not have water quality protection as a priority. The Farm Bill's new Water Quality Incentives Program will expend $3 million to pay for farm plans on 290,000 acres (out of 10 million authorized) in fiscal 1992.

In total this year, then, this back-of-the-envelope inventory shows $2.4 billion of taxpayer funds will be applied to 182 million acres, comprising less than half of all U.S. cropland. The programs catalogued address a variety of environmental conditions, often with little coordination. At present, no one knows whether the 182 million acres currently participating in some form of environmental program are those that present the greatest risk to surface- and ground-water quality. Simply spending more to cover more acres would be difficult to justify even if it were possible to circumvent the funding constraint. Better targeting of existing funds will be the means for enhanced effectiveness in the future and will depend on the simultaneous development of knowledge about how and where to best apply limited resources.

The Farm Bill holds out the promise of a financial carrot that cannot be delivered. The federal budget deficit is one constraint, but so, too, may be society's attitude toward assigning responsibility for pollution prevention. Making a case on behalf of farmers for special treatment (in the form of financial assistance) will be increasingly difficult as other segments of the population have shouldered more and more of the costs of all kinds of pollution prevention and abatement. And, many industries, such as basic metals, face the same competition as does U.S. farming from overseas suppliers not necessarily subject to environmental regulation.

For any other sector of the economy, allocating the financial burden for prevention of contamination is an easily settled matter: The polluter pays and is compelled to do so through regulation. Whether agriculture can escape regulation and also avoid the costs of pollution prevention, however, is problematic. In the absence of federal budget constraints, society could choose to provide farmers with a monetary incentive to avoid polluting. Indeed, cost-sharing programs have a long history in conservation policy for agriculture. However, the scope of the effort needed to avert water quality problems, compounded by a shortage of federal funds, precludes extensive cost-sharing as a viable federal option.

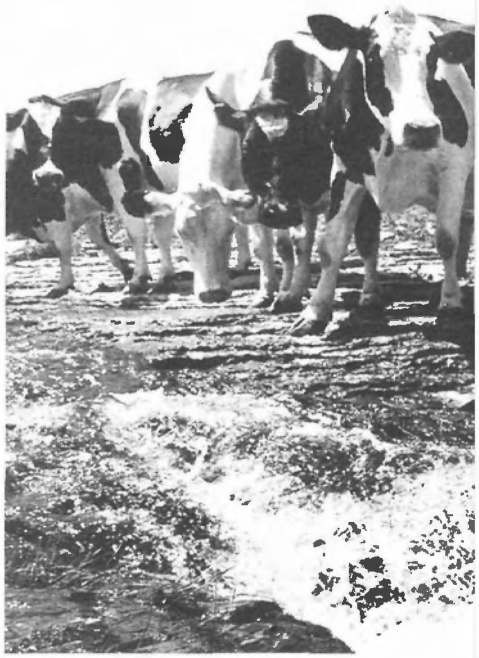
To the extent that farmers cannot pass on the costs of pollution prevention to middlemen and consumers, a case for taxpayer subsidy can be made. However, today's fiscal and political realities dictate that any subsidy will be modest and that, therefore, the voluntary approach remains the alternative to regulatory compulsion.

As debate over the reauthorization of the Clean Water Act proceeds, farmers' responsibility for protecting water quality will be assessed by those outside agriculture. Extension of the usual controls to agriculture—in the form of burdensome regulation—could possibly be averted. To forestall regulation, the agricultural community would have to acknowledge the validity of concerns about water quality and the costs associated with preventing contamination. By assuming responsibility for at least part of those costs, farmers could better negotiate a sensible pact that protects water quality as well as farm prosperity. □

Questions the Reader Might Ask

The public must recognize they are part of the problem.

Nonpoint-source pollution is everyone's problem. Yet many people are not even acquainted with the term, let alone the nature and extent of the problem and how it can be dealt with. To learn more about water pollution from nonpoint sources and about prospective remedies, EPA Journal interviewed Robert H. Wayland III, Director of the Agency's Office of Wetlands, Oceans, and Watersheds, which includes a program for nonpoint-source control.



Mike Brisson photo.

Q Nonpoint-source pollution is not exactly a household phrase. So to begin with, why don't you tell us just exactly what it is; give us some examples.

A We use the term to distinguish the smaller and very diffuse sources of water pollution from the large, individual-industry or municipal point sources that usually discharge directly from a pipe into a river, lake, or estuary, and which EPA has a long tradition of managing very closely.

We've developed water quality standards and effluent guidelines for point sources of water pollution, and we've issued tens of thousands of individual permits to bring them under control. But nonpoint sources are a different animal. They include a suburban lawn from which rainfall carries off pesticides and fertilizer nutrients to nearby waterways. Nonpoint-source pollution is also the atmospheric deposition of nutrients and toxics that originally volatilized off a farm field. It may be associated with automobile air emissions. Its cumulative effect now represents the most significant threat to water quality in most stream segments in the United States. It is a very serious problem in terms of nutrients and toxics. It is a significant problem in terms of simple sedimentation, which changes the contours of stream bottoms and may destroy fish habitat.

Q This question has a curve to it, so take your time. As you indicated, we've made a very determined effort in this country to control the point sources of water pollution—the factory outfall, the sewage treatment plant, and so on—through a federal permit system. In other words, a regulatory program. But under the law, nonpoint sources have been left to the states, and the states, for the most part, have tried to control them through voluntary programs. Isn't EPA, for all intents and purposes, sidelined?

A Not at all. EPA has a very important role to play. The very success of the point-source control program points up the need for EPA to become more involved in helping to bring nonpoint sources under control.

However, the model, the regulatory approach that we took in dealing with oil refineries or with wastewater treatment facilities that collected sewage from tens of thousands of people simply is not appropriate when we are talking about pollution from a small construction site or a small farm. Nonpoint-source control measures, some of which may be simple and inexpensive, have not been adopted in many cases because small scale enterprises or individuals simply do not see their activities as polluting. So, for one thing, we have a public awareness hurdle that we didn't have with point sources.

As I see it, EPA can contribute in three very important ways. First, we can help raise public awareness and understanding of the problem. Second, we can help develop the techniques for controlling nonpoint sources, and we can demonstrate that these techniques work and that they are readily available. Finally, we can help create the institutional framework under which these techniques or practices would be applied.

Q Isn't part of the problem the fact that we are talking to some extent about land use control and that this is a sensitive issue politically? Land use control traditionally belongs to local government, and the states and Congress are reluctant to intercede?

A There are several sensitive issues here, and they are related. The first is that we don't have public recognition of the extent to which tens of thousands of small activities can create a significant environmental problem. It is a question of how we go about persuading people that modifications in their behavior, their lifestyle, may be necessary to protect the water quality on which all life depends.

Land use decisions are the purview of state and local governments. In many cases, they are made through democratic processes, and they find a high degree of public acceptance. The problem is that these decisions are made day after day, year in year out, without being guided for the most part by how they may affect water quality.

I really believe that significant gains can be made if those state and local processes are better informed about the impacts of nonpoint-source problems on water quality, and the opportunities to address them through state and locally adopted measures. And EPA has a role to help states and local governments make land use decisions in a more informed way. For example, we can provide information on how different ratios of impervious surfaces can affect a stream.

Continued on next page

Animal wastes, a significant source of nonpoint-source pollution. EPA and USDA are working cooperatively on farm runoff problems.

THE ISSUES AND THE POLICY

Q Do you expect that in the upcoming reauthorization of the Clean Water Act the approach to dealing with nonpoint-source pollution will be changed?

A I certainly expect that the recognition of the importance of the problem will cause increased legislative attention to it. In the early history of the Clean Water Act, we had so far to go with cleaning up large point sources that they necessarily were the focus of concern and of the tools that Congress placed in our hands.

The experience of EPA and states, and a recent report from the General Accounting Office, all serve to highlight the fact that our priorities need to be adjusted to reflect the progress that has been made and the risks that remain. EPA's Science Advisory Board report on reducing risk, with its emphasis on ecological problems, habitat loss, and nonpoint pollution, I think builds a good foundation for future program and legislative work in this area.

Q Just how effective have the states been in dealing with the problem? Do they have sufficient resources to do the job?

A Resources for state nonpoint-source efforts have increased substantially in recent years. The 319 program, which is our principal framework under the Clean Water Act for making grants to states to demonstrate nonpoint-source control measures, has increased from essentially zero four fiscal years ago to $50 million a year in each of the last two fiscal years.

So, in the face of severe federal budget difficulties, there has been a very substantially increased commitment by the federal government for dealing with this problem. And that has been matched by an increase in state financial and institutional commitments.

Moreover, there are many other federal agency programs which affect nonpoint-source problems, and we believe they can be modified to reduce these problems without detracting from the objectives and missions of the agencies that implement them.

The effectiveness of the state programs varies. Some states have relatively mature nonpoint-source programs which address the whole range of sources, which involve using a wide mix of available tools, and which provide substantial state-allocated resources to do the job. Other states have more modest programs that address only major sources such as agriculture, and only minimal resources are allocated. But in general, states have made major strides in the past several years.

Q At least one state, Wisconsin, we understand, is applying both the carrot and the stick. (See separate article.) How is that working out?

A Several states are using both carrots and sticks. Wisconsin has a voluntary, incentive-based program in which the state shares the capital costs of installing best management practices with agricultural enterprises and other contributors to nonpoint-source problems. And it is a good program.

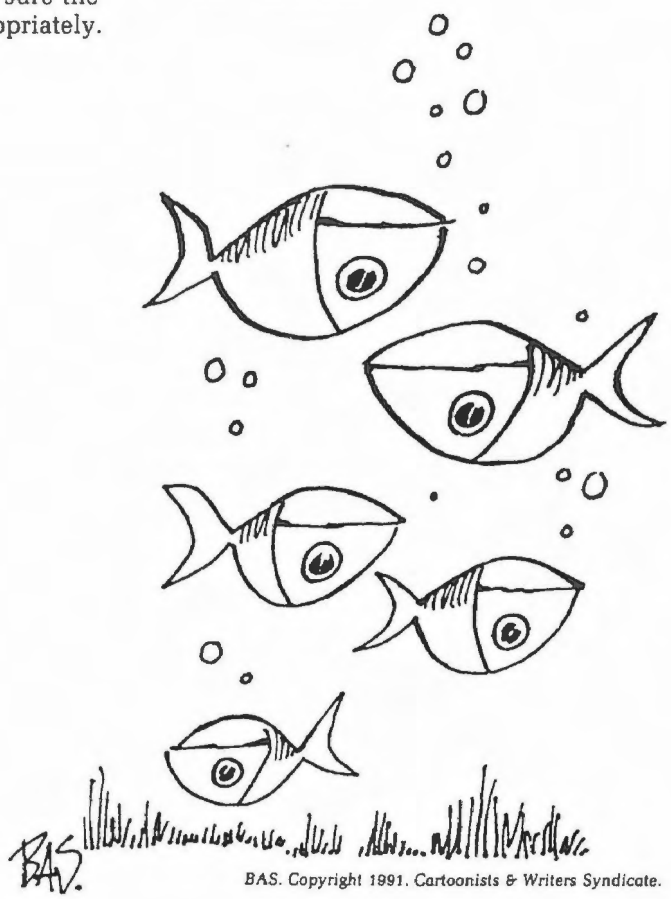
In addition, the state has adopted backup regulatory requirements under which it can require a farmer to undertake clean-up actions when that farmer's operation is contributing to a water quality problem.

So, Wisconsin has a program which provides the carrot, but if that fails, the stick is available to make sure the problem is attacked appropriately.

Q As we understand it, EPA's own comparative risk study showed that nonpoint-source pollution is more of a problem than point source pollution. Yet our budget priorities have overwhelmingly favored the latter. Is that still true?

A It would be a mistake to believe that we've had such success with point sources that they can now be neglected, that the control programs, in other words, would be self-perpetuating. So we can't simply move all of our resources to the nonpoint-source area. And, as I said earlier, it is not at all clear that the approach we took in controlling the smokestack industry would be appropriate in dealing with the nonpoint problem.

I think that we need to evolve toward a balance that on the one hand maintains the important gains we've made in controlling point sources, while on the other allows us to make progress in bringing the nonpoint-source problem under control. Shifting the budget must, therefore, be an *evolutionary* rather than a *revolutionary* process, and I believe we have now begun to move in that direction.



BAS. Copyright 1991. Cartoonists & Writers Syndicate.

Q Runoff from farms is the single most important category of nonpoint-source pollution. Yet according to the General Accounting Office report, which you mentioned, commodity programs run by the U.S. Department of Agriculture tend to reinforce some of the very farm practices that contribute to the problem. What is EPA doing to convince USDA that it should modify its policies?

A EPA has enjoyed a remarkable amount of cooperation from the Department of Agriculture in recent years. We were welcomed into the process of formulating the Administration's proposals for the 1990 Farm Bill, which incorporates a number of provisions intended to move farming toward a more ecologically sensitive way of doing business. In addition, USDA invited us to participate on their work groups for writing rules for implementing the 1990 Farm Bill conservation programs.

Nevertheless, there are 2.5 million farms in the United States. There are extraordinarily complex programs in place both to increase output and to maintain farm income. We can't expect to change these programs overnight to be more complementary to EPA's mission and still keep their original purpose.

What is encouraging is the extent to which many progressive farmers are adopting such practices as conservation tillage and low-input farming that reduce the surface-water and ground-water pollution problems that have been associated with farming. And they are being encouraged to do so by USDA.

I should point out that it isn't just row crops that contribute to the problem. Animal waste from confined feeding operations is a very significant aspect of the nonpoint-source problem. In addition, grazing has proven to be destructive to important riparian areas and stream beds in many of the arid parts of the country. We are working cooperatively with USDA to address these problems as well.

Q We have a similar situation with timber production, another important source of nonpoint-source pollution. The Forest Service, part of the USDA, is one of the country's largest managers of forest land, much of which is commercially harvested for timber. Environmentalists say that the Service tends to emphasize timber production at the expense of protecting water quality. What can EPA do to influence the Forest Service?

A Actually, we are already doing quite a lot. I met only recently with senior officials of the Forest Service to review our joint efforts to ensure that, as land managers, they take a stewardship approach which recognizes the multiple purposes their lands can fulfill.

As with other elements of the Department of Agriculture, we are finding a keen sense of awareness on the part of Forest Service officials that maintaining the habitat, wildlife, and water quality values of watersheds under their management is a key part of their mission. And I expect that part of their mission to gain increasing emphasis in the coming years.

A number of Forest Service personnel are detailed to EPA regional offices and to our office here in Headquarters. We have a similar program with the Soil Conservation Service. We are finding that these programs have been quite useful in giving us an appreciation for the needs and constraints of USDA and its component parts, as well as giving them a better appreciation for EPA's mission and how we can together go about furthering it.

Q In the early days of the Superfund program, we were not only unaware of the magnitude of the problem, we did not have in place proven technologies for correcting the variety of contaminated sites that we eventually had to confront. Does that situation pertain to nonpoint-source pollution? We understand that some states simply do not know whether many of their lakes and streams are polluted or not.

A There is certainly a lot more that we need to learn about the contributions of different kinds of nonpoint-source pollution to water quality impairment. However, in the main, the states are doing a good job assessing threats to water quality.

Sediment, for example, is a pollutant that we have much to learn about. Toxics discharged from both point sources and nonpoint sources many years ago have become bound to sediments. And even though we reduce the input of new pollutants to a body of water, disturbing these sediments can release harmful elements into the water column or can expose bottom-living organisms to them. We are currently developing an agency-wide strategy for acquiring information on the location of contaminated sediments, what has caused the contamination, and what are its effects.

While there is always more to learn about any environmental problem, I don't consider Superfund a particularly appropriate analogy. I believe that we do have an adequate handle on the magnitude and nature of the problem and that there exists a large "menu" of technologies to deal with it—many of them well established.

Q In putting this issue together, we've run across some innovative approaches to pollution control. In Colorado, for example, efforts are being made to increase the capacity of a stream to absorb pollution by altering the stream's physical characteristics. In other words, they are not so much trying to cut back on pollution as they are improving on nature's ability to absorb it. Is there a whole universe of control-technology research and development connected to nonpoint-source pollution, as there is to other EPA programs?

A One of the things we see is that, in many cases, "low-tech" responses are quite effective and, in many cases, quite inexpensive in dealing with nonpoint-source pollution. Many agencies in addition to EPA are developing and evaluating these control approaches.

We do have a modest research program under way. However, our current approach, which encourages the installation of various management practices, has us trying to transfer the technology that others have developed to a wider set of users.

