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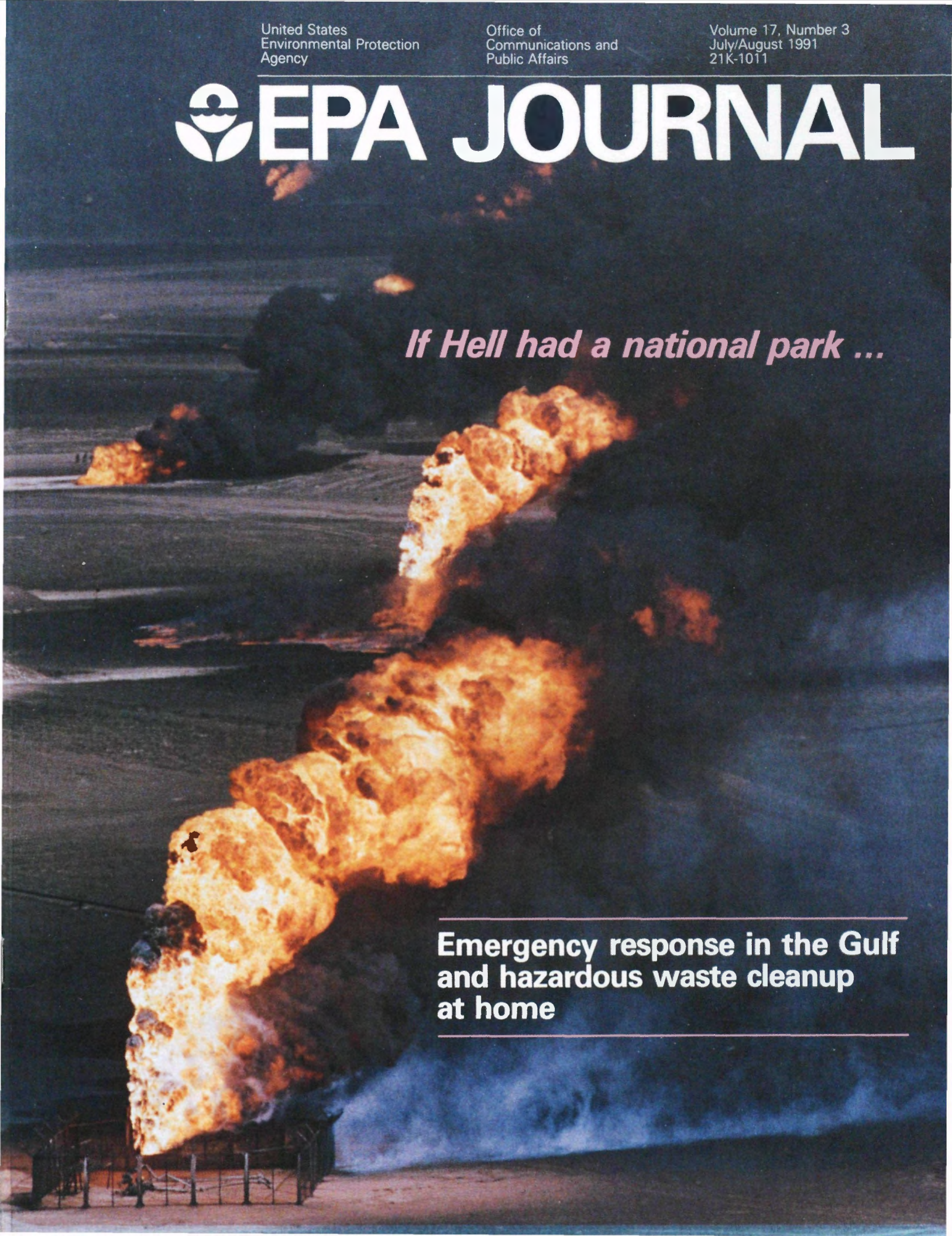

If Hell had a national park ...

Emergency response in the Gulf and hazardous waste cleanup at home

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Front Cover: Kuwaiti oil wells ablaze, a historic challenge to man's ability to fight pollution emergencies. See story on page 23.

Photo by Greg Gibson for Wide World.

From the Editor

What is Superfund and why all the fuss about it? This issue of *EPA Journal* gets into some of the questions about the program and some of the proposed answers. It also looks at Superfund's two partners in cleaning up hazardous waste: the Solid Waste and Underground Storage Tank leak control programs, both mandated by the Resource Conservation and Recovery Act.

The magazine begins its treatment by explaining the three programs in layman's terms. Next, Don Clay, EPA's Assistant Administrator for the programs, answers questions frequently asked by the public.

Then, Thomas Grumbly, President of the independent Clean Sites organization, analyzes some of the difficulties that lie ahead for Superfund and proposes a new strategy for the program.

The Persian Gulf oil fires and oil spills are the focus of the next feature and the subject of the issue's front cover photograph. For EPA's staff, this was the mother of all emergency responses.

The following three articles give the reader a feel for how Superfund cleanups actually proceed, with a "case study" of the completed Bog Farm Site in New Jersey, a report on the experiences of an award-winning, on-scene coordinator, and an article describing how a community near a Kentucky site handled its concerns.

Then the magazine asks four observers with distinctly different perspectives to respond to a hotly debated question in the current Superfund arena: Who should pay for Superfund cleanups?

The development of fascinating new techniques to clean up hazardous waste sites is the focus of the next article. An accompanying piece discusses the outlook for putting these innovative methods into action.

Moving to the two program partners to Superfund, one article describes RCRA Corrective Action, a little publicized clean-up effort that is gearing up for remedial initiatives at thousands of facilities across the country, and a second article fills in the background of UST, which targets leaks from underground fuel storage tanks. The issue then includes a forum, in which experts with different points of view discuss whether our society is getting a handle on disposing of hazardous waste.

On different topics, *Newsline* features EPA news and a sampling of reaction; greenways are the subject of a book review; the Galápagos Islands of Darwin fame provide grist for environmental speculation; and "On the Move" highlights recent appointments to top Agency positions. □

John Heritage

EPA Journal is printed on recycled paper.

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Contents

Editor's note: You, our reader, will be pleased to learn that *EPA Journal* has won first prize in this year's Blue Pencil competition for general audience magazines. The competition is sponsored by the National Association of Government Communicators.

Agreement Reached on Clean Gasolines

Under an agreement between EPA, industry, states, and the environmental community, cleaner gasolines will be sold in those cities having excessive ozone and carbon monoxide levels. All gasoline sold in the nine cities with the worst ozone problems will be reformulated beginning January 1995. The 41 cities with carbon monoxide problems will use oxygenated gasoline during winter months beginning November 1992. Administrator Reilly said: "This agreement represents an essential milestone in reconciling the automboile with environmental quality through cleaner fuels. With the industry, environmental community, states and EPA all endorsing the market-based and clean fuel principles of the Bush administration, refiners are given greater flexibility to obtain environmental benefits at the lowest possible cost. Reformulating fuels is the single most environmentally significant initiative we can take to reduce air pollution."

The Wall Street Journal reported: " . . . The agreement commits the oil industry to invent and begin selling a cleaner-burning gasoline by January 1995 in the nation's nine smoggiest cities, which now account for 25% of gasoline sold in the U.S. They are Baltimore; Chicago; Hartford, Conn.; Houston; Los Angeles; Milwaukee; New York; Philadelphia and San Diego, Calif. The gasoline must emit 15% fewer toxic emissions, such as cancer-causing benzene . . . . By EPA estimates, the gasoline will cost motorists four to five cents more a gallon and the oil industry $3 billion to $5 billion during the next four years to retrofit refineries and storage systems. Even more expensive changes and even cleaner gasoline will be required by the year 2000, but those regulations still must be written . . . . It's predicted that far more cities fighting air pollution will want to start selling the gas than the oil industry believes it can supply . . . . The result will be increasing pressure on oil refiners and the Environmental Protection Agency to expand on [the] agreement reached Friday. The agreement will for the first time lead to changes in fuel—rather than automobiles, alone—to help curb unhealthy levels of smog plaguing almost 100 U.S. cities . . . . A separate dispute also is brewing over a provision in the same set of regulations requiring gasoline with a higher oxygenate content to be sold in the winter in 41 cities with unhealthy carbon-monoxide levels by 1992. The oil industry says it may need one- or two-year extensions of the deadline for some cities because it expects a shortage of oxygenated fuel additives, like ethanol or a methanol derivative, that add oxygen and improve combustion. But ethanol and methanol suppliers insist there is a sufficient supply. The EPA will have to decide if extensions are merited."

The Washington Post said: " . . . the terms of the agreement, and the way it was forged in a process known as regulatory negotiation, give the deal an importance beyond gasoline. The signatories, representing a range of traditionally warring interests—oil companies,

William C. Franz photo.

clean-fuels manufacturers, environmental and consumer groups, auto makers and state governments—are bound not to litigate or lobby against regulations that implement their compromises . . . . The agreement thus enhances chances that a key clean air initiative will avoid the years of court wrangling and regulatory paralysis that have blocked other ambitious laws . . . . Because of gasoline's importance to the U.S. economy, its contribution to air pollution and its complex distribution network, yesterday's accord is considered the most sweeping ever consummated in regulatory negotiation, or 'reg-neg.' By demonstrating the effectiveness of reg-neg in translating contentious laws into regulation, the deal is expected to increase use of this practice across the government . . . . 'This shows the power of the process,' said Phil Harter, a lawyer who mediated the negotiation. 'When this started six months ago, there weren't five people in Washington who thought we could reach agreement. They thought it was too big, too politicized, too controversial. But through the structured process of developing facts and bringing the parties face-to-face, they were able to find common ground.'"

Under a recent agreement, cleaner burning gasolines will be sold in cities with excessive ozone and carbon monoxide levels.

Four States and a Utility Join EPA's "Green Lights" Program

The states of California, Maryland, Florida, and Oregon, and the Southern California Edison company have agreed to join EPA's "Green Lights" program, the voluntary pollution-prevention and electricity-conservation initiative introduced by EPA earlier this year.

Under the program, members commit to upgrade their lighting systems with energy-efficient equipment whenever the new equipment is profitable and maintains or improves lighting quality.

California, which becomes the largest participant, plans to convert at least 70 million square feet of facilities to energy-efficient lighting. The move will save more than 603 million kilowatt hours of electricity each year, at an annual saving to the state of $51 million.

Maryland has committed to upgrade lighting in the more than 55 million square feet of state-occupied or-owned space, with cost savings at a rate comparable to California.

Southern California Edison is the first electric utility to join the program, in which more than 150 corporations have signed up.

According to EPA Administrator William Reilly, with full participation by the commercial-industrial sector, Green Lights could cut electricity demand 10 percent nationally, resulting in a 235 million-ton reduction in the nation's emissions of carbon dioxide, sulfur dioxide, and nitrogen oxide. The reduction in carbon dioxide is equivalent to removing 42 million cars from the road. Green Lights would also save nearly $19 billion in electric bills annually.

For more information, contact Jerry Lawson or Bob Kwartin at 202-245-3791.

Steve Delaney, EPA

Joel Schwartz and his wife, Ronnie B. Levin. She works in EPA's Office of Research and Development.

EPA Scientist Wins $275,000 MacArthur "Genius" Award

Joel Schwartz, EPA environmental epidemiologist, has been awarded a MacArthur Foundation grant of $275,000 for his analysis of the health and environmental effects of lead in gasoline.

Dr. Schwartz is one of 31 recipients of the so-called "genius" awards made each year by the John and Catherine MacArthur Foundation of Chicago. The cash awards, spread over five years, have no strings attached and are made to individuals deemed to be highly talented and creative and who are involved in improving the human condition.

gasoline by more than 90 percent."

Schwartz has twice received EPA's Distinguished Scientific Achievement Award. He was trained as a physicist at Brandeis and came to EPA in 1979, where he has worked on energy and environmental economics, risk assessment, biostatistics, lead epidemiology, and respiratory epidemiology. In collaboration with scientists in this country and Europe, Schwartz is currently conducting new analyses of the effect of exposure to small airborne particles on human mortality. Recent findings by Schwartz and his collaborators strongly indicate that exposure to even very low levels of particulate matter—in one city, the level was 23 percent below the federal limit—may lead to as many as 60,000 deaths each year among people with lung problems.

EPA Clarifies Superfund Clean-up Liability for Banks

EPA has proposed a regulation to clarify the liability, under Superfund, of lenders who hold title to contaminated property. Administrator Reilly said: "This rule allows lending institutions to protect their financial interests on properties they hold as collateral, while it assures that those responsible for contamination are held accountable."

The Wall Street Journal said: " . . . Federal officials hope the protections will reverse bankers' recent reluctance to lend money to companies, small businesses, and individuals whose property could be exposed to hazardous wastes . . . . There are no estimates of the extent to which lending has been crimped by the threat of liability under the Superfund law. But there is anecdotal evidence that banks, especially in small communities, have rejected loans for fear of triggering clean-up liability greater than the value of the credit. Officials cited a Dana, Indiana, couple who couldn't get a $20,000 home loan because their house sits next to a fertilizer plant: Local bankers were worried about the possibility of contamination, for which the couple might be found responsible . . . ."

The New York Times reported: " . . . The rules, developed by the Environmental Protection Agency over the last 10 months, would clarify when lenders are liable for cleaning up toxic waste under the 1980 Superfund law . . . . The law provided federal money to clean up polluted sites, but allowed the government to sue those responsible for the contamination. It originally exempted from liability lenders whose only interest in a property stemmed from having provided loans to the owner. But recent court decisions have eroded the exemption . . . . Last year, a federal appeals court found one lender liable because it could have influenced the borrower's hazardous waste decisions but did not . . . . [Under the new regulations] the lenders could manage, without liability, properties or companies they take over by foreclosure, provided that they begin trying to sell them within a year . . . ."

Industry Release Of Toxics Drops 1.3 Billion Pounds in Two Years

Industry in this country released 5.7 billion pounds of toxic chemicals in 1989, down 18 percent from 1987, according to initial results of the most recent Toxics Release Inventory, which records the amount of such chemicals released into the air, land, and water by 22,650 industrial facilities. The facilities are required to report annually on releases.

Of the 5.7 billion pounds released in 1989, 189 million pounds went into waterways, 2.4 billion were emitted into the air, 445 million disposed in landfills, and 1.2 billion injected into wells. An additional 551 million pounds were transferred to municipal wastewater treatment plants, and 916 million pounds were transferred to treatment and disposal facilities.

In the period covered, air releases declined about 8 percent, water releases 54 percent, and land 39 percent. While the decline in water and land releases appears significant, approximately half the decrease may be the result of faulty estimates of 1987 and 1988 releases, Agency officials say. EPA will provide its own summary and analysis of data and trends later this year.

"The Toxics Release Inventory is fast becoming one of the most powerful tools we have to reduce emissions," Administrator William Reilly said at a recent meeting on pollution prevention in Washington, DC. "One corporate executive told me he had no idea his company was wasting so much high-value product until he saw his Toxics Release Inventory.

Pesticides Come and Go

Goodbye to Granular Carbofuran

The granular pesticide carbofuran (trade name Furadan) will be banned in certain ecologically sensitive areas beginning September 1, 1991, and will be phased out in all but a handful of minor uses nationwide by 1994 under a recent agreement between the maker, FMC Corporation, and EPA.

More than 80 separate bird-kill incidents attributed to granular carbofuran have been received by EPA. Eight field studies in 10 states added to evidence of its acute toxicity to birds, including the bald eagle and other birds of prey which may feed on small birds and mammals contaminated with carbofuran.

EPA estimates 1988 carbofuran use at seven to 10 million pounds. By 1994, only 2,500 pounds of the granular product can be sold annually for all uses.

Hello to Two New Genetically Engineered Pesticides

EPA has given conditional registration to two pesticides derived from biological organisms that have been genetically engineered using recombinant DNA techniques. The Agency also has granted an exception from the requirement for a tolerance for residues of the two pesticides on all the raw food or feed for which use is allowed. The two products, M-One Plus and MVP, are made by Mycogen Corporation of San Diego and will be used to control beetle and caterpillar pests.

The two pesticides contain different, pest-toxic protein crystals generated by *Bacillus thuringiensis* (b.t.), a naturally occurring microbe registered with EPA and widely used as a pesticide for many years. In manufacture, the toxins are grown encapsulated inside a second bacillus, *Pseudomonas fluorescens*, which is killed and made into the pesticide mentioned. Encapsulating the toxins extends the time they are effective.

When target insects and larvae eat foliage sprayed with the pesticides, the creatures' guts become paralyzed; they stop eating and die. There is no evidence of harm to humans, other mammals, birds, or other non-target vertebrates.

Opportunities are there for many businesses to cut toxic emissions sharply and at the same time save a lot of money. They may also reduce liability and reduce the need for future regulatory actions."

The Toxics Release Inventory (TRI) is required under the 1986 Emergency Planning and Community Right-to-Know Act. TRI data is available at more than 4,000 libraries nationwide. Additional information is available from state TRI units or by calling the hotline number 1-800-535-0202.