There are, in fact, a number of research questions pertaining to nonpoint-source pollution—some unique to it, others applicable to a wider array of issues. We are working with EPA's Office of Research and Development to develop a comprehensive research plan in this area.

Continued on next page

THE ISSUES AND THE POLICY

Q As we understand it, one potential bright spot on the horizon is that nonpoint-source control programs developed under the new Coastal Zone Act amendments may be picked up by inland states as well. Is this true? Without going into all of the administrative steps, how will these programs work?

A We were very pleased that EPA was able to meet a very stringent Congressional deadline associated with implementing a new coastal zone nonpoint-source program, and with the high degree of cooperation that EPA and the National Oceanic and Atmospheric Administration (NOAA) have enjoyed in trying to put that program into place.

Fundamentally, the new coastal nonpoint-source law requires EPA to identify management measures, which we have done in a proposal that was open for comment this past fall, then for the coastal states to adopt programs which conform to these measures. It means that existing state coastal zone management plans and existing state nonpoint-source control plans will need to be revised. NOAA and EPA have also issued draft guidance outlining the elements of an approvable state coastal nonpoint-source program and the process by which that review will be conducted.

We are at an early stage in this effort and it's too early to predict how successful it will be, and whether it will be applied inland as well as to coastal areas. Clearly, many in Congress and elsewhere will be watching this effort closely.

We are excited about the opportunity to work under a new institutional framework with NOAA. We are optimistic that it will result in benefits to coastal-zone water quality that were unavailable to us before.

Q You mentioned earlier that, generally speaking, the public is unaware of nonpoint-source pollution and that, consequently, EPA doesn't enjoy the support it needs to cope with the problem. What are you doing to educate the public?

A We have a number of efforts underway. For example, we publish a newsletter, *Nonpoint Source News-Notes*, which reaches out to a broad audience of water quality practitioners, educators, and others. We also distribute posters, brochures, and fact sheets on nonpoint-source problems and solutions. In addition, many of the most effective public education programs are those developed locally because they are closer to the problems. Consequently, a significant portion of section 319 grant money goes to support state and local outreach and educational efforts.

As I said earlier, this is not exclusively a problem of land use decisions by government. It has to do with many decisions that individuals make in their daily lives: Do they dump their crankcase oil down a storm sewer, or recycle it; does a farmer undertake a soil test before fertilizing his crop; are pesticides used on a preventative basis?

All these decisions have important impacts on water quality. The individuals who make them need to be sensitive to those impacts. We're talking about a massive educational undertaking. Fortunately, we aren't in it alone. We're getting a lot of assistance in reaching the agricultural community, both through the Extension Service and the Soil Conservation Service. In coastal areas, state coastal zone management programs and EPA-funded National Estuary Programs and Near Coastal Waters Program projects often provide important vehicles for reaching the public on nonpoint-source and other problems.

We're hoping that EPA's new Environmental Education Office will be a big help to us in placing information on the nonpoint-source problem in schools and elsewhere. We've established an electronic bulletin board through which we can exchange information on best management practices and program developments. We are looking for ways to energize private-sector point sources in helping to bring the nonpoint-source problem under control. And, finally, just as the utility companies have undertaken public information efforts in the energy conservation area, we have major metropolitan wastewater agencies and stormwater agencies that can supplement EPA's efforts trying to reach citizens about the nonpoint-source problem.

Q Well, as I said earlier, it's a problem that you don't see covered very much in the press, and it's not one that we're all that familiar with. Is there anything we've missed that you'd like to touch on?

A Yes. There is one thing. We are in the process of developing a simple, not entirely new, concept that EPA's water quality programs have not emphasized enough to date. We think it will be quite valuable in dealing with the nonpoint-source problem.

We call it the watershed protection approach. Fundamentally, it means taking a particular watershed as a starting point, evaluating what the threats are to water quality, and energizing the people who live in that watershed to address the problem. It is a concept that Bill Reilly has talked about, and others, like Jacques Cousteau. It has to do with people protecting the things they love. It is a concept that applies not just in the case of our large and magnificent resources, like the Chesapeake Bay and the Great Lakes, but which people in thousands of small watersheds can understand and relate to.

Instead of focusing initially on a particular pollutant or a particular industrial category of polluters, as we have so many times in the past, we would start with what is causing a particular river, lake, estuary, or other water body to be a place where you can't swim or a place where you can't catch the range of fish that was there in the past. By engaging the people in existing institutions around that watershed and focusing on that question, then developing solutions that may go beyond those that are appropriate for EPA to implement by itself, we think we can achieve a lot of progress.

So we are working with the EPA regions, the states, and other stakeholders to take this model, which is similar to what we've done in the national estuary program, and apply it to smaller scale watersheds, both coastal and inland.

What the smaller watersheds have in common with those magnificent water bodies is the fact that there are people who live near them, who relate to them, and who can understand in a

Tim McCabe photo. Soil Conservation Service.

Runoff from a development. Land use decisions are often made without regard to water quality.

way that others cannot when we talk about something as abstract as nonpoint-source pollution. In other words, it is their stream or their aquifer; it meets needs in their community; it offers them recreational opportunities, and the problem becomes determining what they can do to protect their watershed.

You can say that what I'm talking about is moving forward to the past, that an earlier version of the Clean Water Act had provisions which called for just this kind of approach. However, in implementing our programs, which have realized an awful lot of progress in the past twenty years, we've lost sight of it. We went after high visibility pollutants and high visibility polluters. In the process, we disconnected from a resource that can be very valuable.

The watershed approach, which is widely endorsed by our regions, doesn't just focus on nonpoint-source pollution—or any other single problem. Rather, it embraces all adverse environmental impacts that affect both the chemical water quality of the watershed and the living resources of the system in terms of physical habitat and biological community structure and function. We think it's an exciting approach that holds a great deal of promise.

Q How did the recent reorganization of the Office of Water affect nonpoint-source activities, and how is your office organized to administer EPA's responsibilities in this area?

A The reorganization that was implemented last spring was designed both to effect some needed administrative streamlining within the Office of Water and to better align programs and functions with similar goals and issues. As a result, the nonpoint-source program was grouped, in the new Office of Wetlands, Oceans, and Watersheds (OWOW), with coastal, marine, wetlands, surface water monitoring and data management, and lake restoration problems. These programs and activities have in common a generally geographic, often ecological, orientation, and they rely mainly on non-traditional approaches. Because of some important mutual reinforcement and because we were able to boost nonpoint-source program resources a bit, I believe that the program was strengthened.

Within OWOW, nonpoint-source responsibilities are administered primarily by the Assessment and Watershed Protection Division, headed by Geoff Grubbs, though other elements of OWOW also contribute in important ways to nonpoint source efforts. The Nonpoint Source Control Branch in that division is the primary focus for these functions, but the Monitoring and Watershed Branches also play key supporting roles. Through what I believe is a rather unique arrangement with regard to roles between my deputy, Dave Davis, and me, Dave is responsible for the day-to-day, office-level management of the nonpoint-source program. □

A FORUM

What Will It Take ...?

The Clean Water Act defines precisely what are the point sources of pollution and subjects them to the control of permits under the National Pollutant Discharge Elimination System. In contrast, the Act defines nonpoint sources only as those that do not meet the legal definition of point sources, and assigns responsibility for them primarily to the states. The states, typically, have tried to control them through voluntary programs. But, according to EPA, nonpoint sources currently are responsible for one- to two-thirds of remaining water quality problems.

The issue is sensitive, involving, as it does, the control of land use, which tends to be considered a local government tool. How, then, does our society come to grips with this serious environmental problem? EPA Journal asked a number of authorities on the issue: What will it take to bring nonpoint-source water pollution under control? Their answers follow.

Clayton County Extension Office photo.

As part of Iowa's Big Spring Basin Demonstration Project, ground water is continuously monitored at more than 50 sites including this deep-monitoring well in Clayton County.

Kenneth A. Cook

Neither a purely voluntary nor a purely regulatory framework will suffice to solve agriculture's nonpoint-source ground-water or surface-water problems. A hybrid system is needed, built of carrots and sticks.

The case for a voluntary approach, consisting of technical assistance, education, even some incentives, is compelling to a point. Obviously, many farmers have spent their own time and money protecting their land and water, and the larger environment of which their farm is a part. But by no means have all farmers, or enough farmers, been effective stewards. It is equally obvious that pollution-control practices that farmers support or initiate by choice are more likely to be successful and enduring than those imposed on them. Society can help by providing funding for some farmers and some practices. But society can't pay for it all, especially with the current severe constraints on the federal budget. The Water Quality Incentives Program authorized in the 1990 Farm Bill, for example, will provide a mere $6.75 million to help farmers prevent nonpoint pollution in 1992.

The case for agricultural nonpoint-source regulation begins with the history of soil conservation policy in this country. For the 50 years prior to 1985, the nation approached the very serious problem of soil erosion control on agricultural lands in an entirely voluntary fashion. The U.S. government spent tens of billions of dollars to provide cost-sharing for erosion-control practices and technical assistance in virtually every agricultural county in the nation.

Yet in 1985, we still faced a serious soil-erosion problem. On tens of millions of acres of highly erodible cropland, farmers were producing wheat, corn, cotton, and other commodities, often with the support of a federal subsidy. Not only were the erosion rates on these lands extremely high, but in many cases not a single soil-conservation practice was in place. That does not say very much for a half century's worth of the voluntary approach.

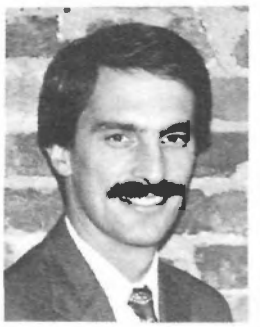
In 1985, Congress drew the line on one aspect of this problem: It enacted the "sodbuster" and conservation compliance policies to end federal farm-program subsidies that contribute to excessive soil loss. Only when these new regulations were added to USDA entitlement and benefit programs did we begin to see significant results. Farmers developed and began to implement conservation plans because they had to. A recent evaluation by the Soil and Water Conservation Society (SWCS) does raise serious questions about the adequacy of USDA implementation. Still, we do know that in the absence of conservation compliance, soil conservation plans and practices would not be a reality today on tens of millions of acres of fragile cropland.

Recent experience with combatting nonpoint-source pollution in the Chesapeake Bay area lends further weight to the case for regulation. Considering the tens of millions of dollars spent on research, planning, financial assistance, and farmer education, the Chesapeake Bay states must be considered to be in the forefront of efforts nationwide to control agricultural pollution over a large area. Recently, EPA convened an independent panel to assess the effectiveness of efforts to reduce nonpoint-source loading into the Bay. (EPA acted on behalf of the Chesapeake Bay Commission and the governments party to the Chesapeake Bay Agreement.) The panel studied whether a "largely voluntary" program to control nonpoint-source pollution would be sufficient to meet the year 2000 goal for reducing nutrient loadings into the bay, or whether more regulatory programs would be required. The panel recommended "that the states and the federal government augment voluntary programs with increased use of regulatory authority for the reduction of nutrient loadings. To minimize financial burdens, regulatory requirements should be accompanied by technical and, where appropriate, financial assistance." In addition, the panel recommended that "nutrient management plans be required and implemented for lands that are targeted as sources of nutrient loading into the bay."

If the nation's most intensive and costliest voluntary effort to date to control nonpoint-source pollution yields these conclusions, I would submit that some form of regulation for agricultural nonpoint-source pollution control should be included in the Clean Water Act when it is reauthorized in 1992. Regulation, combined with a fully funded water quality incentives program, will be necessary to solve agriculture's serious pollution problems.

(Cook is Vice President for Policy at the Center for Resource Economics.)

Ron Phillips



The fertilizer industry practices and strongly supports the use of nutrient management plans as the best way to prevent non-point source pollution. It is important, however, to recognize that good nutrient management plans are site-specific, taking a number of variables including existing nitrogen in the soil and crop needs into account.

For this reason, we support solutions to address non-point source pollution problems that are crafted where the problem occurs—at the local level—and that are administered on a voluntary rather than mandated basis.

Current government programs and voluntary efforts are working to address the non-point pollution problem. The site-specific nature of the problem is a fact that is virtually missing from the debate.

Section 319 of the Water Quality Act of 1987 has directed significant resources

to states to help them develop non-point source pollution programs. States are moving to address the issue. Nebraska is an example of a handful of states that require nutrient management programs in designated water resource areas. Farmers within these special protection areas must have plans for controlling, stabilizing, reducing, or preventing water contamination. Other states require best management practices (BMPs) in instances where water quality standards are violated. Erosion controls are another weapon used by many states to combat water quality degradation.

Agriculture's contribution to non-point source pollution is localized. Solutions, therefore, must be site-specific. The federal government cannot create a national non-point solution that is successful in addressing local problems of varying degrees. As an example, Washington's prescription for reducing nutrient loadings to waterways is to reduce fertilizer use. Yet, in the Chesapeake Bay watershed, fertilizer use is down 30 percent since 1980 even though total nitrogen loadings to the bay have increased.

EPA already administers Section 319 and the Coastal Zone Management Act to address nonpoint problems. That is in addition to a host of USDA programs, including six new programs in the 1990 Farm Bill to address water quality.

The best role for the federal government is to allow these programs to work. A good nonpoint-source pollution program would encourage cooperation among states, farmers, and industry to create site-specific solutions.

Farmers and industry care about reducing nonpoint pollution and protecting the environment. They also possess most of the expertise needed to craft solutions and should be allowed to do so.

(Phillips is Vice President of Public Affairs for The Fertilizer Institute.)

Senator John H. Chafee

Despite the good intentions of Congress when creating the nonpoint-pollution control program in the 1987 Water Quality Act, little has happened under section 319 that has actually improved water quality. Nonpoint pollution was our most serious water quality problem in 1987 and remains so today. I believe that we must take two additional steps before water quality improvements will be seen.

First, we need a significant commitment of federal funds to the nonpoint problem. Federal spending to control the nonpoint sources of pollution has been minuscule compared to our efforts on the point source side. Over the past 20 years, we have spent more than $60 billion of federal funds to build municipal sewage treatment plants. Industry has spent additional billions of dollars controlling point-source discharges.

But nonpoint-pollution control efforts have been starved for dollars. After a decade of appropriating $2 billion or more annually to construct sewage treatment plants, I hope that we can now shift as much as $500 million per year to the nonpoint side of the equation. These dollars would be used to build and carry out state programs.

Second, we must put our efforts into the field. Too much of the nonpoint program in the past, both under section 208 in the 1970s and section 319 now, has been spent on analyzing, planning, and reporting by government agencies. We need to get in closer touch with the farmers, foresters, builders, and city public works departments that can actually make a difference for water quality.

Recent amendments to the national farm program offer a perfect opportunity. They pledge dollars and the expertise of local agricultural agents in soil conservation districts and extension offices to help farmers and ranchers develop water quality plans for their land. We need to adopt that model for the Clean Water Act. It is this work in the field—one field at a time—that has the greatest promise to actually improve water quality.

(Chafee (R-Rhode Island) is ranking minority member on the Senate Environment and Public Works Committee.)

Edward G. Stein, Jr.

When major projects are under construction, any particular watershed can be severely impacted by erosion and sediment runoff created by that construction. To offset these potential negative impacts, it is imperative that an effective sediment control plan be developed as an integral phase of the design process. Equally important is the timely implementation of the plan during construction. Constant inspection of the project and the ability to react to occasional deficiencies in the plan and severe weather conditions is also very important. The Maryland State Highway Administration adopted this concept in 1984. We feel we have been successful because we have undertaken an extensive training program for our design, construction, and maintenance personnel.

We have established a two-tiered level of inspection for sediment control, and have the ability to take immediate action against contractors who are in noncompliance. We can and do shut down projects, and in 1990 enacted a penalty system. This penalty is a minimum of $1,000 per day. Since we are in the business of building roads, and shut-downs are not in anyone's best interest, we have instituted a program that lets us interact with and educate contractors in the area of sediment control.

Public agencies that are charged with large public works projects, especially highway-related efforts, need to set an example for the private sector. We have been successful in Maryland and strongly recommend that other states follow our example.

(Stein is Assistant to the Chief Engineer at the Maryland State Highway Administration.)

John Charles Wilson

As a full-time farmer and producer of cotton, soybeans, corn, wheat, and cattle, I am a skeptic when it comes to nonpoint-source pollution in agriculture. I believe that in production agriculture, we have point-source problems just as many industries do. Most producers are using pesticides and nutrients at or below labeled rates in applications on their crops. This has been dictated by the poor economy of our industry over the last decade. Producers have learned to use chemicals and fertilizers effectively and safely. In my opinion, most resource contamination occurs at points of pesticide spills, spray tank ruptures, agricultural equipment filling and washing, around well heads, and from pesticide container disposal.