EPA Proposes Drinking Water Standards For Radon

EPA has proposed regulations setting federally enforceable maximum levels for radon and other radioactive pollutants in drinking water. Radon is found in some drinking water that comes from ground-water sources. Most large water-supply systems are based on surface water (river, lakes, and streams) which is not likely to pose a problem with radon.

When the standards become final, the Agency expects them to reduce the exposure of 20 million Americans to radioactive drinking-water contaminants and prevent 83 cancer deaths per year. Of all kinds of radiation in drinking water, radon is by far the most frequently found.

Under the proposed standards, 80,000 public water suppliers would have to monitor for radioactivity. EPA estimates that 28,000 may have to treat their water at a total annual cost of $310 million. For more information about radon in drinking water, call the Safe Drinking Water Hotline: 1—800-426-4791.

Rights to Acid Rain Emissions Can Be Bought and Sold

EPA has proposed rules for selling the rights to emit sulfur dioxide under the acid rain provisions of the Clean Air Act. It is the first time the Agency has proposed selling emission rights. "This innovative approach to reducing acid rain demonstrates the Bush Administration's commitment to use the power of the marketplace to produce a healthy, productive environment," said Administrator Reilly.

The Washington Times reported: " . . . The Environmental Protection Agency yesterday unveiled plans to auction off the rights to emit sulfur dioxide, a major industrial air pollutant and a key component of acid rain . . . . The proposed regulation is the vehicle by which EPA plans to limit sulfur dioxide emissions in the year 2000 to 100 million tons less than pumped into the atmosphere in 1980 . . . . With EPA-run auctions beginning in 1993, electric power utilities and other industries would be able to buy or sell the rights to release the by-product of coal combustion . . . ."

The Los Angeles Times said: " . . . Coal- and oil-burning power plants through the South and Midwest are blamed for killing thousands of lakes in the northeastern United States and across Canada with sulfur dioxide falling as acid rain . . . . EPA hopes that utilities will be able to focus acid rain control efforts at power plants where emission cuts will be the most efficient. The Agency expects that some utilities will make rapid emissions cuts, then sell their unused allowances to others . . . . Sale of the first allowances will take the federal government into an untried realm of pollution prevention, using market incentives in place of fines or suspended operations . . . ."

John Shaw photo.

Among other problems, acid rain may damage trees at high elevations in the eastern U.S.

Stratospheric Ozone News

China Ratifies CFC Treaty

China has become the 70th nation to ratify the Montreal Protocol calling for international phaseout of chlorofluorocarbons (CFCs) and other depleters of the stratospheric ozone layer. China made its announcement at the third meeting of parties to the protocol, held in Nairobi, Kenya, June 18-21.

With China having about one-fourth of the world's population and a rapidly expanding industrial base, its action was welcome as a major step toward reducing the long-term threat to the ozone layer.

EPA Official to Head CFC Fund for Developing Nations

Industrial nations are establishing a multilateral fund of between $160 million and $240 million over the next three years to support recycling, product substitution, and other efforts by developing countries to reduce the use of CFCs and otherozone-depleting substances.

At the recently held Nairobi conference of signatory nations of the Montreal Protocol, members chose EPA's Eileen Claussen, director of Atmospheric and Indoor Air Programs, to head the landmark fund beginning in 1993. Developing nations that are parties to the protocol are eligible to tap the fund.

Another CFC First for Mexico

Mexico, the first nation to ratify the Montreal Protocol protecting the ozone layer, has become the first to submit project proposals under the protocol for phasing out CFCs. In a joint announcement with EPA and the Northern Telecom Company, the environmental agency of Mexico (SEDUE) set out a program under which Mexico will phase out the use of CFC solvents prior to 2010, the date mandated under the protocol.

Ongoing Enforcement Actions

Justice and EPA Act Against 36 Accused of Lead Violations

In a nationwide crackdown against businesses releasing lead into the environment, the Department of Justice and EPA took legal action against 36 companies charged with violating rules to reduce exposure to that toxic element.

Justice filed 24 judicial enforcement actions in federal courts around the country, while EPA took administrative enforcement action against 12 facilities in seven states. To broaden the impact of the federal environmental enforcement program, Justice and EPA are applying six environmental statutes simultaneously against a single pollutant—in this instance, lead.

In 21 cases involving lead contamination of soil, water, and air, the joint federal action was initiated under the Resource Conservation and Recovery Act (RCRA). The two agencies also filed six complaints and lodged two consent decrees under the Superfund law. Also brought into play were the Clean Water Act, the Safe Drinking Water Act, the Clean Air Act, and the Emergency Planning and Community Right-to-Know Act. Together, the statutes address a significant number of lead compliance problems.

Judicial actions in the lead initiative filed by Justice call for civil penalites up to $25,000 per day per violation. Administrative actions by EPA seek penalties in excess of $10 million.

Consent Decree Caps First Superfund Cleanup in Puget Sound

Champion International and Simpson Tacoma Kraft Company have signed a consent decree lodged in federal district court in Tacoma, Washington, June 23 to culminate a landmark 12-party agreement on a federal Superfund cleanup in Puget Sound.

Under terms of the decree, a minimum of $1 million will be devoted to assessing damage to natural resources of the Tacoma waterfront, restoring habitat, and rehabilitating the area's aquatic environment.

The waterfront is the location of a pulp mill operated in the past by Champion and currently by Simpson Tacoma. The two companies, which signed the consent decree as potentially responsible parties, are contributing the money to a natural resources trust account.

$575,000 Penalty Proposed Against Mobil

A Mobil Oil facility in Paulsboro, New Jersey, failed on three occasions to notify, in a timely way, federal, state, and local officials of releases of hazardous substances, EPA investigators say. The facility released hydrogen sulfide in amounts ranging from 450 to 2,900 pounds in 1989 and 1990 and failed to immediately notify proper authorities as required by the Superfund law and the Emergency Planning and Community Right-to-Know Act. EPA has proposed penalties of $575,000 for the three incidents.

Ground-water Action Against 10 Major Oil Companies

More than 1,800 service stations operated by major oil companies in 49 states and territories have been guilty of discharging contaminated automotive fluids into, or directly above, underground sources of drinking water, according to proposed administrative orders issued by EPA and agreed to by the companies involved.

Contaminated fluids from automobile servicing were discharged by the stations into sinks and floor drains connected to shallow "injection wells" such as septic tanks, drywells, or cesspools. This is in violation of Underground Injection Control regulations and ground-water protection rules of the Safe Drinking Water Act.

All 10 companies pledged that by March 1991 they had already ceased the discharges at the locations cited. In addition to proposed penalties totaling $838,761, the companies agreed to extensive clean-up measures and other steps to protect ground water around the stations. The companies will provide EPA with quarterly progress reports.

Companies involved in the proposed administrative orders are: Amoco Oil Co., Ashland Oil Inc., BP Oil Co., Exxon Corp., Marathon Oil Co., Mobil Corp., Shell Oil Co., Sun Refining and Marketing Co., Texaco Refining and Marketing Inc., and Unocal Corp.

Steel Company to Pay $6 Million for Illegal Discharges into the Ohio

Wheeling-Pittsburgh Steel Corporation will pay a civil penalty of $6 million under terms of a consent decree lodged in federal district court for violations of the Clean Water Act at three of the company's mills along the Ohio River. The mills were charged with releasing chrome, lead, ammonia, zinc, oil, and grease.

According to EPA officials in the region, this is the largest federal civil penalty ever obtained from a single settlement under the Clean Water Act. More than 3 million people get their drinking water from the Ohio, say regional officials, and other millions use the river for boating and fishing.

United Technologies Fined $3 Million for Six Felony Violations of RCRA

United Technologies Corporation (UTC) has pleaded guilty to six felony violations of illegally disposing of hazardous waste at the company's Sikorsky Aircraft Division in Stratford, Connecticut.

UTC has agreed to pay a fine of $3 million for the criminal violations, according to EPA and Justice officials.