We in agriculture are well aware of the need for resource protection and conservation. It is our livelihood and heritage. Even though I am a skeptic about area-wide contamination from pesticides and fertilizers, I am not naive enough to believe that the potential is not there. I believe that intense monitoring in heavy agriculture production areas will keep us on the cutting edge of what our production tools are doing to our environment.

My conservation district (Shelby County, Tennessee), along with Fayette and Tipton counties, has embarked upon a 5-year, $6 million monitoring program in the 100,000-acre Beaver Creek Watershed in West Tennessee. This program, *which was established by farmers* in conjunction with the U.S. Geological Survey, Soil Conservation Service, Tennessee Department of Agriculture, Tennessee Department of Conservation and Environment, University of Tennessee, and Memphis State University, is seeking to gain through monitoring more knowledge about our production activities. Monitoring includes: stream channel water sampling (12 samples per storm event), soil core sampling to a depth of 5 feet, and deep well water sampling. The farmers in our area are committed to correcting any problems highlighted by the monitoring system.

Farmers in increasing numbers are demonstrating their awareness of the potential problems caused by nonpoint-source pollution. How aware is the general public concerning its contribution to this problem? The Saturday afternoon gardener who drains the oil out of his lawnmower into the driveway; the homeowner who fertilizes his quarter-acre lawn with a 50-pound bag of fertilizer twice a year; the gardener who produces homegrown vegetables and over-applies pesticides; or the Sunday boater who spills gas and oil into our rivers and lakes: How do we make these individuals more aware of their responsibilities? I believe that increased education and publicity are the answer.

Nonpoint-source pollution is a problem created by all of society. Not any one sector can be given full responsibility. Therefore, it is a problem all of us need to work together to solve.

(Wilson is a Tennessee farmer.)

Robert W. Adler

Nonpoint-source pollution, a bureaucratic term for poison runoff—badly contaminated runoff from farms, city streets, construction sites, and other lands—has been a poor stepchild under the Clean Water Act. During consideration of the Clean Water Act in 1972, 1977, and 1987, Congress clearly recognized the critical need to address this form of pollution. Yet past legislative responses have been weak, calling for vague planning programs and voluntary approaches to poison runoff control. And funding for poison runoff programs has been almost nonexistent.

Three critical changes are needed when Congress reauthorizes the Clean Water Act next year. First, EPA and states must be required to impose mandatory controls on runoff sources where necessary to solve water quality problems. These controls need not be uniform. Rather, as we required for coastal states last year in the Coastal Zone Management Act, EPA should be required to identify a menu of poison runoff controls, from which states can choose the most appropriate controls for specific regions.

Second, water quality standards must be broadened and applied to the poison runoff problem. Current water quality standards often do not apply to poison runoff. For example, few states have standards that address pesticides, nutrients, and the hydrologic effects of runoff. More important, poison runoff control programs must be linked specifically to the goal of water quality compliance.

Finally, Congress must fund poison runoff programs at levels appropriate to the magnitude of the problem. It is estimated that at least $10 million per state per year will be needed to make state poison runoff control programs effective. Ultimately, the funding level for poison runoff programs is the best yardstick to measure Congress' commitment to solve this problem.

(Adler is a Senior Attorney with the Natural Resources Defense Council.)

(Forum continued on next page)

A FORUM

Neal D. Emerald

In 1988, the Madison-Gallatin Chapter of Trout Unlimited (TU) appealed the Gallatin National Forest (GNF) Management Plan. TU was concerned about the impacts of timber harvesting and grazing on the world-class trout fisheries of the GNF. Key points in the appeal included the plan's failure to address requirements of the Clean Water Act (CWA), the National Forest Management Act (NFMA), and the National Environmental Policy Act (NEPA).

The plan violated both the CWA and Montana antidegradation standards for timber harvest operations in selected watersheds. The plan further violated NFMA mandates for the protection of fisheries habitat by failure to protect riparian areas, to address sediment impacts, to inventory streams, and to set standards for adverse effects. Additionally, the plan allowed logging in drainages occupied by the native Yellowstone cutthroat trout.

The plan also violated NEPA requirements because it failed to discuss the impacts of timber harvest, to provide for a watershed analysis, and to address fisheries' economic value.

TU made it clear that it was willing to work with the U.S. Forest Service (USFS) to resolve the concerns. The USFS went right to work. It agreed to monitor streams which contained world-class trout populations and, if necessary, halt logging and grazing activities to protect the quality of those streams. As part of the settlement, the USFS agreed to revise its plan to carry out the following:

- Provide for implementation, effectiveness, and validation monitoring for fish habitat, water quality, and soils (in doing so, the USFS will provide an annual monitoring report and schedules for monitoring and evaluation)
- Provide for stream-classification system guidelines which will consider substrate composition, water temperature, pool habitat, stream bank composition, shading and stream cover, bank stability, debris, and streamflow, and develop implementation standards for these items
- Provide for riparian area management to meet riparian-dependent resource objectives for fisheries, wildlife, and watersheds (this included the elimination of timber harvest activities; it also provides for a project halt or modification if sediment occurs over levels specified in the plan)
- Meet NEPA requirements for watershed site-specific and cumulative-effects analysis for proposed actions as they affect fisheries and watershed-related values.

TU signed the settlement with the USFS on January 10, 1990. The settlement was a landmark precedent in forest planning management because it was the first time that extractive resource activities were banned from sensitive watershed areas. The USFS was forced to realize that protection of riparian areas is essential in maintaining the higher water quality standards required by trout and salmon.

(Emerald is Grassroots Coordinator at Trout Unlimited.)

S. Lake Cowart, Jr.

As a lifetime resident of the Northern Neck town of Lottsburg, Virginia, located on the lower Potomac River, I see the problem of bringing nonpoint-source pollution under control as a very real one. It is real to the residents of Tidewater Virginia because of their dependence on the tidal waters of the Chesapeake Bay for their livelihood.

Nonpoint runoff has been addressed by the farm community in recent years. No-till farming, sod waterways, buffer strips, drop structures, and nutrient management plans have been utilized to the extent the farm community could effect these practices. Much work must still be done on the farm, as well as in urban areas, to bring nonpoint pollution under control.

The answer to this problem is not more federal and state government regulations. Landowners must be educated and encouraged to prevent nonpoint-source pollution through the use of existing regulations and with the help of governmental cost-share programs.

One possible approach would be to encourage the construction of thousands of strategically located ponds which would catch the runoff

FRANK & ERNEST BOB THAVES

Frank and Ernest reprinted by permission of NEA, Inc.

during and after high rainfall periods and store the water. The ponds would allow sediment removal and percolation of water into the soil. These ponds should be designed to allow a regular, slow release of water. They could also serve as a source of water to meet growing farm and urban needs. Environmental tradeoffs would have to be made since certain non-tidal wetland areas would best serve as locations for these holding ponds.

This approach would yield less sediment entering tidal waters and a more regular flow of fresh water into our estuaries. The long-term results will help solve the problem of nonpoint pollution, and any environmental tradeoff will be positive.

(Cowart is an oyster grower and tomato farmer.)

Thomas Mumley

Successful control of urban runoff will require a carrot, a stick, and common sense. Common sense equates to pollution prevention. There are many low tech, cost-effective solutions at hand. These include providing information on the proper use and disposal of materials; preventive maintenance by public works; planning procedures to ensure that development will not increase pollutants in urban runoff; and flood management activities which reduce the amount of pollutants in urban runoff while achieving flood-control objectives. The list goes on; it just makes sense to implement the myriad of control measures that we have been aware of for years.

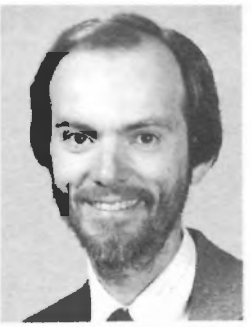
Unfortunately, human nature does not equate with common sense. We need incentives to change our ways; we need directions. We now have a big stick to drive these needed efforts, in the form of the NPDES storm water regulations which require implementation of these control measures. Fortunately, the current regulations promote flexibility and don't impose a lot of bureaucratic red tape, and therein lies the carrot.

The carrot is the human drive to control our own destiny. A municipality's own interests will be served if it develops a self-determined urban runoff management program. Municipalities will find that if they commit to meaningful actions, regulators will be generous in their scrutiny. On the other hand, I guarantee that municipalities won't be happy with a program designed in a state capital or in Washington, DC.

The bottom line is that action is needed, and if municipalities don't do it on their own, the regulatory stick will get big, and it will hurt. We'd all prefer to keep the stick out of the formula. This will only happen if municipalities take advantage of the current opportunity to control their own destinies by implementing the common-sense, cost-effective, environmentally beneficial measures available for urban runoff management.

(Mumley is Associate Water Resource Control Engineer at the San Francisco Regional Water Quality Control Board.)

George Hallberg



Aggressive marketing! While there are many actions needed to reduce nonpoint-source pollution, an aggressive marketing approach to public education is a necessity—and one often overlooked. Resolving many NPS problems requires changes in the way we conduct our daily activities. Examples range from the way we handle and use fertilizers, manure, and pesticides on farms, lawns, and golf courses, to our use and disposal of household toxic and hazardous materials. Altering such activities is as much a sociological process as a technical one.

It seems unrealistic to suggest we can simply regulate such behavior. To affect voluntary change, at the large scale needed, requires an aggressive program to change attitudes and perceptions. Evaluation of effective education efforts to promote voluntary change suggests such programs must address several issues. First, we must enhance, or even initiate, awareness of the problem. We can't expect change when our target audience doesn't know they have a problem! Second, we must provide contact with alternative practices and potential solutions and provide confidence these are viable.

These are only first steps, and they presuppose we have defined our market audience; we must know who the audience is and how to reach them. Also, responsibility for many nonpoint problems cuts across traditional authorities, and resolution requires cooperation from many agencies and institutions. Another key is development of a consistent message among these cooperators; nothing can kill the "marketing" plan faster than contradictory information from supposed collaborators.

Voluntary approaches likely will not fully resolve nonpoint-source problems. But without targeted educational programs that begin the process of changing fundamental attitudes and behavior, more stringent measures will hardly be palatable publicly or politically.

(Hallberg is Supervisor of Environmental Geology at the Iowa Department of Natural Resources.)

FINDING SOLUTIONS

Filter strips are one method of protecting stream banks. Both sides of this creek have been stabilized by recently planted willow trees and sweet clover.

USDA photo.

My Experience

The more the residue, the less the pollution of surface water.

by William Richards

My perspective on curbing agricultural nonpoint-source pollution is that of a farmer—

- A farmer who lives by the philosophy that every producer and land owner has the duty and the moral obligation to use the best soil- and water-conservation technology available
- A farmer who believes that good environmental decisions and good business decisions are compatible
- A farmer who, for the past 35 years, helped pioneer "conservation tillage," the practice of maximizing the crop residue you leave as a protective mulch on the surface of a field instead of plowing it under.

Interest in conservation tillage is growing rapidly around the country. As a farmer, I am excited about this because I know the competitive advantage of this technology. I am also excited as Chief of the Soil Conservation Service (SCS), the USDA agency that has helped America protect and conserve soil and water since the Dust Bowl crisis of the 1930s.

The agricultural community's concerns about water quality and soil erosion control are our highest priorities at SCS. We are helping producers to understand the interrelationships between soil, water, air, plants, and animals and to apply the information that comes from research and extension agencies and from our own surveys of soil characteristics and other resource conditions.

Last year, more than 1.2 million farmers, ranchers, and units of government sought SCS help in developing a conservation plan to ensure that their operations are environmentally and economically sound. We offered this help through voluntary conservation programs and through one of the most effective public and private partnerships in this country—our partnership with the more than 3,000 locally organized and locally run soil and water conservation districts.

A tremendous array of technology is available to help with a range of environmental concerns. But conservation tillage, in my opinion, should be the technology considered first for soil erosion control and water quality protection. In conservation tillage, the residue of husks, stems, and leaves covers the soil surface, protecting it from wind and the impact of raindrops. The more residue you have, the less runoff—and the less chance that surface water will be polluted by sediment and by nutrients or pesticides adhering to soil particles.

This basic concept of crop residue management is beautifully simple, and you find it used in home gardens. But on the large scale of production agriculture, the technology is complex.

Intensive management is the key. For example, the amount of residue cover needed to reduce soil erosion to acceptable levels depends primarily on the type of soil, the slope of the ground, the kinds of crops grown on a field and their order in the crop "rotation," and the tillage systems and equipment used.

Fortunately, conservation tillage is a flexible technology that allows the farmer to balance market decisions with environmental decisions. One way of leaving more crop residue on the ground is to include high-residue-producing crops in a crop rotation sequence. Corn and grain sorghum generally are high-residue crops. Planting a winter cover crop, such as rye or wheat or even a winter-hardy grass, is a good option when growing soybeans during the spring and summer.

Other ways to leave more residue include tilling only in the spring; reducing the number of passes with equipment; using equipment that minimizes disturbance of the soil; and using equipment that works under the residue, leaving maximum cover evenly distributed over the surface.

Intensive management is required for weed control when you minimize or eliminate plowing. Here we benefit from precision chemical control.

We have come a long way in conservation tillage technology. The machine industry is responding with a lot of attachments and a lot of retrofit

(Richards is Chief of the Soil Conservation Service, U.S. Department of Agriculture.)

Crop residue management aids in protecting soil, producing crops, and improving water quality. This productive no-till farm is in Ohio.

Gene Alexander photo. Soil Conservation Service.

equipment that can convert a planter at reasonably low cost. So farmers have lots of options in making investment decisions concerning crop residue management.

We have a whole new generation of herbicides that allow us to be much more precise and sparing in our applications. The "post-emergence" herbicides are a boon to conservation tillage farmers in that we can apply them after the weeds have sprouted—instead of before planting—so we know how much is needed and where. This is a real breakthrough.

As a corn farmer in Ohio, I had a real problem with a weed called Johnson grass. But just in the last year or two, my sons, who have taken over the family farm, have been controlling Johnson grass quite well with the new herbicides. And we are finding that we just do not need the quantities of chemical we used to need. The new chemistry has opened up whole new areas to conservation tillage.

We have a lot of help from technology, and we have dispelled a lot of the myths about herbicide use, environmental sensitivity, productivity, profitability, and flexibility.

Management is the key. For the farmer, there is less room for error—less opportunity to remedy mistakes with a plow—but the other side of the coin is that conservation tillage rewards management. Early on, I learned the competitive advantage that comes from investing primarily in management and brain power instead of labor and horsepower.

Back in the 1950s and 1960s, when we first started experimenting with conservation tillage, we were looking for ways to cut trips across the field in

Continued on page 46

Some Other Options

On the Farm

There are many different soil-conserving agricultural methods that also act to reduce nonpoint-source pollution. Intelligent use of these methods—either a single one or a combination of several—is in the financial best interest of the farmer who wants both to keep his soil rich and fertile for coming generations and to protect water quality.

Conservation Cover: Establishes and maintains a perennial vegetative cover to protect soil and water on land retired from agricultural production. Conservation cover reduces erosion and can help improve water quality and create or enhance wildlife habitat.

Crop Rotation: Growing different crops in recurring succession on the same land. For example, on a steep slope currently planted in corn or soybeans, a farmer might choose alternately to grow small grains and hay in later plantings and then rotate back to corn or soybeans.

Contour Farming: The practice of preparing land, planting crops, and cultivating them on the contour. Each crop row, by serving as a small dam to hold water on a slope, cuts soil losses. Some contour systems use buffer strips—wide rows of grass between tilled contour rows; others use contour plantings of trees.

Contour Stripcropping: Growing crops in a systematic arrangement of strips and bands on the contour to reduce water erosion. The crops are arranged so that a strip of grass or a

close-growing crop is alternated with a strip of clean-tilled crop or fallow.

Terraces: An earthen embankment, channel, or combination ridge and channel constructed across the slope breaks long slopes into a series of shorter ones. On shorter slopes, water doesn't build up as much speed and has less power to tear away soil particles. Terraces catch water at intervals down the slope to temporarily store it before delivering it through underground tile or a grassed waterway to the bottom of the slope.

Diversion: A channel constructed across a field slope with a supporting ridge on the lower side diverts excess water from one area for use or safe disposal in other areas.

Grade Stabilization Structure: A structure used to stabilize the grade and control erosion in natural or artificial channels so as to prevent formation of gullies.

Filter Strips: Bands of vegetation along streams or other bodies of water filter sediment and other pollutants from runoff before it enters the water body. Grass and, in some cases, trees may well be the last line of defense against erosion and nonpoint pollution.

"Windbreaks": Rows of trees and more random tree and shrub plantings all help to trap sediment from farm fields.

Grassed Waterway: A natural or constructed channel that is graded or shaped to required dimensions and established in suitable vegetation for the stable conveyance of runoff. If waterways are shaped into a parabolic form and seeded to provide a grass cover, the grass will lay down like a carpet as water flows over it. The soil is undisturbed, and cleaner water is delivered to streams, lakes, and reservoirs.

Field Border: A strip of perennial grass, legumes, or a mix of the two established at the edge of a field, like the frame around a picture. It retards soil erosion from the field and both slows and filters polluted runoff.

In the City

Controlling nonpoint pollution in urban areas is challenging. Here are several things that you can encourage your community to do:

- Protect open space adjacent to shorelines: The natural vegetation serves as a filter to reduce pollution entering surface waters.
- Establish used oil and household hazardous waste collection programs.
- Identify areas which are eroding or prone to erosion and plant vegetation to stabilize the soil.
- Use and promote walkways and parking lots designed with pervious (not impervious) surfaces.
- Collect leaves and yard trimmings frequently enough to prevent them from washing into stormdrains.
- Increase the frequency of street sweeping in areas where high levels of pollutants accumulate.
- Purchase vacuum street sweepers when obtaining new equipment.
- Establish a tree protection program.

—Jack Lewis

Steve Delaney photo.

Runoff from city streets and parking lots carries oil and other pollutants into storm sewers.

order to save fuel and labor. But we quickly realized the importance of surface mulch for moisture retention and consistent yields and for erosion and water quality protection.

My Corn Belt experience with conservation tillage may differ from farmers' experience elsewhere. We have different crops, soils, and climate. However, the basic principles work almost everywhere, including in cotton country.

Early on, I learned the competitive advantage that comes from investing in management and brain power . . . .

It is important to understand that conservation tillage is not just a change in field practices. It is a change in farming tradition and culture. Farmers like to plow; it is part of our heritage. But now, we are making the more profitable, more environmentally enhancing practice of conservation tillage part of our culture and part of the heritage we pass on to the next generation. I am proud that American farmers are turning to this technology in increasing numbers. It represents a big decision for that 2 percent of our population who make their living growing food for the other 98 percent and much of the rest of the world, all the while coping with nature, the market, and public sentiment.

Spreading this technology is one of my highest priorities. You might say it is one of the highest priorities for American agriculture because of the challenge to get conservation tillage in the hands of producers subject to conservation compliance requirements of the 1985 and 1990 farm laws. These laws tie commodity crop payments and other USDA program benefits to erosion control requirements on highly erodible land.

Conservation compliance is an enormous task that involves roughly half the farms in this country. It is a task that will double conservation tillage over the next two and one-half years. Right now, we have 73 million acres of conservation tillage. We expect to reach 150 million acres by 1995, the statutory deadline for implementing conservation compliance plans. Those are the estimates if you look only at crop residue management defined as "conservation tillage." By that I mean crop residue management practices that leave at least 30 percent residue cover on the surface. Many plans call for other specified levels of residue cover.

Cooperation between private industry, the university and extension community, and government in providing this on-farm technology is unprecedented. The equipment and chemical industries are beginning to see great need and great opportunity for the technology. To come, are machines that will help us minimize compaction of soil between crop rows, even more precise spraying technology, and smarter computer-driven technology overall. We are looking forward to more conservation tillage attachments for our farm machinery and flexibility so farmers can convert present equipment. Ultimately, I want to see a completely engineered "system" for crop residue management.

The systems approach to residue management and to all of our conservation activities is essential for total resource management. By "total resource management," I simply mean finding the optimum system of practices that is good for the soil, water, air, plants, and animals and for the producer's profit margin. It means doing our best to fit together all the pieces of the economic and environmental "puzzle."

Let me assure you that the risk of agricultural nonpoint-source pollution can be—and is being—significantly reduced by more prudent application of nutrients and pesticides and by good overall land and water management.

We have found in the agricultural community that most soil erosion problems and other environmental problems are very manageable. Even if the solution is not conservation tillage, other practices such as farming on the contour, using cover crops, or stripcropping—perhaps along with conservation tillage—are solutions at our fingertips.

I believe, however, that conservation tillage will be a key technology for environmentally and economically sound farm management, whatever the issue at hand. And I will do everything I can to help industry, government, and the farm community get this technology on the ground. □

Nutrient Trading—in the Wings

The Phosphorus Club recommended the Dillon Bubble.

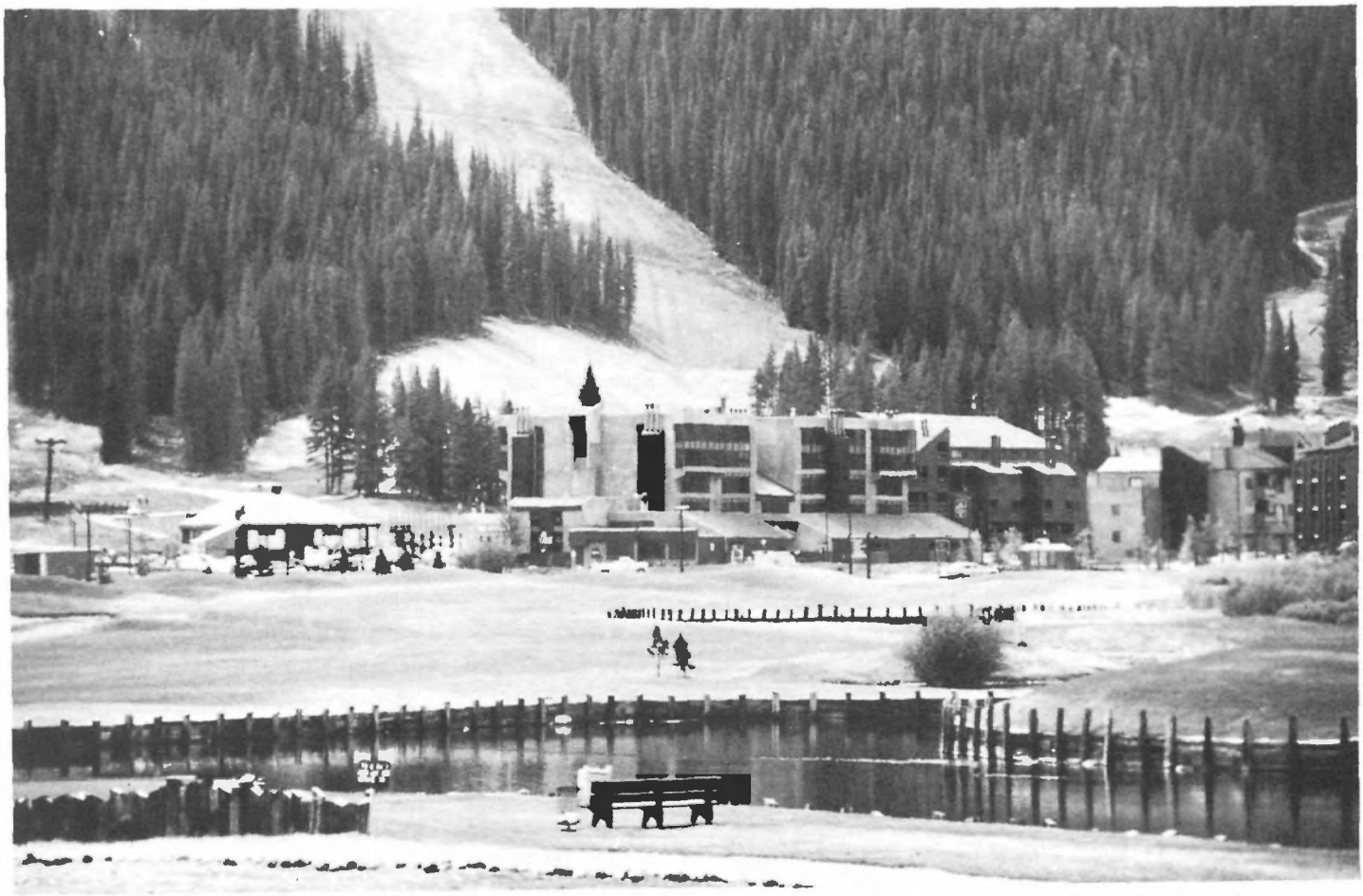
by Bruce Zander

(Zander is an Environmental Engineer in the Water Management Division of EPA's Region 8 Office in Denver, Colorado.)

As you approach the Continental Divide on Interstate 70 from Denver, an array of majestic mountain peaks greets you. These extraordinary land forms host the origins of several water sources which feed streams and rivers bound for both the Pacific and Atlantic Oceans.

As you begin the descent into Summit County, Colorado, you catch a glimpse of a mass of water nestled in the steep valley below. This reservoir, known as Lake Dillon, is a focal point for recreational activities. It has also been the focal point of an innovative water quality program for the basinwide management of phosphorus, which is one of the leading threats to Lake Dillon's water quality. Phosphorus is a common nutrient that comes from various sources including fertilizers, some detergents, and septic tanks.

Although Lake Dillon is situated in a secluded part of the Rocky Mountains, it is threatened by water quality problems shared by many other lakes and reservoirs across the country. Like other water bodies, Lake Dillon has been subject to excessive loadings of



Bruce Zander photo.

Golf and ski resort at Lake Dillon. A conflict arose between those who wanted more development and those who worried about further lake degradation.

The pristine quality of Lake Dillon had always been part of its attraction. The "Dillon Bubble" strategy preserves the status quo by dealing with both point and nonpoint sources of pollution.

nutrients, particularly phosphorus, which can result in unwanted algae blooms and loss of water clarity.

In the early 1980s, as Summit County grew at a tremendous rate, people became aware of declining water quality in Lake Dillon. The Colorado Water Quality Control Commission maintained a strong control over the wastewater treatment facilities that discharged into the Lake. As is often the case, the point sources of pollution were required to carry much of the responsibility for cleanup by providing advanced levels of treatment. It was documented, however, that the vast majority of phosphorus coming into Lake Dillon originated from nonpoint sources within the basin. About one half of the nonpoint-source phosphorus came from activities including runoff from parking lots, golf courses, construction sites, and seepage from septic tanks.

A conflict emerged between those interests that wanted to continue expanding recreational use and land development in the Dillon basin and those that wanted to halt any further degradation of the lake. Along with expanded growth in the basin, increased nonpoint sources could be expected. The issue became particularly difficult since the pristine quality of Lake Dillon had always been a key attraction which brought people into the basin.

Summit County was already the center of a tremendous and rapidly growing ski industry. Also, during the summer, more people were coming to the basin for activities such as sailboating and fishing. Meanwhile, the Denver metropolitan area was relying more and more on Lake Dillon as a source of drinking water (transported to Denver via tunnels through the mountains).

The problem came to a head when the towns and special districts had to consider adding expensive state-of-the-art technologies to their wastewater treatment facilities and local authorities had to consider moratoriums on new development. The Northwest Colorado Council of Governments rose to the challenge and organized a committee of unprecedented membership: Local representatives from the county, towns, special districts, ski areas, and mining interests made up the group as well as representatives from the state, EPA, and the Denver Water Board. The emerging problem at Lake Dillon served to unite these entities under one purpose. Self-named "the Phosphorus Club," this group proved to be intensely committed to finding a solution. They met every week for an extended period of time, evaluating technical and administrative innovations for solving the problem.

Meanwhile, the Denver metropolitan area was relying more and more on Lake Dillon as a source of drinking water . . . .

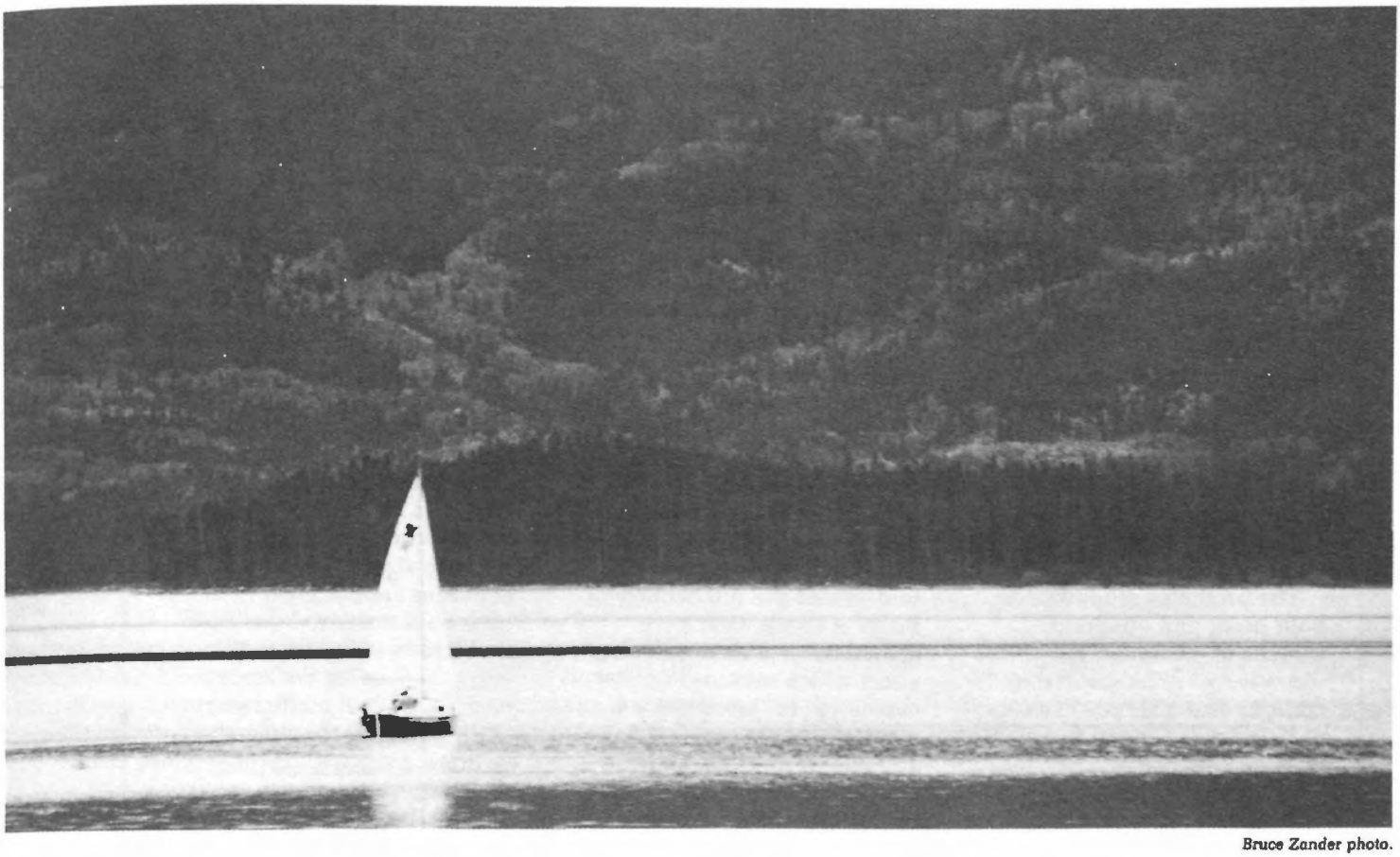
The first challenge of the Phosphorus Club was to re-evaluate what the acceptable level of quality should be for Lake Dillon. As a minimum, water quality targets needed to be set to protect all the diverse uses of the reservoir. It was especially difficult to establish standards to protect the lake from algal blooms and loss of lake clarity, given the subjective aspects involved.

Ultimately, the Phosphorus Club addressed the issue of water quality standards by recommending the status quo: No further increase in phosphorus loadings should be allowed. Initially, this goal of no further water quality degradation in Lake Dillon seemed strictly allied with the intent of curtailing further development in the basin. However, the Phosphorus Club came up with an innovative strategy designed to allow growth in the basin while at the same time maintaining—or even improving—the water quality of Lake Dillon. This approach, first dubbed the "Dillon Bubble," was accepted by the state and EPA as a viable method for managing phosphorus in the basin.