The charges against UTC stem from illegal dumping of cleaning solvents, including perchloroethylene and trichloromethane, from 1982 to 1986. The case was jointly investigated by the U.S. attorney's office in Connecticut and by EPA. □

Superfund, RCRA, and UST: The Clean-up Threesome

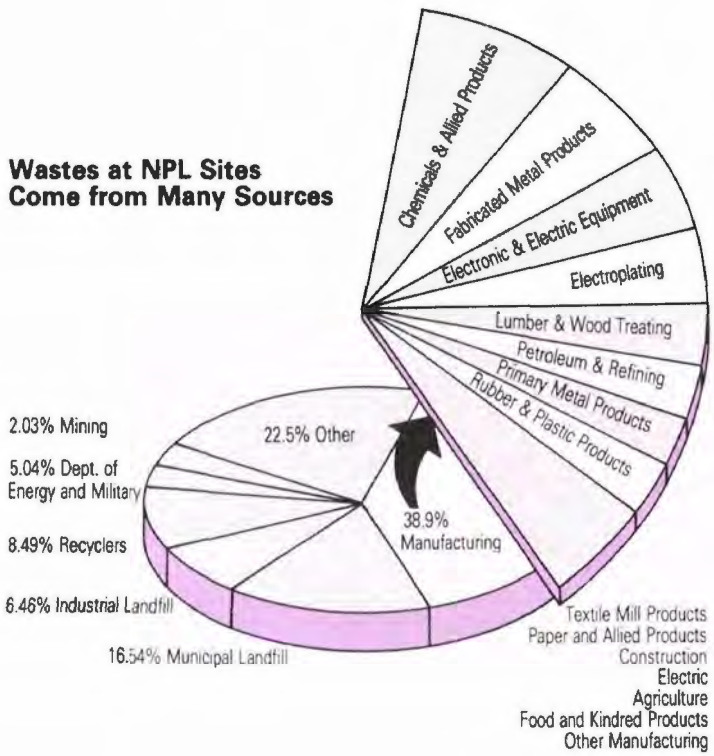
by Jack Lewis

Love Canal legacy—Where are we now?

(Lewis is an Assistant Editor of EPA Journal.)

As the 1970s came to a close, a series of headline stories gave Americans a look at the dangers of dumping wastes on the land. One particularly famous case was New York's Love Canal. Hazardous waste buried there over a 25-year period contaminated streams and soil and endangered the health of nearby residents. The result: evacuation of several hundred people. In Kentucky, the Valley of the Drums attracted public attention. The site of these leaking storage barrels quickly became front page news. The Chemical Control site in Elizabeth, New Jersey, contained over 40,000 barrels of hazardous wastes together with at least 100 pounds of a powerful explosive. A fire or explosion could have exposed the New York Metropolitan area population to a toxic cloud of chemicals.

Wastes at NPL Sites Come from Many Sources



In all these cases, public health and the environment were threatened; in many instances, lives were disrupted and property values depreciated. It was becoming increasingly clear that large numbers of serious hazardous waste problems were falling through the cracks of existing environmental laws. The magnitude of this problem moved Congress to enact the Comprehensive Environmental Response, Compensation, and Liability Act in 1980. CERCLA, commonly known as Superfund, was the first federal law dealing with the dangers posed by the nation's abandoned and uncontrolled hazardous waste sites.

After Discovery, the Problem Intensified

The news stories turned out to be just the beginning. Few realized the size of the problem until EPA began the process of site discovery and evaluation. Not hundreds, but thousands of potential hazardous waste sites existed, and they presented the nation with some of the most complex pollution problems it had ever faced.

In the 10 years since the Superfund program began, hazardous waste has become a major environmental concern in every part of the United States. It wasn't just the land that was contaminated by past waste-disposal practices. Chemicals in the soil were spreading into the ground water (a source of drinking water for many) and into streams, lakes, bays, and wetlands. At some sites, toxic vapors were rising into the air. Some pollutants—such as metals and solvents—had damaged vegetation, endangered wildlife, and threatened the health of people who unknowingly worked or played in contaminated soil, drank contaminated water, or ate contaminated vegetables, meat, or fish.

As site discoveries grew, cost estimates rose. Clearly, the $1.6 billion originally set aside for the fund was

not enough to clean up the nation's most serious hazardous waste sites. Realizing the long-term nature of the problem and the enormous job ahead, Congress reauthorized the program in 1986 for another five years, adding $8.6 billion to the fund. In 1990, Congress authorized continuing the program for another five years and added another $5.1 billion.

Priorities Had To Be Established

From the beginning of the program, Congress recognized that the federal government could not, and should not, be responsible for addressing all environmental problems stemming from past disposal practices. Therefore, EPA was directed to establish a National Priorities List (NPL) of sites to target. The program responds to hazardous emergencies wherever they occur, but only those sites listed on the NPL qualify for long-term cleanup under Superfund. Problems at other sites are dealt with by state and local governments, individuals, or companies. (On EPA's separate authority under the Resource Conservation and Recovery Act to compel clean-up actions by owners and operators of hazardous waste management facilities, see "Corrective Action" below.)

Sites on the NPL are a relatively small subset of a larger inventory of potential hazardous waste sites, but they do comprise the most complex and environmentally compelling cases. EPA has logged approximately 34,000 sites on its inventory. The Agency assesses each site within one year of its being logged. In fact, almost 32,000 sites have been assessed. Of these, 20,500 have been found to require no further federal action. Approximately 11,000 sites are awaiting further investigation.

To date, there are nearly 1,200 hazardous waste sites on the NPL; sites qualify for the NPL based on a variety of factors, including the quantity and toxicity of the wastes involved; the number of people potentially or actually exposed; the likely pathways of exposure; and the importance and vulnerability of the underlying supply of ground water. The historical rate of sites aded to the NPL is approximately 100 sites per year. The Agency estimates that this rate will continue over the next several years.

For sites on the NPL, EPA is committed to taking actions that protect human health and the environment—in both the short and long term—from unacceptable risks by eliminating, reducing, or controlling exposures to hazardous substances. As a matter of policy, to reduce the need for long-term management of the site or its waste, whenever practical the hazards posed by the contaminated material are destroyed; otherwise, the contaminated materials are to be recycled or treated to significantly reduce their toxicity, mobility, or volume. Another key goal: to return usable ground waters to their beneficial uses wherever practicable or, at a minimum, to stem further contamination and prevent exposure to the contaminated water.

At 373 NPL sites, EPA has made progress toward permanent cleanup of contamination of the land, surface water, or ground water—or a combination of these. This progress is incremental, reflecting the strategy of making sites safer by controlling acute threats immediately and of making sites cleaner by addressing the worst first.

All needed construction has been completed at 63 sites. Right now, cleanup work is underway at 310 other NPL sites, and the "pipeline" is full of sites headed for cleanup: Currently, remedies have been selected for an additional 270 sites and are either in the engineering design state, or will be shortly. And 503 sites are at the "investigation" step, where the nature of the contamination problem is thoroughly investigated and alternative remedies are evaluated. As EPA streamlines its program to address NPL sites, the Agency hopes to accelerate the pace of full site cleanup.

A site can be deleted from the NPL only if, after any cleanup has been completed, no further action is appropriate to address an actual or threatened release of a hazardous substance.

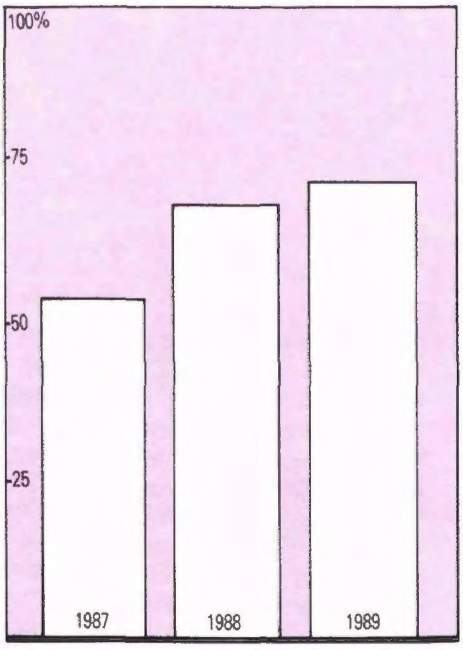
The net result of Superfund cleanup work at NPL sites has been to reduce potential risks from exposure to hazardous waste to more than 23.5 million of the 41 million people who live within four miles of these sites. This work includes the elimination of threats posed by direct contact with hazardous waste to more than 950,000 people—580,000 of whom were threatened by contact with land contamination and 411,000 of whom have had alternative drinking water supplied.

EPA estimates that the Superfund will spend approximately $27 billion on the sites currently on the NPL. And that is only part of the cost. Currently, the parties responsible for the waste perform roughly 65 percent of the work, which will account for billions more in clean-up dollars. The total average cost per site runs $26 million, and there is every reason to believe that the costs will climb as some of the more complex sites move into the clean-up phase.

Hazardous Waste Sites Are Diverse

It's virtually impossible to describe the "typical" hazardous waste site: They are extremely diverse. Many are municipal or industrial landfills. Others are manufacturing plants where operators improperly disposed of wastes. Some are large federal facilities dotted with "hot spots" of contamination from various high-tech or military activities. The chief

EPA has Increased Use of Treatment Technologies at NPL Sites



contributors of these wastes are in our manufacturing sector.

While many sites have been abandoned, a site may still be an active operation, or it may be fully or partially closed down. Sites range dramatically in size, from a quarter-acre metal plating shop to a 250-square-mile mining area. The types of wastes they contain vary widely, too: Some of the chief constituents of wastes present in solid, liquid, and sludge forms include heavy metals—a common byproduct of many electroplating operations—and solvents or degreasing agents.

NPL sites are found in all types of settings: Slightly more are found in rural/suburban areas than in urban areas, but very few are truly remote from either homes or farms.

Yet the idea of a "site"—some kind of disposal area or dump—still doesn't portray the entire picture. Transportation spills and other industrial process or storage accidents account for some hazardous waste releases. The result can be fires, explosions, toxic vapors, and contamination of ground water used for drinking.

Since every NPL site is unique, cleanups must be tailored to the specific needs of each site and the types of wastes that contaminate it. The range of possibilities is enormous. First, the site's physical characteristics (its hydrology, geology, topography, and climate) determine how contaminants will affect the environment. Then, there is the variation in site type—landfill, manufacturing plant, military base, metal mine—the list is long. The type of waste present adds another complex dimension. Information on the health and environmental effects of hazardous wastes comes mainly from laboratory studies of pure chemicals. There still is much to learn about the nature of the complex mixtures of wastes generally found at these sites, how they affect the environment, and how best to control them.

No matter how exhaustive preliminary studies may be, sampling and site observation simply cannot reveal the full extent of the problem at many sites. Uncertainties exist right up until the point where ground is broken for the clean-up work and throughout the final clean-up process. That's why there is no ready answer to the question: "How long will it take?" On average—and this includes a broad range—six to eight years will elapse between the start of the clean-up study and remedy completion.

EPA Is Developing New Site Clean-up Technologies

While technological concepts were not fully field-tested in the early 1980s, hazardous waste clean-up efforts have begun to yield the information needed to design permanent site clean-up solutions. Since 1986, the move has been away from "containment" of hazardous wastes. Containment entails segregating the wastes in a particular place, but unfortunately many materials cannot reliably be controlled this way. This is particularly true of liquids, highly mobile substances (like solvents), and high concentrations of toxic compounds. For these wastes, treatment is the preferred approach: It reduces the toxicity, mobility, and volume of wastes.

In 1987, some type of waste treatment was being used in about 50 percent of clean-up remedies EPA selected. By 1989, that number had risen to more than 70 percent.

Hazardous Waste Poses A Variety Of Threats

Hazardous waste can include products and residues from a variety of industrial, agricultural, and military activities. Some of the hazard lies in the waste itself: its concentration and quantity; physical or chemical nature. But much of the danger arises from

Superfund Clean-up Indicators

(Waste Removed from the Environment, 1980 — 1990)

Pathway		Volumes Addressed
	**Land Surface**	
	Soil	4,130,000 cubic yards
	Solid Waste	5,270,000 cubic yards
	Liquid Waste	1,000,000,000 gallons
	**Ground Water:**	3,880,000,000 gallons
	**Surface Water:**	104,000,000 gallons

improper handling, storage, and disposal practices. The result is that humans or the environment are exposed to contamination.

Wastes were poorly managed in the past because the disposers often failed to understand the potential toxic effects or realize how strictly they had to be contained. Dangerous chemicals have often migrated from uncontrolled sites. They may percolate from holding ponds and pits into underlying ground water. They may be washed over the ground into lakes, streams, and wetlands. They may evaporate, explode, or blow into the air, spreading hazardous chemicals. They may soak into soil, making land and ground water unfit for habitat or agriculture. Some hazardous chemicals build up—or bioaccumulate—when plants, animals, and people consume contaminated food and water.

Human and Environmental Health At Risk

Determining the risks of hazardous waste to human and environmental health is a complex undertaking. Risk hinges upon how dangerous the chemical is, how people may come into contact with it, how frequently, and in combination with what other chemicals. EPA conducts risk assessments at each site, analyzing the possible ways people, animals, and plants could come into contact with contaminants.

Like the sites themselves, possible effects on human and environmental health span a broad spectrum. Adverse effects on people can range from minor physical irritation to serious health disorders. Such effects also can take the form of slowly degenerating health or of sudden serious damage. Vegetables and livestock may become contaminated and enter the food chain. A sudden poisoning event, like a hazardous waste spill or the breaching of a hazardous waste impoundment, can pose serious immediate health risks.

Steps Through the NPL Pipeline

Detailed study at the site. Analysts observe site conditions and take samples for analysis to obtain precise information on the types and quantities of wastes present, the type of soil and water drainage patterns, and specific human health and environmental risks. The analysts also identify and evaluate clean-up alternatives for the wastes.

Remedy selection. EPA analyzes findings from the study and chooses the remedy from among the alternatives suggested. Remedy options must, at a minimum, protect human health and the environment and comply with all applicable federal and state laws.

Engineering design. EPA or its designate—often the U.S. Army Corps of Engineers—prepares specifications and drawings for the selected remedy.

Clean-up construction and follow-up. Although various parties may construct or otherwise carry out the remedy designed, EPA is always in charge. Cleanup is often followed by a requirement to operate, maintain, or monitor the site for several years.

On average, a site spends 7 to 10 years progressing from investigation through construction of the clean-up remedy. The public has the right and opportunity to comment at every step in the process.

Health and environmental risk is complicated by the fact that, if nothing is done, people and ecosystems can suffer a gradual deterioration for years and show adverse health effects long after the fact. In addition, certain populations are sensitive: elderly people and children, endangered or threatened plants and animals. Some environments are more sensitive in the way they respond to the effects of hazardous chemicals: wetlands, coastal areas, estuaries, and many other water bodies, for example, or wildlife refuges, or rare pine or shale barrens. These are fragile and valuable ecosystems that must be protected.

Industry Pays For Hazardous Waste Cleanup

Industry pays for hazardous waste cleanup through specific taxes. Over 80 percent of the fund known as "Superfund" is supported directly by excise taxes on petroleum and feedstock chemicals, some imported chemicals, and corporate environmental taxes. Financial settlements from site polluters also are returned to the fund.

Superfund dollars are used to clean up sites when those who caused the contamination can't or won't pay. Companies may be unable to pay for a variety of reasons. They may be too small—an individual or a small company without sufficient assets. Perhaps they have declared bankruptcy. In other cases, responsible owners can't be identified or found. On the other hand, many companies can and do pay for cleanup at sites they helped to contaminate.

EPA spends considerable effort tracking down the "potentially responsible parties" (PRPs)—firms and individuals who created or added to a hazardous waste problem. Indeed, the Superfund program makes it a high priority to find parties who can perform or pay for cleanup.

EPA uses a variety of enforcement tools (e.g., administrative orders, consent decrees, negotiations) to engage responsible parties in site cleanup. Every successful negotiation of a private-party cleanup means that the money in the Superfund can be directed instead to those sites that represent immediate emergencies, or that have no hope of ever being

Safe transport of hazardous waste is a concern of the Resource Conservation and Recovery Act. This driver is checking his manifest before proceeding.

cleaned up by those responsible.

Success in making polluters pay is measurable. Participation in cleanups by PRPs increased from 40 percent in 1987 to more than 60 percent in 1989. Strictly enforcing laws that enable EPA to recover clean-up costs has saved the Superfund about $2 billion in work value since 1980. Half of that sum has been recovered since late 1986.

EPA Tackles Imminent Threats Immediately

The Superfund responds immediately to situations posing imminent threats to human health and the environment at both NPL sites and sites not on the NPL. The purpose is to make sites safe by stabilizing, preventing, or tempering the effects of a hazardous release, or the threat of one. Imminent threats might include tire fires or discarded waste drums leaking hazardous chemicals.

EPA has invested considerable resources in identifying sites that present imminent threats and in undertaking the emergency responses required. The Agency has developed teams of professionals to combat threatening situations. These emergency workers may assist in cleanup of a dangerous spill or advise state and local officials on the need for a temporary water supply, air and water monitoring, removal of contaminated soils, or relocation of residents. Either EPA or the U.S. Coast Guard has taken Superfund-financed emergency action to attack the most imminent threats of toxic exposure in more than 2,000 cases. EPA has used its enforcement authority to have responsible parties perform emergency actions in approximately 450 additional cases.

RCRA: Post-War Consumer Demand Created A Problem

Following World War II, our nation's phenomenal industrial growth was matched by a surge in consumer demand for new products. The country seized upon new "miracle" products, such as plastics, semiconductors, and coated paper goods, as soon as industry introduced them. Our appetite for material goods also created a problem: how to manage the increasing amounts of waste produced by industry and consumers alike.

In 1965, Congress passed the Solid Waste Disposal Act, the first federal law to encourage environmentally sound methods for disposal of waste. Congress amended this law in 1970 by passing the Resource Recovery Act and again in 1976 by passing the Resource Conservation and Recovery Act (RCRA).