The so-called Dillon Bubble represented a total watershed approach towards phosphorus control. Instead of managing pollutant sources in a piecemeal fashion, with the regulatory agencies addressing point sources and local authorities addressing nonpoint sources, all sources were managed under one process. Moreover, the successes in curbing nonpoint sources in the basin could provide relief to the point-source facilities, enabling them to accommodate growth in the county. One big advantage of broadening pollution control to include nonpoint-source as well as point-source treatment is the potential cost savings. Many nonpoint source controls are low-tech, simple approaches such as detention ponds and grass filter strips.

The Lake Dillon strategy included a plan for "trading" pollution discharges between nonpoint sources and point sources that called for the removal of 2 pounds of nonpoint-source phosphorus for every 1 pound of phosphorus credit awarded a point-source facility. This 2:1 trading ratio was established to account for any increase in nonpoint-source loading due to growth and to allow an environmental safety margin.

An example will help illustrate how the trading system works. The Town of Frisco on the western shore of Lake Dillon has made modifications to its urban stormwater collection system to achieve phosphorus removal. By redesigning the system with



Bruce Zander photo.

phosphorus removal in mind, the town created a network which acts like a series of underground detention ponds. Once the removal effectiveness of these modifications is documented, Frisco can apply for a credit of 1 pound of phosphorus for its treatment facility for every 2 pounds of stormwater phosphorus removed by the upgraded stormwater system.

The Colorado Water Quality Control Commission has incorporated the Dillon Bubble approach into state regulation. The regulation specifies the phosphorus loading limits for Lake Dillon and allocates limits to all sources, allowing for phosphorus trading.

As part of the Dillon trading approach, local governments were required to demonstrate a commitment to cleaning up nonpoint sources by enacting land use ordinances which address items such as erosion controls, septic tank maintenance requirements, and standards for how close construction could approach streams. In addition, the local entities made a strong pledge to maintaining water quality by funding a field sampling program to monitor the condition of Lake Dillon.

The Dillon approach is potentially applicable to other situations in the country. The benefits of this approach in the Dillon basin have included:

- Allowing population and recreational growth to coincide with a policy of antidegradation of water quality
- Linking the control of nonpoint source and point sources under a watershed approach
- Allowing "trading" between the various sources of phosphorus, thus minimizing costs to the community while protecting or enhancing the water resource
- Providing incentives to control nonpoint sources while tying those controls to enforceable point source programs.

Since the inception of the Dillon Bubble concept, the municipal treatment facilities have made great progress in improving their phosphorus treatment. Because of this improvement and a slowed rate of population growth, the original nature of the trading program has also changed. Point source/nonpoint source trades continue to be proposed, but there is also discussion of nonpoint source/nonpoint source trading.

Although future nonpoint-source phosphorus will be controlled through local ordinances, new development will likely contribute some phosphorus. To counter this increase, "old" nonpoint-source phosphorus could be treated and eliminated to mitigate newly created sources of phosphorus. Again, such trading would be designed to prevent further degradation of the reservoir and possibly improve water quality.

The water quality concerns of the basin still have the attention of the local governments. The Phosphorus Club has evolved into the Summit Water Quality Committee, which considers a range of issues. The committee believes that Lake Dillon has a strong chance of maintaining its good water quality now that there is a concerted, integrated effort to control both point and nonpoint sources of pollution. □

Innovations at Boulder Creek

Boulder Creek quickly changes character as it leaves the shelter of the canyons along Colorado's front range. It loses speed and power as it becomes an urban stream, making its way through the city of Boulder. It widens as it flows eventually to rural, flatland areas east of the City. Here, in this lower section, Boulder Creek has difficulty supporting a healthy aquatic life community.

The problems are linked to both point and nonpoint sources of pollution, but degraded physical habitat of the creek is also a factor. The City of Boulder is solving these problems in a nontraditional way by taking a holistic, watershed approach that addresses all causes of environmental stress.

At first, on looking at the water quality problems of Boulder Creek from a traditional perspective, the solution appeared to be straightforward. Reports showed exceedences of the state water quality standards below the city's wastewater treatment facility. In particular, discharges from the facility were causing toxic levels of ammonia in the creek. The obvious solution was to invest in changes at the facility to improve its effluent quality. According to initial estimates, the plant expansion and upgrade would cost over $20 million.

Close scrutiny of the creek, however, showed that this investment would not necessarily revive the creek to a healthy state. True, the principal point source of pollutants into Boulder Creek was the treatment facility, but stream studies indicated many other complications to restoring the creek. Among these were stormwater runoff from urban and rural areas, livestock grazing, gravel mining, irrigation return flow, and streambank erosion.

In an effort to better understand the full ecology of Boulder Creek, the city embarked on a data-gathering effort which included further evaluation of the stream's water quality, inspection of its fish and macroinvertebrate life, assessment of physical habitat characteristics, an inventory of land use practices in the watershed, and an accounting of all nonpoint sources of pollution. Resources from the city, the University of Colorado, and local consultants were supplemented with funds from the state and EPA to accomplish much of the work.

After consulting with stream biologists, the city recommended an approach that included full chemical, biological, and physical restoration of the creek below the wastewater treatment plant. In other words, the approach addressed the full ecology of Boulder Creek, rather than just water quality. The restoration activities included in this approach were diverseand ambitious: fencing the creek to control access by cattle and horses, stabilizing the creek with anchored logs to prevent erosion, planting willow and cottonwood trees to provide shading and riparian habitat, physically reshaping the creek back to its natural shape, building re-aeration structures such as rock clusters to promote higher dissolved oxygen levels in the water, and creating wetlands for the treatment of irrigation return flows.

These stream renovation activities are designed to bring back environmental qualities that had been lost over the years. Reshaping the stream back to original configurations and replanting the streambank riparian areas will foster habitat that is more conducive to aquatic life as well as wildlife. Additional benefits will include cooler stream temperatures and moderation of stream pH levels due to shading from the new streamside vegetation. These renovations will not only help improve water quality but also diminish the toxic effect associated with ammonia found in Boulder's wastewater discharge.

The community has responded in a very positive way to the city's restoration initiative. Local groups have contributed materials and labor as well as streamside easements to the city for this effort.

And the total cost of restoration? Estimates indicate that the expense will be far less than the cost of a traditional expansion and upgrade at the municipal treatment plant.

—*Bruce Zander*

Wisconsin's "Bad Actors" Program

The bad actors lost the manure wars.

by Ed Odgers

Since 1984, Wisconsin's programs to address nonpoint pollution have included regulatory or "bad actor" components in addition to voluntary cost-share initiatives. Though the two approaches are complimentary, they have historically been applied through independent programs. Right now, state legislators are considering expanded regulations to supplement traditionally voluntary programs.

Following an intensive cleanup of industrial and municipal point sources of pollution during the 1970s, nonpoint pollution now represents the gravest threat to Wisconsin's abundant ground and surface water resources. According to a recent assessment, 40 percent of Wisconsin's rivers and streams and 93 percent of its lakes are degraded by nonpoint pollution. More than 10 percent of the state's 700,000 private water supply wells are contaminated with nitrate leels exceeding state standards, and again the blame is placed on nonpoint sources.

Though urban stormwater runoff and construction site erosion are contributing sources, agriculture continues to be the major source of nonpoint pollution. Cropland erosion, manure runoff from feedlots, over-application of fertilizers, leaching of pesticides, and stream banks trampled by cattle are all examples of agricultural pollution sources.

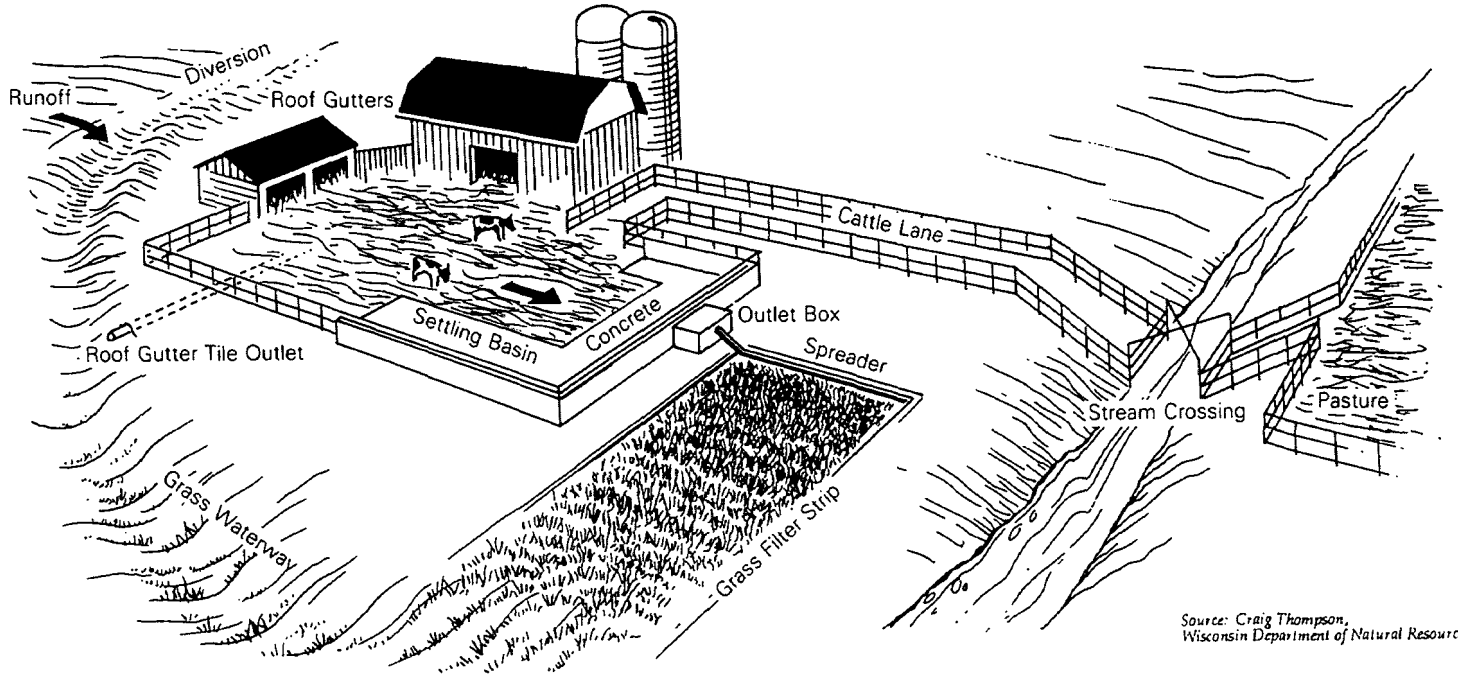
With 80,000 farms, 5.4 million head of cattle and hogs, and 12 million acres of cropland, agriculture is the dominant land use in Wisconsin and the state's largest industry. The large number of potential pollution sources places serious limitations and demands on the programs charged with the cleanup. The economic stress now shadowing agriculture deepens the challenge.

(Odgers is an agricultural engineer with the Wisconsin Department of Agriculture, Trade, and Consumer Protection.)

"Bad Actor" Regulations

Following a protracted legislative debate that came to be known as the "manure wars," the Wisconsin state legislature first established annual waste management regulations in 1984. These landmark regulations set up a two-tiered approach, separating large farms of more than 1,000 animal units from other livestock producers. As a result, about 40 large operations in Wisconsin are now required to meet state standards for runoff control, manure storage, and land application of manure through a permitting system. The remaining 70,000 livestock producers are subject to clean-up orders if a complaint is registered against them and subsequent

Typical Barnyard Runoff Management System



Source: Craig Thompson, Wisconsin Department of Natural Resources.

investigations determine there was a "significant discharge" of pollutants. Each year, approximately 200 citizens' complaints are made, resulting in about 40 clean-up orders or "Notices of Discharge."

The vast majority of these orders have been issued for manure runoff from feedlots to surface waters. Corrective measures for feedlot runoff problems may be as simple as diverting clean stormwater runoff around the barnyard and fencing off livestock to provide protective buffer zones along stream or lake shores. However, critical sites may require the installation of more costly structural practices for the containment and filtration of the manure-laden runoff.

Overflow and seepage from improperly constructed or mismanaged manure storage systems represent the next largest category of problems. Though less common, these problems can result in equally devastating damage to the surface water and an even greater threat to ground water.

Wisconsin state agencies and county conservation departments work in concert to create a cooperative environment for the resolution of these animal waste management problems. When cited, a farmer is allowed from 60 days to two years to make management changes or install corrective measures. During this time, fines are not imposed unless serious negligence is involved. Cost-share grants for up to 70 percent of the costs for corrective measures are provided in the approximately 20 cases a year that require capital improvements. Project grants average about $15,000 and usually are accompanied by technical assistance provided by county-based conservation technicians. This kind of assistance has been decisive in helping farmers comply with clean-up orders.

In 1988, another regulatory tool was enacted to address pollution from nonpoint sources other than animal waste, such as eroded sediment, pesticide and fertilizer runoff, and stream bank erosion. This more recent legislation was born of the state's frustration in attempting to halt one farmer's negligent tillage practices, which dumped thousands of tons of sediment into a popular lake, but it is not restricted to agricultural pollution sources. The resulting program is limited in scope; only about six enforcements are projected annually. Examples of recent enforcement actions have involved the severe erosion of a ski hill and sediment runoff from a golf course under construction.

Administrators of both these regulatory programs agree that the current number of clean-up orders is just the tip of the nonpoint pollution iceberg. The current system is limited by staff shortages and the need to rely on complaints by private citizens to target potential sources. Ultimately, a more comprehensive mechanism will be needed to effect a statewide cleanup.

Preventive Local Ordinances

Some Wisconsin counties are pursuing a preventive, regulatory approach to nonpoint pollution. Following state guidelines, 30 of the state's 72 counties have enacted manure storage facility ordinances primarily intended to protect ground water. Permits required for the installation of storage facilities ensure that these systems are designed and installed according to approved standards.

A model ordinance is also being developed by state agriculture department officials for streambank protection from uncontrolled livestock access. As with manure storage ordinances, counties will be encouraged to develop streambank protection ordinances tailored to their needs and administrative capabilities.

To complete the picture, municipalities have been encouraged to adopt construction site erosion ordinances and stormwater control plans in an effort to curb non-agricultural sources of nonpoint pollution.

Proposed Legislation

Wisconsin's flagship nonpoint program is its Priority Watershed Program, with an annual budget of $7 million and a project area encompassing 37 critical watersheds. Voluntary participation rates are 70 percent, yet many watershed projects have fallen short of their goals because key polluters have failed to participate.

Recognizing the slow progress and unfulfilled goals brought about by priority watershed "holdouts," the legislature is now considering modifications to this traditionally voluntary program that would initiate a regulatory mop-up if voluntary efforts fail to achieve project goals.

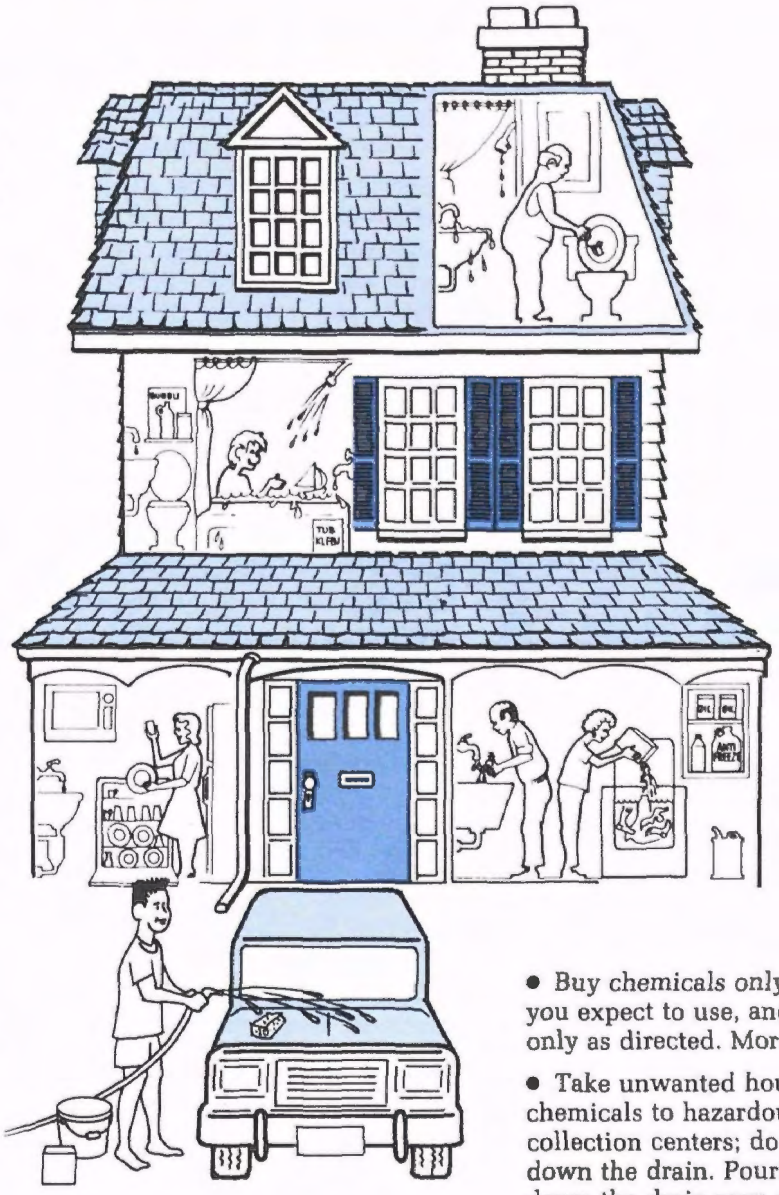
Proponents of legislation to incorporate "bad actor" provisions in the Priority Watershed Program maintain that regulations are necessary to protect the state's investment in these watersheds and to assure progress toward pollution reduction. Additionally, they argue that the threat of pending regulations will stimulate voluntary participation, and clean-up orders rarely will be needed.