As our knowledge about the health and environmental impacts of waste disposal increased, Congress revised RCRA, first in 1980 and again in 1984. The 1984 amendments were created, in large part, in response to strongly voiced citizen concerns that existing methods of hazardous waste disposal, particularly land disposal, were not safe.

Generally speaking, Superfund focuses on mistakes of the past, whereas RCRA addresses the problems of the here and now through a system of controlling hazardous waste from generation to ultimate disposal. However, RCRA does authorize EPA to require "corrective action" cleanups at RCRA-regulated hazardous waste management facilities. RCRA also regulates toxic substances and, through the UST program, petroleum products stored in underground tanks.

Hazardous Wastes Had To Be Defined

Hazardous wastes come in all shapes and forms. They may be liquids, solids, or sludges. They may be the byproducts of manufacturing processes, or simply commercial products—such as cleaning fluids or battery acid—that have been discarded.

In order to regulate hazardous wastes, EPA first had to determine which wastes would be considered hazardous under the law. The Agency spent many months talking to industry and the public to develop a definition for its regulations. As a result of this work, the regulations identify hazardous wastes based on their characteristics and also provide a list of specific wastes.

A waste is hazardous if it exhibits one or more of the following characteristics:

- *Ignitability*. Ignitable wastes can create fires under certain conditions. Examples include liquids, such as solvents that readily catch fire, and friction-sensitive substances.
- *Corrosivity*. Corrosive wastes include those that are acidic and those that are capable of corroding metal containers, such as tanks, drums, and barrels.
- *Reactivity*. Reactive wastes are unstable under normal conditions. They can create explosions and/or toxic fumes, gases, and vapors when mixed with water.
- *Toxicity*. Toxic wastes are defined as containing one or more of 39 specific compounds at levels that exceed established limits. These wastes can contaminate ground water at levels high enough to cause detrimental human health effects.

Rules for Generators of Waste

EPA designed its regulations to ensure proper management of hazardous waste from the moment the waste is generated until its ultimate disposal. The first step in the cycle is the person who actually produces the waste. Generators include large industries, small businesses, universities, and hospitals.

Under the regulations, generators must determine if their waste is hazardous and must oversee its

Tri-State Motor Transit Co. photo.

ultimate fate. They must obtain an EPA identification number for each site at which the waste is generated.

According to EPA estimates, generators treat or dispose of about 98 percent of the nation's hazardous waste on site. On-site treatment, storage, and disposal facilities generally are found at larger businesses that can afford treatment equipment and that possess the necessary space for storage and disposal. Smaller firms, and those in crowded urban locations, are more likely to transport their waste off site where the waste is managed by a commercial firm or a publicly owned and operated facility. EPA regulations apply to both on-site and off-site facilities.

The generator must package and label waste that is to be transported off site. Proper packaging ensures that no waste leaks during transport. Labeling enables transporters and public officials, including those who respond to emergencies, to rapidly identify the waste and its hazards.

The Manifest Tracks The Waste

Although only a small percentage of the nation's hazardous waste is actually transported off site to treatment, storage, or disposal facilities, this still comprises a substantial volume: approximately 4 million tons per year. EPA requires generators to prepare a one-page form, or manifest, which identifies the type and quantity of waste, the generator, the transporter, and the facility to which the waste is being shipped.

The manifest must accompany the waste wherever it travels. Each individual handler of the waste must sign it. When the waste reaches its destination, the owner of that facility returns a copy of the manifest to the generator to confirm that the waste arrived. If the waste does not arrive as scheduled, generators must immediately notify EPA or the authorized state environmental agency.

Transporters must carry copies of the manifests and must put symbols on the vehicle to identify the waste. These symbols, like the labels on the containers, enable fire fighters, police, and other officials to immediately identify the potential hazards in case of an emergency.

Permits Ensure Safe Operation of Treatment, Storage, and Disposal Facilities (TSDFs)

The facilities that receive hazardous waste from the transporter must obtain an EPA permit to operate. *Treatment* facilities use various processes to alter the character or composition of waste. Some processes enable waste to be recovered and reused, while others reduce the volume of waste to be disposed of. *Storage* facilities hold waste until it is treated or disposed of. Historically, prior to RCRA restrictions on land disposal, most disposal facilities buried hazardous waste or piled it on the land. (See below, "Land Disposal Has Posed a Threat.")

Virtually all operating land disposal facilities and incinerators, as well as several hundred storage and treatment facilities, have now been issued RCRA permits. RCRA permits contain detailed design and operating specifications that each hazardous waste unit must comply with. Until a RCRA facility receives its permit, it is required to operate under "interim status" and comply with a more general set of management standards.

As their capacity becomes used up, and as new stringent operating requirements are imposed, many hazardous waste disposal facilities have decided to close. RCRA regulations require TSDF owners to prepare carefully for the time when their facility will close. Owners must:

- Acquire sufficient financial assurance mechanisms (such as trust funds, surety bonds, or letters of credit) to pay for completion of all operations.
- Where waste will be left on site, be prepared to pay for 30 years of ground-water monitoring, waste system maintenance, and security measures after the facility closes.
- Obtain liability insurance to cover third-party damages that may arise from accidents or waste mismanagement.

Corrective Action

The 1984 amendments added a remedial dimension to RCRA in the form of extensive "corrective action" authorities that apply to RCRA-permitted facilities and facilities operating under interim status. Under the corrective action program, if contamination is suspected at a RCRA-regulated facility, due to past or ongoing releases of hazardous waste, the owners/operators of the facility may be required to perform an investigation and follow through with remedial measures. By mandating the RCRA corrective action program, Congress supplemented EPA's existing clean-up authority under Superfund, which is meant to focus specifically on the worst abandoned or uncontrolled

hazardous waste sites in the United States—namely those sites which qualify for the NPL.

EPA or an authorized state may initiate corrective action through the normal RCRA permit process or, alternatively, through an enforcement order.

Unlike Superfund, there is no federal fund to support corrective action under RCRA. Instead, facility owners and operators must provide financial assurance that they can complete corrective action as necessary. Specific corrective action requirements depend on the kind and degree of contamination identified at a facility; they may include such diverse measures as erecting a fence around a contaminated area, repairing waste unit liners, installing a pump-and-treat system to remove a plume of contamination, or excavation and treatment or removal of contaminated "hot spots."

The basic procedural steps of the corrective action process are roughly analogous to the steps followed at a Superfund NPL site (see box on page 11). They are:

- *RCRA Facility Assessment*: Systematic identification of actual or potential releases through examination of each solid waste management unit at a facility.
- *RCRA Facility Investigation*: Characterization of the nature, extent, and rate of migration of each release.
- *Corrective Measures Study*: Identification of appropriate corrective measures; study of their likely effectiveness and feasibility.
- *Corrective Measures Implementation*: Design, construction, and implementation of corrective measures. (Appropriate interim measures may be taken at any point in the process.)

All steps except the initial facility assessment are conducted by the owner/operator of the RCRA facility, with oversight by EPA or a state. RCRA facility assessments are conducted directly by EPA or the state.

Land Disposal Has Posed a Threat

In the past, most hazardous waste was disposed of with only limited treatment. Improper disposal endangered public health and the environment. As a result, in the 1984 RCRA amendments Congress banned the land disposal of untreated waste unless EPA finds that there will be "no migration of hazardous constituents . . . for as long as the wastes remain hazardous."

The RCRA restrictions on land disposal have given considerable impetus to the development of waste treatment. EPA is sponsoring research on technologies to destroy, detoxify, or incinerate hazardous waste; on ways to recover and reuse it; and on methods to reduce its volume. The amendments also encourage generators to reduce the volume of waste through process changes, source separation, recycling, raw material substitution, or product substitution.

Underground Storage Tanks

Leakage Problems

In the small community of Truro on Cape Cod, residents discovered their wells were contaminated with gasoline that had leaked from a nearby underground storage tank. The courts ordered the company responsible to provide residents with bottled water and to spend millions of dollars to restore the water supply. On the other side of the country, in the South Bay area of San Francisco, leaks and spills of toxic solvents from underground tanks and their pipes have severely contaminated the ground water. Thousands of other communities across the country face similar problems.

Both accidental releases and the slow seepage of petroleum products or hazardous chemicals from buried storage tanks can contaminate ground water. EPA estimates that as many as 15 to 20 percent of the approximately 1.8 million underground storage tanks in the United States covered by the federal law are either leaking now or are expected to leak. Facts such as these led Congress, in the 1984 RCRA amendments, to require EPA to regulate underground tanks containing petroleum products and hazardous chemicals. In 1986, Congress set up a $500 million trust fund, to be paid for over five years, to clean up leaks from underground petroleum storage tanks. The fund is supported by a 1/10 of a cent federal tax on certain petroleum products, primarily motor fuels. In 1990, Congress reauthorized the trust fund for an additional five years, this time with no cap on the amount of funds collected.