Opponents argue that forcing participation in watershed projects would impose more stringent standards on farm operations in these watersheds than would be required outside the watershed boundaries. They maintain that increased and uniform application of current statewide regulations would be sufficient to bolster voluntary program participation.

In summary, Wisconsin's present approach relies on both voluntary and regulatory tools to address agricultural nonpoint pollution. This combination is generally considered one of the most progressive systems in the nation, yet more rapid progress is needed if the state hopes to protect and restore water quality. It now appears that regulations will see expanded use as the state searches for ways to accelerate the cleanup of nonpoint pollution. Success will depend on how well state programs capitalize on the complimentary effect that can be achieved with a balance of voluntary and regulatory tools. □

Dos and Don'ts around the Home

by Robert Goo



The importance of education in bringing nonpoint-source pollution under control is a recurring theme in this issue of *EPA Journal*. The reason for this is pragmatic: What you don't know can hurt the environment. When rain falls or snow melts, the seemingly negligible amounts of chemicals and other pollutants around your home and premises get picked up and carried via storm drains to surface waters. The ramifications include polluted drinking water, beach closings, and endangered wildlife.

So what can you do to help protect surface and ground waters from so-called nonpoint-source pollution? You can start at home. Begin by taking a close look at practices around your house that might be contributing to polluted runoff: You may need to make some changes. The following are some specific tips to act on—dos and don'ts, organized by categories, to help you become part of the solution rather than part of the problem of nonpoint-source pollution.

(Goo is an Environmental Protection Specialist in EPA's Nonpoint-Source Control Branch.)

Household Chemicals

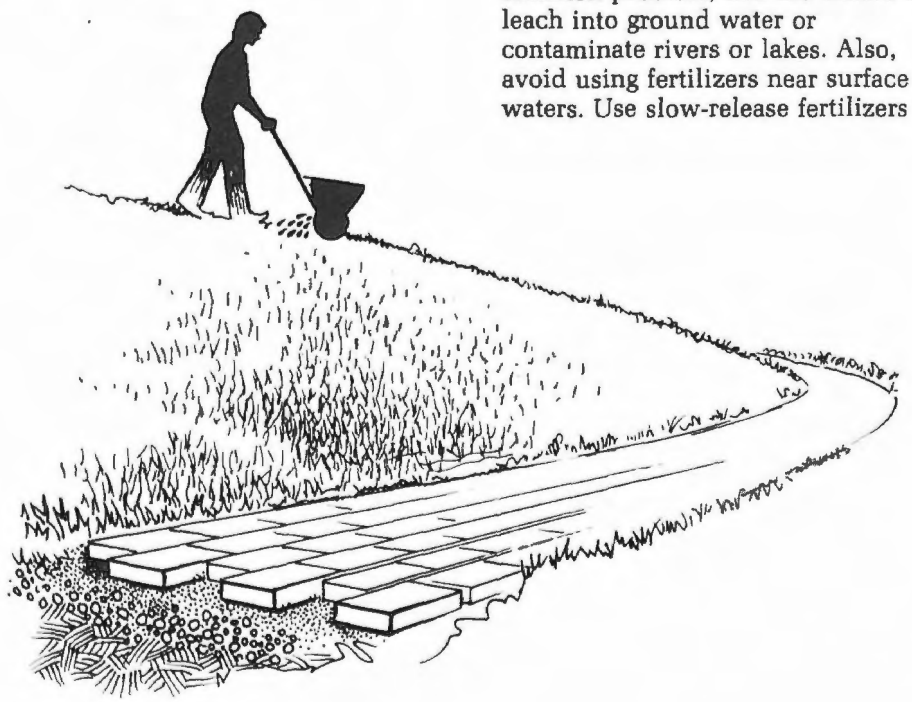
- Be aware that many chemicals commonly used around the home are toxic. Select less toxic alternatives. Use non-chemical substitutes wherever possible.

- Buy chemicals only in the amount you expect to use, and apply them only as directed. More is not better.
- Take unwanted household chemicals to hazardous waste collection centers; do not pour them down the drain. Pouring chemicals down the drain may disrupt your septic system or else contaminate treatment plant sludge.
- Never pour unwanted chemicals on the ground. Soil cannot purify most chemicals, and they may eventually contaminate runoff.
- Use low-phosphate or phosphate-free detergents.
- Use water-based products whenever possible.
- Leftover household pesticide? Do not indiscriminately spray pesticides, either indoors or outdoors, where a pest problem has not been identified. Dispose of excess pesticides at hazardous waste collection centers.

TAKING ACTION

Landscaping and gardening

- When landscaping your yard, select plants that have low requirements for water, fertilizers, and pesticides. Cultivate plants that discourage pests. Minimize grassed areas which require high maintenance.
- Preserve existing trees, and plant trees and shrubs to help prevent erosion and promote infiltration of water into the soil.
- Use landscaping techniques such as grass swales (low areas in the lawn) or porous walkways to increase infiltration and decrease runoff.



Other landscaping tips:

—Install wood decking or bricks or interlocking stones instead of impervious cement walkways.

—Install gravel trenches along driveways or patios to collect water and allow it to filter into the ground.

—Restore bare patches in your lawn as soon as possible to avoid erosion.

—Grade all areas away from your house at a slope of one percent or more.

- Leave lawn clippings on your lawn so that nutrients in the clippings are recycled and less yard waste goes to landfills.
- If you elect to use a professional lawn care service, select a company that employs trained technicians and follows practices designed to minimize the use of fertilizers and pesticides.
- Compost your yard trimmings. Compost is a valuable soil conditioner which gradually releases nutrients to your lawn and garden. (Using compost will also decrease the amount of fertilizer you need to apply.) In addition, compost retains moisture in the soil and thus helps you conserve water.
- Spread mulch on bare ground to help prevent erosion and runoff.
- Test your soil before applying fertilizers. Over-fertilization is a common problem, and the excess can leach into ground water or contaminate rivers or lakes. Also, avoid using fertilizers near surface waters. Use slow-release fertilizers on areas where the potential for water contamination is high, such as sandy soils, steep slopes, compacted soils, and verges of water bodies. Select the proper season to apply fertilizers: Incorrect timing may encourage weeds or stress grasses. Do not apply pesticides or fertilizers before or during rain due to the strong likelihood of runoff.
- Calibrate your applicator before applying pesticides or fertilizers. As equipment ages, annual adjustments may be needed.
- Keep storm gutters and drains clean of leaves and yard trimmings. (Decomposing vegetative matter leaches nutrients and can clog storm systems and result in flooding.)

Septic Systems

Improperly maintained septic systems can contaminate ground water and surface water with nutrients and pathogens. By following the recommendations below, you can help ensure that your system continues to function properly.

- Inspect your septic system annually.
- Pump out your septic system regularly. (Pumping out every three to five years is recommended for a three-bedroom house with a 1,000-gallon tank; smaller tanks should be pumped more often.)
- Do not use septic system additives. There is no scientific evidence that biological and chemical additives aid or accelerate decomposition in septic tanks; some additives may in fact be detrimental to the septic system or contaminate ground water.
- Do not divert stormdrains or basement pumps into septic systems.
- Avoid or reduce the use of your garbage disposal. (Garbage disposals contribute unnecessary solids to your septic system and can also increase the frequency your tank needs to be pumped.)
- *Don't use toilets as trash cans!* Excess solids may clog your drainfield and necessitate more frequent pumping.

Water Conservation

Homeowners can significantly reduce the volume of wastewater discharged to home septic systems and sewage treatment plants by conserving water. If you have a septic system, by decreasing your water usage, you can help prevent your system from overloading and contaminating ground water and surface water. (Seventy-five percent of drainfield failures are due to hydraulic overloading.)

- Use low-flow faucets, shower heads, reduced-flow toilet flushing equipment, and water saving appliances such as dish and clothes washers. (See table on water savings possible with conservation devices.)
- Repair leaking faucets, toilets, and pumps.
- Use dishwashers and clothes washers only when fully loaded.
- Take short showers instead of baths and avoid letting faucets run unnecessarily.
- Wash your car only when necessary; use a bucket to save water. Alternatively, go to a commercial carwash that uses water efficiently and disposes of runoff properly.
- Do not over-water your lawn or garden. Over-watering may increase leaching of fertilizers to ground water.
- When your lawn or garden needs watering, use slow-watering techniques such as trickle irrigation or soaker hoses. (Such devices reduce runoff and are 20-percent more effective than sprinklers.)

Other Areas Where You Can Make a Difference

- Clean up after your pets. Pet waste contains nutrients and pathogens that can contaminate surface water.
- Drive only when necessary. Driving less reduces the amount of pollution your automobile generates. Automobiles emit tremendous amounts of airborne pollutants, which increase acid rain; they also deposit toxic metals and petroleum byproducts into the environment. Regular tuneups and inspections can help keep automotive waste and byproducts from contaminating runoff. Clean up any spilled automobile fluids.
- Recycle used oil and antifreeze by taking them to service stations and other recycling centers. Never put used oil or other chemicals down stormdrains or in drainage ditches. (One quart of oil can contaminate up to two million gallons of drinking water!)

Community Action

- Participate in clean-up activities in your neighborhood.
- Write or call your elected representatives to inform them about your concerns and encourage legislation to protect water resources.
- Get involved in local planning and zoning decisions and encourage your local officials to develop erosion and sediment control ordinances.
- Promote environmental education. Help educate people in your community about ways in which they can help protect water quality. Get your community groups involved.

For more information on how you can help, contact your

State Water Quality Coordinator or Local Cooperative Extension Officer. □

Editor's note: A useful booklet entitled Handle with Care: Your Guide to Preventing Water Pollution *(Terrene Institute, 1991; v + 36 pages) is available from the Terrene Institute; 1000 Connecticut Avenue, NW, Suite 802; Washington, DC 20036; phone: (202) 833-8317; FAX: (202) 466-8554. Copies are $9.95 each; quantity discounts available on request. (A catalogue of other Terrene Institute publications is available free of charge.)*

Examples of Savings with Water-Saving Fixtures/Devices

Conventional	Gallons Used*	Water Savers**	Gallons Used
Toilet	4-6	Air-assisted toilet	0.5
Shower head	4-6	Low-flow shower head	2.1
Faucets		Faucet-flow control aerators	
Bathroom	4-6	Bathroom	0.5
Kitchen	4-6	Kitchen	1.5
Top-load clothes washer	40-55	Front-load clothes washer	22-33

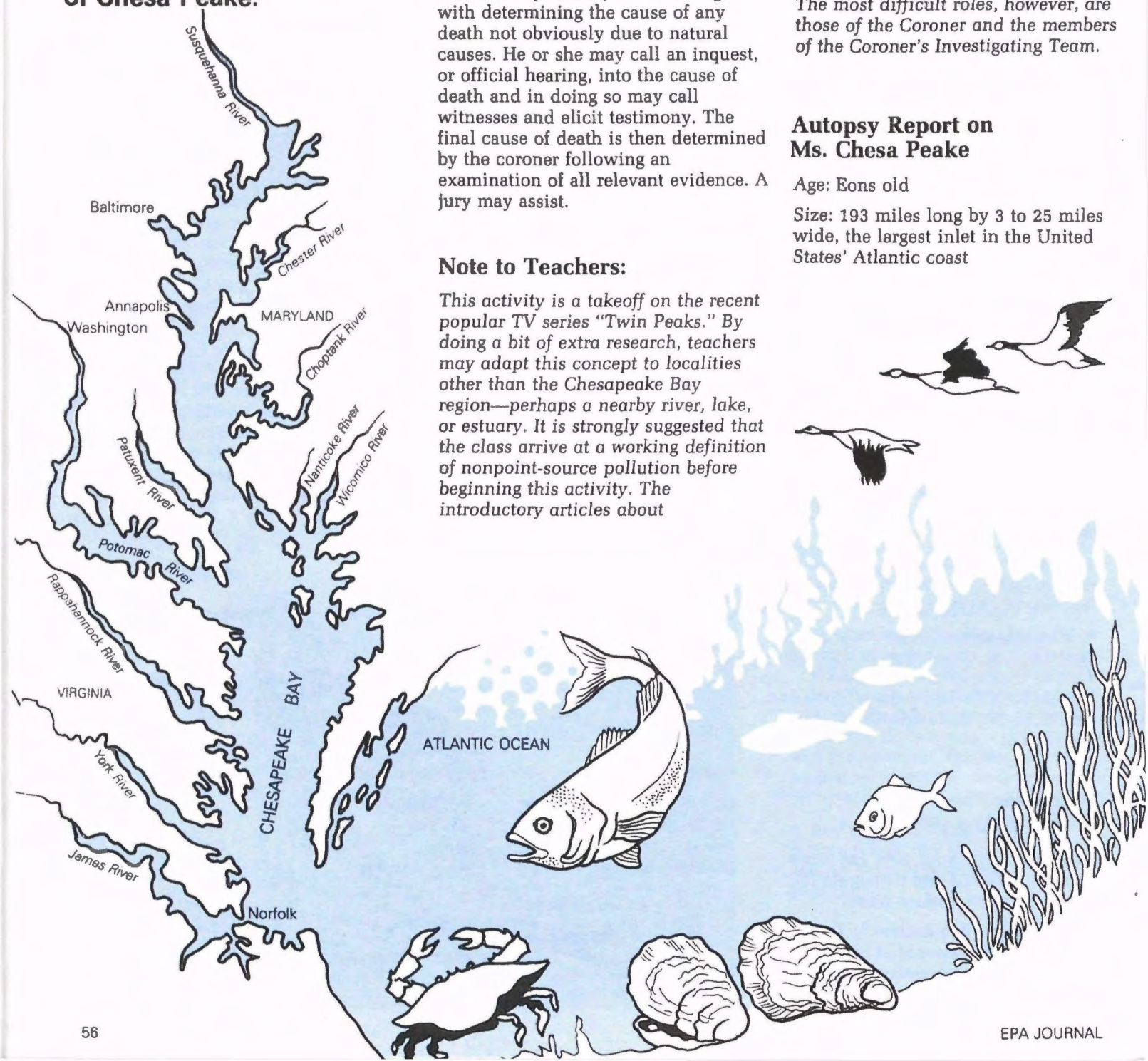
*Toilets: gallons per flush.
Shower heads, faucets: gallons per minute.
Clothes washer: gallons per use

**Installation of all these devices should reduce water use by about 35%.

Source: Pennsylvania State Special Circular No. 302

A Lesson Plan on NPS Pollution

Investigating the demise of Chesa Peake.



Staging a Coroner's Inquest

This is an investigation into the reported "death" of Chesa Peake. Key to the inquest will be the autopsy report, which consists of a brief description of the condition of the water "body" together with a map of the Chesapeake Bay Drainage Basin.

A Coroner is a public officer (usually a medical specialist) who is charged with determining the cause of any death not obviously due to natural causes. He or she may call an inquest, or official hearing, into the cause of death and in doing so may call witnesses and elicit testimony. The final cause of death is then determined by the coroner following an examination of all relevant evidence. A jury may assist.

Note to Teachers:

This activity is a takeoff on the recent popular TV series "Twin Peaks." By doing a bit of extra research, teachers may adapt this concept to localities other than the Chesapeake Bay region—perhaps a nearby river, lake, or estuary. It is strongly suggested that the class arrive at a working definition of nonpoint-source pollution before beginning this activity. The introductory articles about nonpoint-source pollution in this issue of EPA Journal can provide grist for class discussion.

For the purpose of staging an inquest, assign a role to each student in your class—or, better yet, have them pick their own roles if they have strong preferences. Jury selection is strongly recommended if your class is large enough; still other students can be witnesses or concerned citizen spectators (possibly demonstrators?). The most difficult roles, however, are those of the Coroner and the members of the Coroner's Investigating Team.

Autopsy Report on Ms. Chesa Peake

Age: Eons old

Size: 193 miles long by 3 to 25 miles wide, the largest inlet in the United States' Atlantic coast

Close Relatives: Emptying basin of the Susquehanna, James,York, Rappahannock, Potomac, Patuxent, Wicomico, Nanticoke, Choptank, and Chester Rivers; major port, Baltimore

Offspring: Home to alewives, croakers, shad, oyster, and crab, as well as huge quantities of duck, heron, and other wildlife—all in diminishing supply since the 1970s

Personal History: After being pristine and incredibly abundant for centuries, bountiful home to Indians, commercial fisheries and recreational users, Ms. Peake took a turn for the worse in the 1970s when residential and industrial development near her shorelines led to significant pollution of her bay by sewage, industrial wastes, and nonpoint-source sediments from nearby farms and urban facilities. Recreational use and commercial fishery yields continued to decline in the 1980s until major environmental initiatives were undertaken to turn the tide.

The question to be considered at the inquest is, *Who (almost) killed Chesa Peake?* Was it treated and untreated sewage? Was it industrial point sources? Or was it nonpoint-source pollution? Or some combination of the three?

Runoff from parking lots is just one of many sources of nonpoint pollution. Take a look around a parking lot near your school or home. What pollutants might be washed away with the next rainstorm or snowmelt?

Dramatis Personae

The following list of characters can be adapted as appropriate to fit class size.

The Coroner: The leader of the inquest, Mr. or Ms. Coroner

The Investigating Team: Three or four students with names like Sherlock Holmes, Hercule Poirot, Jane Marple, and Nero Wolfe

Albert Auto: Automobile Owner

Gus Gas: Filling Station Operator

Barney Boatowner: Pleasure Boat Owner

Wally Waterman: Commercial Fisherman

Mary Mayor: Town Mayor

Brenda Bureaucrat: Federal Government Official

Boyce Bureaucrat: State Government Official

Belinda Bureaucrat: Local Government Official

Frieda Farmer: Livestock Owner

Sally Soybean: Crop Farmer

Buddy Builder: Housing Developer

Martina Marina: Boat Marina Owner

Teddy Timberman: Commercial Logger

Freddy Freight: Owner, Commercial Tanker

Malcolm Miner: Strip Miner

Lydia Lawnservice: Owner of Lawn-Service Business

Barbara Bayside: Another Bay Area Homeowner

Veronica and Virgil Voter: Concerned Citizens

Getting Started

The Coroner presides at the inquest. Witnesses should be sworn in when called to the witness stand for questioning. The Coroner should begin the inquest by reading the autopsy report stating the facts known to be related to the death of the victim.

Each student should be encouraged to live his or her role. Costumes would help. It is especially important, however, for each student to research his or her own role by carefully reading the appropriate article in *EPA Journal* (the teacher may need to help determine which article is appropriate for which particular role). Students should be prepared to answer questions related to two major areas:

- How might your character's actions have contributed to the death of Chesa Peake?
- What action or actions can your character take to change those behaviors?

The Coroner and the members of the Investigating Team need to research the appropriate articles for *all* characters so that they can subpoena and question everyone intelligently. (The teacher may need to help them divide up this work.) A list of questions should be prepared for each witness ahead of time.

Continued on next page

Additional Activities

Classes with additional time and interest may wish to try some of these related activities:

- Organize a field trip to a nearby stream, lake, or bay known to be suffering from nonpoint source pollution problems. Have students take notes on their observations and make reports afterward.
- Monitor the quality of your local body of water by using water and soil testing kits. Compare your results with those of your local water board or commission.
- What is the biggest nonpoint source pollution problem in your locality? Survey neighbors and public officials to find out their views and compile a top 10 (or a top 5) list. Consider how these problems might be addressed by your local governing body.Invite one of your local officials to your class to discuss your findings.
- Create several audio or videotaped Public Service Announcements (PSAs) addressing the problem of nonpoint source pollution in your locality. Ask local radio or TV stations to use these in an effort to create public awareness.
- Create entries in the diary of a waterman or other figure whose life has been impacted by the adverse changes in a local body of water.
- Write a speech to be delivered before your local governing body or your school board. In this speech, you should discuss the problems of nonpoint-source pollution in your community and suggest possible actions to be taken.
- Adopt-a-stream in your locality by contacting your local water management officials. Choose an area of a stream, lake, river, or bay, and begin a regular clean-up program. Find out how it becomes polluted, and try to come up with ways to prevent its future contamination.
- Start a program in your area to mark storm drains with flags or signs so as to draw community attention to their location and their environmental significance. This is an important public awareness project. It helps educate the public and acts as a deterrent to direct dumping of pollutants. *Warning*: Remove markings before they become unsightly eyesores.

Sources

"Chesapeake Bay," *Encyclopedia Britannica*.

EPA Journal, November/December 1991. (Obtain from the EPA Public Information Center: (202) 260-2080.)

"Baybook: A Guide to Reducing Water Pollution at Home," prepared by a consortium of organizations and funded by EPA. (Obtain by writing the Citizens' Program for the Chesapeake Bay, Inc., Suite 100, 6600 York Road, Baltimore, MD 21212; phone: (301) 377-6270. First copy is free; additional copies at $1 each. It's okay to xerox the "Baybook" for students.)

"Chesapeake Bay Restoration: Innovations at the Local Level," prepared by the Chesapeake Bay Local Government Advisory Committee. (Call (202) 962-3360 or write Eric Jenkins, 779 N. Capitol Street NE, Suite 300, Washington, DC 20002, for free copies.)

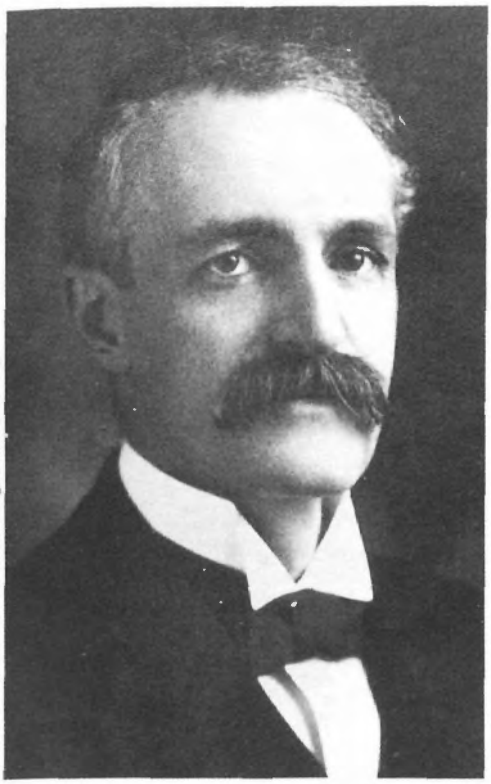
"Nonpoint Source Pollution: Land Use and Water Quality," prepared by the Washington County Project with funds from EPA, Region 5. (For information about obtaining copies, phone Louise Ollarvia, EPA Region 5 Publications Specialist, at (312) 353-6198.)

"Pointless Pollution," a videotape narrated by Walter Cronkite and produced by the Lower Colorado River Authority. (Contact Bullfrog Productions, 1 (800) 543-FROG, for copies at $250 apiece.) □

Acknowledgement: Teachers Sue Rafferty, Anne Alexiou, and Fran Earle of Yorktown High School in Arlington, Virginia, worked with EPA Journal staff to prepare this feature.

Glimpses of Pinchot

by Jack Lewis



Forest Service Collection, National Agricultural Library.

Gifford Pinchot

He was considered a kind of walking, talking Johnny Appleseed, an intelligent, sparing Paul Bunyan, a noble forester who almost singlehandedly popularized the concept of conservation in the United States. To be sure, he built on firm groundwork laid by Thoreau, Muir, and other environmental pioneers, and he was greatly helped in every way by his friend, Theodore Roosevelt. By the time Gifford Pinchot died in 1946, he had lived to see his ideals widely embraced by the public and thoroughly institutionalized at both the federal and state levels of government. Some sources even credit Pinchot with coining the term "conservation" itself. He always had a way with words: He dubbed unsightly signs and billboards "highway halitosis."

According to novelist Owen Wister, Pinchot's eyes "look as if they gaze upon a Cause," as indeed they did, and those eyes were an uncommonly handsome sky-blue. They had competition in the form of an overgrown handlebar moustache, which drooped down over a mouth never known to touch liquor or tobacco. Always athletic, Pinchot stood a lean and muscular six foot one, hardly surprising in a man who once played six straight sets of tennis with Teddy Roosevelt, then ran a footrace with the President to the White House. (History does not record who won.)

Pinchot began the Forest Service with a staff of 10 people and a budget of $4,133, at a time when the entire federal bureaucracy totaled 17,000 people (it now employs over three million); 17,000 is the current population of EPA alone.

Pinchot and others of the National Forest Commission took an inspection tour of western forests in 1896. Famed naturalist, John Muir, traveled with them.

"At long last I met the Commission—Sargent, Brewer, Hague, and Abbot—at Belton, Montana, on July 16. To my great delight, John Muir was with them. In his late fifties, tall, thin, cordial, and a most fascinating talker, I took to him at once. It amazed me to learn that he never carried even a fishhook with him on his solitary explorations. He said fishing wasted too much time . . .

"From Oregon I headed for the California Sierras, where Colonel S. B. M. Young, from his camp at Wawona, sent me with a pack outfit to the Tuolumne Meadows, from which enchanting spot I made my solitary way to the top of Mt. Dana and saw the glorious chain of the Sierras tumbling like granite waves from south to north, and wearing about its middle a girdle of green trees. There are some sights you never forget.

"From the Meadows my way led down Bloody Canyon and by wagon past the alkali waters of Mono Lake. In one day the mules I drove behind made seventy miles. Then to the little town of Independence, where I hired a horse to take me and my pack up the long grade to and through the Keersarge Pass, and a man on another horse to lead him home. (Years afterward a pass and a peak were named for me just here or hereabouts.) At Bullfrog Lake I made my first camp, and the next day, pack on back, started down King's River . . .

"At Millville, outside the Sierra Forest Reserve, I ran into the gigantic and gigantically wasteful lumbering of the great Sequoias, many of whose trunks were so huge they had to be blown apart before they could be handled. I resented then, and I still resent, the practice of making vine stakes hardly bigger than walking sticks out of these greatest of living things.

"All in all, it was a journey beyond my power to describe—from bare rocks

(Lewis is an assistant editor of EPA Journal.)

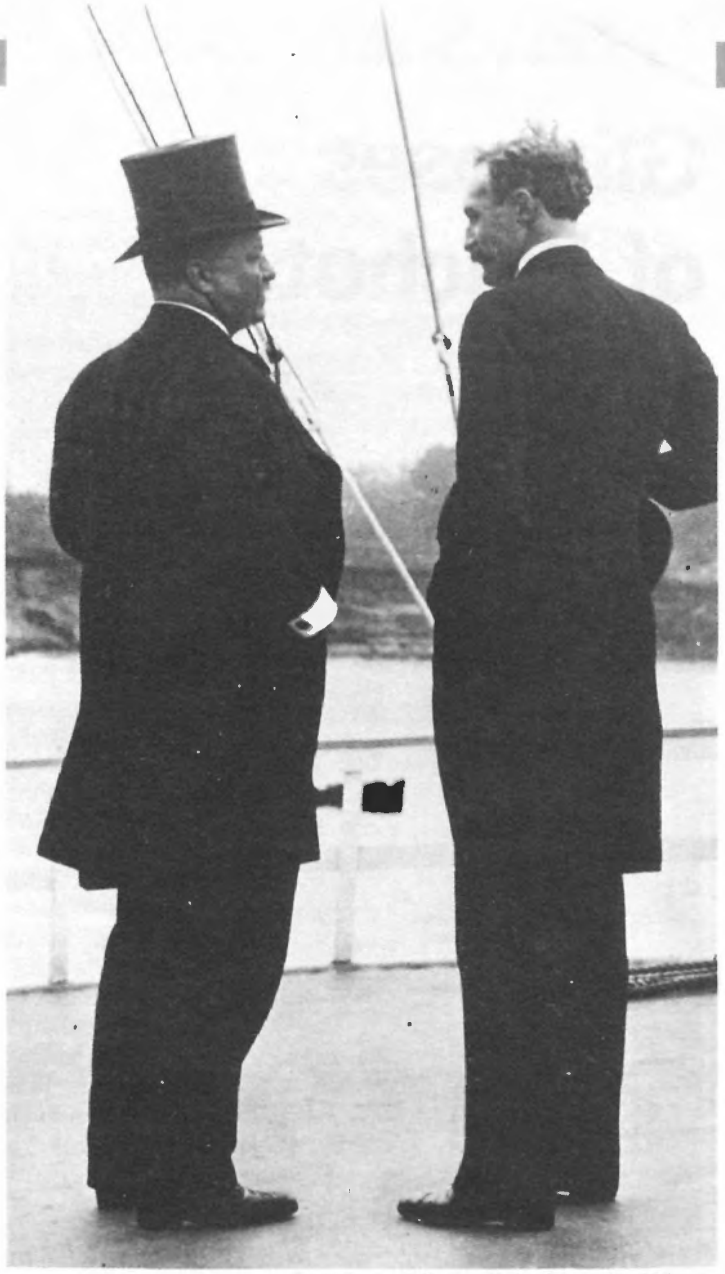
and snowdrifts and glacial lakes and wind-twisted Pines and Cedars at timber line down to magnificent huge Sequoias and Sugar and Ponderosa Pines and Firs and Incense Cedars, down again to Digger Pines and out into the chaparral, and so at last to the vines and orchards of the San Joaquin Valley around Visalia.

"From Los Angeles the Commission took a look at the San Bernardino Mountains, already reserved, and the San Jacintos, which were to be. Next came Flagstaff, and the great Coconino Forest, still to be saved, at least in part. At the Grand Canyon, by this time, a sort of tent hotel offered a place to sleep and eat.

"While the others drove through the woods to a 'scenic point' and back again, with John Muir I spent an unforgettable day on the rim of the prodigious chasm, letting it soak in. I remember that at first we mistook for rocks the waves of rapids in the mud-laden Colorado, a mile below us. And when we came across a tarantula he wouldn't let me kill it. He said it had as much right there as we did.

"Muir was a storyteller in a million. For weeks I had been trying to make him tell me the tale of his adventure with a dog and an Alaskan glacier, afterward printed under the title of *Stickeen*. If I could get him alone at a campfire— We had left from our lunches a hard-boiled egg and one small sandwich apiece, and water enough in our canteens. Why go back to the hotel?

"That, it developed, suited Muir as much as it did me. So we made our beds of Cedar boughs in a thick stand that kept the wind away, and there he talked until midnight. It was such an evening as I have never had before or since.



Pinchot was helped in every way by his friend Theodore Roosevelt. In this 1907 photo, they cruise the Mississippi River to promote inland waterways.

Forest Service Collection. National Agricultural Library.

"That night it froze, but the fire kept us from freezing. In the early morning we sneaked back like guilty schoolboys, well knowing that we must reckon with the other members of [our party], who probably imagined we had fallen over a cliff. They had done just that, and they told us what they thought of us with clarity and conviction." (*Breaking New Ground*, 1947, p. 103)

Ahead of his time in this as in so much else, Pinchot regarded pollution prevention as an integral part of conservation:

". . . conservation stands for the prevention of waste. There has come gradually in this country an understanding that waste is not a good thing and that the attack on waste is an industrial necessity. I recall very well indeed how, in the early days of forest fires, they were considered simply and solely as acts of God, against which any opposition was hopeless and any attempt to control them not merely hopeless but childish. It was assumed that they came in the natural order of things, as inevitably as the seasons or the rising and setting of the sun. Today we understand that forest fires are wholly within the control of men. So we are coming in like manner to understand that the prevention of waste in all other directions is a simple matter of good business. The first duty of the human race is to control the earth it lives upon.

Milestones

1865 Pinchot is born August 11th in Connecticut, heir to a New York dry goods and real-estate fortune.

1889 Graduates from Yale.

1890 Becomes the first American to receive formal instruction in forestry when he studies at the National School of Waters and Forests, in Nancy, France.