Owners Had To Register Their Tanks

Prior to 1984, only a few states had programs to monitor underground storage tanks (USTs). Therefore, one of the first steps EPA took was to require owners to notify and register their tanks with state or local agencies. To assist in this effort, the Agency required anyone who deposited petroleum or regulated hazardous substances in an underground storage tank—for example, the driver of a gasoline tank truck—to inform the tank owner of his or her responsibilities to fill out a notification form.

New Rules for Tank Owners

The major goal of the UST program is to protect human health and the environment from underground storage tank releases. To achieve that goal, EPA developed regulations to: ensure the use of sound, protective tank technology and management practices; require that contamination from tanks be cleaned up; require owners and operators to acquire the financial means to clean up contamination from their tanks, as mandated by the law; and establish practical and reasonable standards for the states to meet in carrying out the program.

Following are some of the specific requirements established by the UST program:

- Depending on the age of the tank, leak detection requirements for tanks and piping are being phased in over five years (by December 1993).
- Tank upgrading requirements, amounting in essence to new tank standards, for existing USTs must be met by December 1998.
- Corrective action requirements have been set whereby all suspected releases must be investigated, and for confirmed releases, specific remedial requirements must be satisfied.
- Tank owners are subject to financial responsibility requirements to assure that resources are available to pay for damage caused if leaks occur. □

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Questions the Public Is Asking

An Interview with Don Clay

Few environmental problems loom larger in public perception than toxic waste, and few EPA programs come under more intense scrutiny than those aimed at cleaning up hazardous waste sites and toxic spills. EPA Assistant Administrator Don R. Clay has a big job: He heads the Agency's Office of Solid Waste and Emergency Response (OSWER), which oversees hazardous waste clean-up programs under both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or "Superfund") and the Resource Conservation and Recovery Act (RCRA). EPA Journal interviewed Clay about how work is going on the front lines of EPA's Superfund and RCRA programs. The questions and answers follow:

Q We realize that Superfund sites vary a great deal, but can you describe a typical one—how big it is, what it contains, how long it's been there?

A I don't think I can describe a typical Superfund site. Although many have similar characteristics, a large number of sites are unique. The topography is different; the ground water is different and so on. That is one of the things that makes this program so different from any other.

There is a popular misconception that all Superfund sites are abandoned. Most are, but many still have ongoing activities. A lot of the municipal waste dumps, for example, still have things going on. So they are not just abandoned off in the corner.

Most often, though, when people go out to look at a site, they are disappointed. One of the first things we do, through our removal authority, is take away the surface contamination: the drums, the barrels, and that type of thing. In other words, we remove the acute threat. By the time people get there, little visible contamination remains. What is left is a ground-water problem. You can go out to some of the worst sites in the country, and you'll think you're looking at a parking lot. Go out to Rocky Flats, one of the most famous sites, and you might think it's an ordinary field; there's nothing there but a few wells.

Q You have close to 1,200 sites on the National Priorities List, and you're spending about $25 million per site. That's a lot of money. Why does it cost so much to clean up a site?

A A lot of the cost is in cleaning up ground water. It is fairly easy to take away the surface contamination, the barrels and what have you, but once you have materials going down into the ground, cleanup can be very difficult.

Generally speaking, the RCRA and Superfund programs began cleaning up ground water in 1980. But unlike some of the other programs—the air program, for example—the technology wasn't available. We didn't know how to do it. We still have a lot to learn.

We've done a lot of pumping and treating, which certainly helps to keep pollution from spreading. But we still might not be getting all the contaminants out. It is just very difficult, once the ground water is polluted, to clean it up. That really makes us strong believers in pollution prevention.

When you've been in the program for a while, prevention is one thing you start believing in: It is a whole lot better to keep pollution from becoming a problem in the first place than it is going in afterwards to clean it up.

Q Is that why only 34 sites have been pronounced clean and taken off the NPL?

A Getting sites off the NPL is not our only criterion for success. We think that the 2,000 cases in which we've gone through and removed the surface contamination, thereby taking care of the acute threat, are also very important. These removals are where we've had the most risk reduction.

Also, we have a strong commitment to do worst sites first, and the worst parts of a site first. Each site has more than one unit where cleanup is needed. If a site has five units, for example, and only four are high risk, we will focus on cleaning up the first four but not the fifth. We will clean up high-risk units at other sites before we go back and finish the lower-risk unit. Reducing risk is our priority, not just getting sites off the NPL.

Continued on next page

You mention 34 that have already been delisted, but 63 or 65 have had all of the work completed and are in the process of being delisted.

Q Typically speaking, how do you clean up a Superfund site? Do you treat the waste, or do you move it to a new site that is operated properly?

A In the early days, we moved a lot of waste off site. Most of the remedies now, over 70 percent, involve treatment at the site itself. In some cases, we incinerate the waste, but the public is becoming increasingly resistant to incineration. And one of the things that Superfund does, perhaps better than any other program, is involve the immediate community in what we are doing.

More and more, people want waste cleaned up on site. They don't want the trucks going in and out. And where do you move the waste? Nobody else wants to take it either. It is becoming harder and harder to move waste around.

That's why we've been working hard to identify and test innovative technologies. Bill Reilly and I are very committed to this effort. We've established a Technology Innovation Office to work with the Agency's Office of Research and Development (ORD) on trying to get new technologies out there.

We have a whole series of technologies coming. In the old days, it was mostly incineration or take it somewhere else. Now, we are doing air stripping, soil washing, and a lot of bio-remediation. We are trying lots of new things, and many of these new technologies are coming along.

Q Staying with the technology for a moment, the trade journals, among others, say that the cost of cleaning up Superfund and RCRA sites over the next few decades will run into hundreds of billions of dollars. You would think that the industry would be falling all over itself to develop and apply new technologies. However, reports say they are sticking with conventional methods.

A No one likes to do a job twice. When you use innovative technologies you are taking a chance, because innovative technologies, almost by definition, seldom work the first time around. One of the ideas behind our Technology Innovation Office is to persuade the industry to take a chance, to try different things.

We're making progress. For example, we're bringing together federal facilities, which provide the land, with contractors, who provide the technology, and we see what works. But it's difficult. Cost and liability are always a concern.

In addition to our Technology Innovation Office, we also have the SITE program (Superfund Innovative Technology Evaluation program), which is run out of ORD in Cincinnati. They put money into the development of new technologies and then go out and try them out at a site. We also encourage use of the federal technology transfer program, which involves cooperative research.

The innovative technology market has a great deal of potential for growth. It is important to realize that the EPA market is not the only market. The Department of Defense and the Department of Energy are going to be spending much more for cleanup at federal facilities than EPA is spending on Superfund. The Department of Energy remediation budget for federal facilities is already something like $4 billion and going up.

Within a few years, EPA will no longer be the biggest force in the clean-up arena. We will always keep control of the rules and monitor how well cleanups are done, but the big bucks are going to come from other parts of the federal government: as much as $20 billion from Defense; maybe $85 to $100 billion from Energy. The Hanford plant, alone, is going to cost billions to clean up.

Q Take us through your program for locating the parties who dumped waste at a site. Is it worth it? Do you recover that much in the way of clean-up costs?

A We put a lot of emphasis on finding the parties responsible for the waste. The procedure varies, but we always start by contacting the people we think have dumped at the site and attempt to engage them voluntarily in the clean-up work.

To identify potentially responsible parties (PRPs), we use whatever tools are available: newspaper ads, interviews, etc. Some EPA regional offices have gone so far as to use radio ads to solicit information from those who might remember dumping activity. We've searched out the truck drivers that hauled the waste and had them retrace their routes for us. We've even hired private investigators to help us track down former employees.

As to it's being worth it, last year 60 percent of the new work that was scheduled will be paid for by responsible parties. In other words, we had more money being spent by them than by us. In the last two years, we've

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gotten over $2 billion worth of work signed up by responsible parties; it was $1.3 billion last year alone.

Q Some argue that EPA gets so tied up in litigation that cleanups are delayed. Are you shooting yourself in the foot with the enforcement-first principle?

A Actually, the time difference in startup between a cleanup paid for by Superfund and one paid for through enforcement is less than a month. There is no question that a lot of lawyers are involved in the program, and we're work- ing on studies that will tell how much it's costing in transaction costs. But the time involved is not much different at all.

Q Tell us about your emergency response teams. How do they get called into action, and what do they do?