1892 Introduces America's first systematic forest management practices to North Carolina's Biltmore forest.

1896 He is appointed to the National Forest Commission by the National Academy of Sciences; the Commission's recommendations lead to passage in 1897 of the Forest Reserve Act, calling for the designation and protection of America's national forests.

1898 Becomes Chief Forester, Division of Forestry, United States Department of Agriculture, which he administers until 1910. (It assumes its current name, the U.S. Forest Service, in 1905.) During Pinchot's administration, the national forests increase in acreage from 51 million to 175 million.

1900 Founds Yale's School of Forestry and the Society of American Foresters.

1910 He is fired from the Forest Service by President Taft for publicly clashing with Interior Secretary Richard A. Ballinger on issues of water conservation in the state of Washington; organizes and becomes President of the National Conservation Association, intended to keep the conservation cause moving forward; publishes *The Fight for Conservation* (Pinchot also published five other books during his lifetime.)

1931-35 Serves as Republican Governor of Pennsylvania; during his first term, 1923-27, he founds the nation's first anti-pollution agency, the Sanitary Water Board. He is quoted as saying, "I have been a governor now and then, but I am a forester all of the time."

1946 He dies October 4th, at age 81.

"We are in a position more and more completely to say how far the waste and destruction of natural resources are to be allowed to go on and where they are to stop. It is curious that the effort to stop waste, like the effort to stop forest fires, has often been considered as a matter controlled wholly by economic law. I think there could be no greater mistake. Forest fires were allowed to burn long after the people had means to stop them. The idea that men were helpless in the face of them held long after the time had passed when the means of control were fully within our reach. It is the old story that 'as a man thinketh, so is he'; we came to see that we could stop forest fires, and we found that the means had long been at hand. When at length we came to see that the control of logging in certain directions was profitable, we found it had long been possible. In all these matters of waste of natural resources, the education of the people to understand that they can stop the leakage comes before the actual stopping and after the means of stopping it have long been ready at our hands." (*The Fight for Conservation*, 1910, pp. 34-5)

Pinchot never stated his central vision more precisely and more eloquently than in this passage:

"The central thing for which Conservation stands is to make this country the best possible place to live in, both for us and for our descendants. It stands against the waste of the natural resources which cannot be renewed, such as coal and iron; it stands for the perpetuation of the resources which can be renewed, such as the food-producing soils and the forests; and most of all it stands for an equal opportunity for every American citizen to get his fair share of benefit from these resources, both now and hereafter.

"Conservation stands for the same kind of practical common-sense management of this country by the people that every business man stands for in the handling of his own business. It believes in prudence and foresight instead of reckless blindness; it holds that resources now public property should not become the basis for oppressive private monopoly; and it demands the complete and orderly development of all our resources for the benefit of all the people, instead of the partial exploitation of them for the benefit of a few. It recognizes fully the right of the present generation to use what it needs and all it needs of the natural resources now available, but it recognizes equally our obligation so to use what we need that our descendants shall not be deprived of what they need." (*The Fight for Conservation*, p. 79)

Pinchot, in effect, stumbled on his own epitaph during his early years as a forester in North Carolina:

The North Carolina mountain people "had no newspapers and few books except the Bible. But a sentence written by one of them I shall never forget. Riding a saddle mule one day between Biltmore and the Pink Beds and meditating generally on the state of the nation, I came to a little house with a fence around it and a tombstone inside the fence. I rode over to look at it. On the stone, under a man's name, was this, 'He left this country better than he found it.' No man ever earned a finer epitaph." (*Breaking New Ground*, p. 62)

Under the auspices of the Environmental Education Act of 1990, EPA's Administrator, sometime in 1992, will present the first Gifford Pinchot Prize "in recognition of outstanding contributions to education and training concerning forestry and natural resource management, including multiple use and sustained yield land management." □

Enlisting Space in the Cause

Satellite measures ozone depletion.

by Alan B. Nichols

So long as the ozone hole stayed over Antarctica, the problem of stratospheric ozone depletion seemed fairly remote. But last spring, the National Aeronautics and Space Administration (NASA) announced that the ozone layer, which shields life on Earth from the Sun's harmful ultraviolet radiation, is thinning over the mid-latitudes. More disturbing news: The ozone layer over the United States has been depleted 4 to 5 percent since 1978. By EPA estimates, this could mean 200,000 more deaths from skin cancer in the United States over the next 50 years.

Responding to the new NASA data, EPA quickly came out in favor of stronger national and international action. On April 4, Administrator William Reilly said more had to be done "to assist developing countries and to bring ozone-safe substitutes on line." Then, on September 19, the Agency proposed that U.S. companies phase out all production and imports of chlorofluorocarbons (CFCs) and other ozone-depleting chemicals by the year 2000, in accordance with the 1990 amendments to the Montreal Protocol.

EPA's response has not stopped at making proposals. A three-year, $200 million multinational fund has been set up under the Protocol to which the United States will contribute some $50 million. EPA has been helping a number of countries, including Mexico, Egypt, and Ecuador, develop proposals for projects that could be eligible for grants from this fund.

Also, EPA co-chairs one of three international assessment panels studying the economic, technical, scientific, and environmental aspects of upper atmospheric ozone depletion. The panels' reports will provide the basis for the development of recommendations on further controls to be considered at the 1992 meeting of the Protocol parties in Copenhagen, Denmark.

Meanwhile, EPA scientists are working with their counterparts at NASA and other federal agencies to solve the mystery of ozone depletion worldwide. EPA is providing NASA with pollutant emissions trends data that are being incorporated into the computer models used to predict future atmospheric effects. Scientists generally agree on the mechanisms of ozone loss at work in the South Pole. However, these mechanisms may not be the same over the industrial globe. To dispel uncertainties, more comprehensive data are needed on the processes involved.

Enter the Upper Atmosphere Research Satellite (UARS). On September 15, 1991, astronauts aboard the space shuttle Discovery deployed this very special orbiter, whose deployment kicks off "Mission to Planet Earth," NASA's long-term global climate research program. Scientists heralded the deployment with superlatives, calling the UARS "a giant laboratory experiment in the sky" that will deliver "a world of new information."

The UARS technology is undeniably dazzling. The project represents a major advance in the evolution of remote sensing technology. Until now, atmospheric ozone was tracked by a few instruments including the Total Ozone Mapping Spectrometer (TOMS), which flies aboard the satellite NIMBUS-7. Scientists speak glowingly of TOMS, which generated spectacular images of the Antarctic ozone hole and provided the evidence of mid-latitude thinning. However, TOMS cannot show variations of ozone concentrations at different altitudes—a critical weakness since ozone is not distributed uniformly in the atmosphere. TOMS cannot monitor the different chemical processes that occur, nor can it monitor winds or energy input, two factors that influence chemical distribution and catalyze the chemical reactions that cause ozone depletion.

The UARS, equipped with multimillion dollar instruments that can perform three kinds of measurements simultaneously, is designed to fill these data gaps. It will measure key parameters of some 18 man-made and natural chemical species in three-dimensional space. It will monitor winds, temperature, and other dynamic factors that influence the concentrations and distribution of chemicals in the atmosphere. And it will measure solar ultraviolet radiation and the flux of solar charged particles—both sources of energy which catalyze atmospheric chemistry. In addition to these ozone-related investigations, an instrument aboard the UARS monitors total solar irradiation in connection with NASA's global climate change research.

The UARS mission is to better understand energy input, global photochemistry, and the dynamics in the upper atmosphere, the coupling among these processes, and the coupling between the upper and lower atmosphere.

The UARS has been set in a 600-kilometer, non-sun-synchronous orbit with an inclination of 57° to the equator. In addition, the instruments' angle of sight extends an additional 23° higher in latitude, resulting in coverage of virtually the entire globe. UARS will provide data from its full instrument complement for 20 months, covering two complete winters in the northern hemisphere. It will generate measurements simultaneously and continuously over the full range of local times at all geographic locations every 36 days. This will yield what UARS program manager Michael Luther calls a "snapshot of the Earth in three-dimensional space."

The UARS measurements are being sent to several relay satellites, which transmit the data to NASA's receiving station in White Sands, New Mexico. From there, the data are transmitted over phone lines to Goddard Space

(Nichols is a writer for the Water Environment Federation.)

UARS will send back data from the northern hemisphere for two complete winters.

NASA photo.

Flight Center in Greenbelt, Maryland, where computers make digital conversions that yield charts, graphs, and maps. Researchers will use these data in their computer models to improve the predictability of ozone depletion.

Ironically enough, in the lower atmosphere, ozone (O_3) is a pollutant that can cause severe respiratory and other health problems. In the upper atmosphere, its effect is benevolent: Ozone filters most of the Sun's ultraviolet radiation, which in excessive amounts or under prolonged exposure causes skin cancer and disrupts plant photosynthesis. Ozone is continuously being created and destroyed naturally, but man-made chemicals in the atmosphere have tipped the natural balance, according to Luther. Without the stratospheric ozone shield, life as we know it could not exist.

Ozone depletion occurs when solar radiation dissociates CFCs to form free chlorine atoms, or when methane and nitrous oxide react in the atmosphere to form other free radicals, creating molecules with an odd number of electrons. These "radicals" react with ozone to convert atomic oxygen (O) and ozone into molecular oxygen (O_2), which does not filter ultra-violet rays. The radical survives the conversion and moves on to initiate successive reactions. Source molecules have extremely long residence times in the atmosphere (up to 100 years), accumulating in the troposphere and then migrating to the stratosphere. Free radicals of chlorine or nitrogen oxides can destroy thousands of ozone molecules.

Scientists believe that other atmospheric ingredients like solar-charged particles and sulfur aerosols from volcanic eruptions may accelerate ozone depletion. Data from the UARS investigations are expected to help clarify the relative roles of man-made and natural influences on ozone.

Stratospheric ozone depletion was first detected in 1985 by a British team stationed in Antarctica using ground-based measurements. Meanwhile, TOMS had been in orbit since 1978 and was generating enormous amounts of data. Review of these data after the British discovery indicated that the ozone hole was not just over the British Antarctic station, but was a continental phenomenon.

The polar ozone hole was relatively easy to see, but detecting clear indications of mid-latitude thinning has been much more difficult. Moreover, scientists are puzzled because the same chemical and meteorological conditions that prevail in the Antarctic are not present in the northern latitudes.

A current explanation of Antarctic ozone loss is that during the long, cold dark winter, free radicals combine with reservoir or sink molecules, which occur naturally in the stratosphere and include nitric acid and hydrochloric acid. Ice clouds in the polar stratosphere catalyze chemical reactions that liberate the free radicals from the bond to do their destructive work on ozone. However, it takes sunlight to trigger the ozone-depleting reactions. This explains why the ozone hole is seasonal, taking place in the austral spring when the Sun reemerges over the continent.

In the northern latitudes, the composition and frequency of clouds are quite different, and the polar vortex, which sustains the extremely cold temperatures longer over the South Pole, is far less stable. Scientists, therefore, conclude that mid-latitude ozone thinning is caused by a more complex set of influences. □

ON THE MOVE


Tate


Cantor


Devaney


Fulton


Wynne

Former New Jersey Prosecutor **Herbert H. Tate, Jr.**, has been selected as EPA's new Assistant Administrator for Enforcement.

Tate was appointed in 1986 by former New Jersey Governor Thomas H. Kean to a five-year term as Essex County Prosecutor. During this period, he developed criminal processing procedures that have efficiently handled over 30,000 adult criminal cases and 15,000 juvenile delinquency cases.

He began his law career at the Essex County Prosecutor's Office as an assistant prosecutor from 1979 until 1983. There he set criminal-law enforcement policies for municipal Youth Aid Bureaus and developed enforcement programs for assistant prosecutors and municipal police officers. He also directed the Juvenile Trial Section, managing juvenile delinquency cases.

Prior to his position as country prosecutor, Tate established a private practice in 1985 that specialized in federal and state criminal defense, probate and estate matters, and environmental law. The last focused on matters related to New Jersey's Environmental Clean-up Responsibility Act and resource recovery projects.

Tate received a B.A. in American history and government from Wesleyan University in 1975 and earned a J.D. from Rutgers University in 1978.

Richard A. Cantor has been appointed Deputy Associate Administrator for the Office of Regional Operations and State/Local Relations (OROSLR). He is also serving as Acting Associate Administrator for OROSLR.

Cantor came to EPA in 1991 as Special Assistant to the Associate Administrator of OROSLR, leaving the Urban Mass Transportation Administration at the U.S. Department of Transportation. As an attorney-advisor in the Office of the Chief Counsel, his responsibilities focused primarily on legislative and regulatory matters. He worked on the surface-transportation reauthorization legislation and directed the rulemaking for Congressionally mandated bus-testing procedures.

From 1982 until 1986, Cantor was Executive Director and General Counsel of the Oil Investment Institute, a national trade association concerned with federal tax issues as they affect capital formation in the energy industry. While managing the Institute and representing its interests before Congress, he participated in the tax reform efforts of the mid-1980s.

He received his B.A. from Tulane University in 1972, worked on Capitol Hill for two years, and was later a founder and treasurer of an independent political action committee. In 1979 he received a J.D. from the Northeastern University School of Law.

Earl Devaney has been named Director of the Office of Criminal Enforcement. He came to EPA from the U.S. Secret Service, where his last assignment was Special Agent in charge of the Fraud Division.

Devaney has an extensive criminal investigative history with the Secret Service dating back to 1971. For eight years he served as a Special Agent in the Buffalo and Chicago Field Offices. He then became a Senior Course Instructor in the Service's Training Division in 1979, a position he held until 1982.

The next three years he spent in Las Vegas, Nevada, as the Resident Agent in Charge. He later became Assistant to the Special Agent in charge of the Los Angeles Field Office.

He returned to Washington in 1987 to serve for a year as the Deputy Special Agent in charge of the 1988 Campaign Operations Branch. After the election, he was promoted to Special Agent in charge of the Office of Investigations.

Devaney is the recipient of four Treasury Department Special Achievement Awards. He received a B.A. in Government from Franklin and Marshall College in 1970.

Scott C. Fulton has been named the new Deputy Assistant Administrator for the Office of Enforcement. Prior to his appointment, Fulton served as the Director of the Office of Civil Enforcement. He came to EPA in 1990 as a Senior Enforcement Counsel.

Prior to joining EPA, Fulton served eight years with the Department of Justice in the Environmental Enforcement Section, Environment and Natural Resources Division. He was an Assistant Section Chief from 1986 until 1990, a senior attorney from 1985 to 1986, and a trial attorney from 1982 until 1985. He also served as a Special Assistant with the Washington, DC U.S. Attorney's Office in 1984.

Fulton earned a B.A. in Business Management from the University of Massachusetts in 1976. In 1982 he graduated with honors from the University of South Carolina's School of Law, where he served as the Associate Editor-in-Chief of the Law Review.

Buck Wynne has been nominated to be the new Regional Administrator for Region 6, the Agency's Dallas office which oversees EPA's activities in Texas, Louisiana, Arkansas, New Mexico, and Oklahoma.

Since 1987, Wynne was a member of the Texas Water Commission, the principal environmental regulatory body in Texas. He chaired the three-member commission from 1988 to 1991. The commission has more than 1,000 employees, a budget of $62 million, and jurisdiction over several state and federal environmental programs. These include hazardous and solid waste management, Superfund cleanups, surface and ground-water protection, and enforcement.

Before his appointment to the commission, Wynne was Legislative Counsel to the Governor's office in Austin, Texas (January 1987 to August 1987), and before that, a legislative assistant in the Governor's office (1978 to 1981). He practiced law with the firm of Shank, Irwin, and Conant from 1984 to 1986.

Wynne earned a B.S. in biology from Tulane University in 1978 and a J.D. from Southern Methodist University in 1984. □

(As the *Journal* went to press, **Laurie Goodman** was recommended by Administrator Reilly to be Associate Administrator for OROSLR. Ms. Goodman's most recent position was legislative assistant and assistant administrative assistant to Senator Alan Simpson (R-Wyoming). More on the selection will be in the next issue.)

Ray Muzika photo.

In landmark legislation, Congress has called for a stronger federal role regarding nonpoint-source pollution of coastal waters. Under the 1990 amendments to the Coastal Zone Act, affected states will be required to have federally approved programs for coastal nonpoint pollution control.

Back cover: Livestock farming contributes to nonpoint-source pollution in a number of ways. What's wrong with this picture? Photo by Grant Heilman for Grant Heilman Photography, Inc.