A The teams are called into action either directly, by a regional office, or indirectly, through the National Response Center, which is operated by the Coast Guard. We dispatch an on-scene coordinator, who goes out and makes an assessment of what has to be done.

These on-scene coordinators are the stars of the Superfund program. They are the ones who are out on the front lines. They are a very talented group of people, very dedicated, and they love their work.

They are real go-getters. They will go do anything that has to be done. If you told them that you wanted this building moved six feet north by tomorrow morning, by tomorrow morning this building would be moved six feet north.

Q Superfund has been in business now for more than 10 years. And, in a very real sense, Superfund sites are in people's backyards. How are you doing with community relations?

A Community relations is an important part of the Superfund program. Sometimes I feel a little ambivalent—I've been out on sites and almost been taken hostage—but it is important to involve the community, and overall we think we're doing a good job. The program sets a lot of conflicting goals: Go fast, try new technologies, involve the community.

EPA photo.

Hazardous waste can contaminate ground water. This man from EPA's Robert S. Kerr Environmental Research Lab, Ada, Oklahoma, uses a vacuum pump to take a sample from a well.

And it's hard to balance them. Our technical assistance grants (TAG) program helps. We use the grants to fund community groups who bring in independent consultants to see how we're doing.

In the long term, I believe involving the community speeds things along. It's frustrating at times, but to have people understand what is going on is important. You have to remember, people can be very emotional on this subject. You may not find people getting very excited about ozone depletion, but if they live next to a Superfund site, you'll know it.

Some of the best people in the Agency are working in community relations at the controversial sites. It is an amazing thing to watch when it's done right. They have an ability to calm troubled waters by getting information and sharing it. In many cases, that's all people want—for somebody to tell them the truth about what is going on.

Q Progress with Superfund sometimes seems to be a battle of numbers. How can EPA communicate in plain English to the general public without necessarily using all these numbers, thereby inviting more debate about whether there is real progress?

A We're taking two approaches. One is to publish National Priority List books. We do books by sites, and we do books by states. The books tell people what is going on at their site. They communicate in plain English: Here is what's happening; here is where we're at; here is the status.

The second approach is to report progress in terms of what we call environmental indicators. We are trying to get across that the number of sites deleted is not the sole indicator of how well we're doing. For example, we talk about the volume of waste that we handle, which is massive. We've taken away 9.4 million cubic yards of waste. We've treated 16 gallons of water for each person in the United States. To put it another way, we've treated something like 4 billion gallons of water. We have work going on at the majority of sites, and so on.

These indicators cannot substitute for actual risk reduction, but risk is very difficult to measure and communicate. A lot of the risk reduction is done at the very first stage, when we take the surface contamination away. We're trying to communicate the real progress we're making at thousands of sites while helping the public understand that we still have a long way to go.

Q What is your prognosis? Are we ever going to "sunset" Superfund? How long is it going to take to clean up all these sites?

A It is going to take a long time. When we started 10 years ago, no one, including ourselves, understood how many sites there were going to be and how long it was going to take to clean them up.

We're adding about 100 sites every year to the National Priorities List, and we expect to do that out to the year 2000. We will be taking some off, but not quite as fast. So we expect the list to continue to grow.

In the first 10 years of the program, an emphasis was placed on initiating cleanups, developing management systems and controls, and establishing the science needed throughout the clean-up process. We undertook a major assessment of where the program stood in mid-1989. That

resulted in strengthening enforcement efforts to compel responsible parties to clean up sites, making sites safer by controlling acute threats immediately, making sites cleaner by addressing worst sites and worst problems first, and developing new clean-up technologies. Now, drawing on a decade of experience, EPA is examining whether and how Superfund site assessment and clean-up activities can be accelerated by identifying and eliminating any unnecessary delays at points in the "pipeline" and by evaluating opportunities for streamlining the current process.

Part of what we have to do is balance the risk of these sites against the other kinds of risk that society has to pay for. The Superfund was reauthorized very contentiously in 1986. Then there was a second reauthorization, with taxing authority, last year.

But that doesn't mean the debate is over. People are already starting to gear up for a debate in the 103rd Congress. They are going to go back and look at how well we've done, how well we should be doing, and whether there is a more efficient way of going about it.

The American people want this problem addressed. If you look at any sort of poll, you will find that abandoned hazardous waste sites rank very high among the American people's environmental concerns. So do active waste sites.

No one thinks the program is going to go away in the short term. There are various schemes being proposed for funding the program; Congress will enter into that debate. But the program will be around for awhile.

Q Let's talk about RCRA for a moment. As we understand it, the so-called RCRA corrective action program could involve many more hazardous waste sites than Superfund.

A Corrective action is the sleeping giant of the RCRA program. What it means is: As a condition of getting a permit to keep operating a hazardous waste treatment, storage, or disposal facility, you have to go back and clean up the whole facility.

Unlike Superfund, in which we might have to go out and find the party, in RCRA corrective action we have parties applying to us. In order to get their permit, they have to go out and look at the back 40 and give us a plan for cleaning up the whole plant.

There are a lot of potential sites there, maybe 3,600 to 4,000 in the universe, which is much bigger than the 1,200 that we have on the Superfund NPL. However, many of them, perhaps two-thirds, are much simpler to clean up. Somewhere between a third to a half will be serious.

It's a big problem. The money will have to come from the people who want the permit. What we have to watch out for is the financial health of the industry. If companies go out of business, sites are abandoned. Then we'll have to clean them up through the Superfund program. After all, one of the goals of RCRA is to prevent creating new Superfund problems.

Q Could you touch on the Underground Storage Tank program? Is the UST trust fund like Superfund?

A The UST program is designed to address the problem of gasoline leaking from underground storage tanks at service stations and other facilities. Again, it is a sleeping giant. We estimate that in the next eight years society will spend something like $50 billion on the problem, which means we'll be spending more on underground storage tanks than on Superfund sites.

One difference is that the trust fund is not the same. The UST fund is much smaller, and it is designed to help states run programs, rather than to directly fund cleanups. The states really own the UST program. Thirty-seven states have created their own funds. They are augmented a little by the federal fund, but there is not the same level of federal involvement. We keep a minimal UST staff at headquarters and very lean regional office staffs.

Whereas UST is almost completely a state program, RCRA defers a lot to the states; and the role of states in Superfund is still being developed. So there is a contrast all the way across the three programs.

Q Would you comment on the so-called "fairness" issue regarding Superfund?

A Well, to put it simply, 10 or 20 years ago, people went out and disposed of waste in the best way they knew how. They went to a state-licensed facility and did everything according to the law as it was then. Now, we come back years later and Superfund says you have to pay to clean it up.

As a result, Superfund offends a lot of companies' sense of fairness. If they were doing everything according to the law at the time, how can we go back now and say they have to pay? They already paid once to dispose of the waste.

Congress thought about it, and still wrote the law as it is. As we enter the next reauthorization, I think a lot of firms are going to raise this issue again.

My position is that it is EPA's job to carry out the law the way it was written. We try to involve as many people in the process as we can, but it's difficult.

Overall, I am upbeat about the program. It got off to a slow start, but I think it has matured, and I think we are running it in a consistent manner. There is no question that the law can be perceived as unfair by those who are caught in it. But I think these issues will be addressed during the debates in Congress. EPA will certainly participate in those debates but will also continue to carry out the program and continue making progress on cleanups within the current law.

Superfund: Candidly Speaking

EPA has a lot of balls in the air, but can't get them down.

by Thomas P. Grumbly

(Grumbly is President of Clean Sites, Inc., a non-profit organization working to solve America's hazardous waste problem. In addition to providing direct on-site assistance, Clean Sites develops policy recommendations and conducts educational and outreach activities.)

Is the Superfund program, which has come under so much criticism during its 10-year history, finally succeeding? Given the quick reauthorization last year by Congress, one might be tempted to say "yes." But this enormous program still faces serious obstacles. To announce success, as EPA did in December, and not tackle the problems still facing the program, could reverse what clearly has been an upward trend in achievements over the last three years.

This article presents a strategic analysis of the improvements needed in the program under current law. As a preliminary to the analysis, it is important to understand why Congress reauthorized the program at the end of the last session, and the lessons we should take from it. The impetus derived from a number of interests coming together at the same time:

- Congressional staff had worked long and hard on amendments to the Clean Air Act, and many still remembered the bruising nature of the previous Superfund reauthorization.
- Members of Congress and the Administration understood that hazardous waste cleanup is a "hot button" with constituents and that not enough progress had been made to warrant bringing the problem to the political forefront again.
- Environmental interests, in general, believed that the current statute favored their concerns; industrial interests were not convinced that raising their concerns would result in improvement.
- And finally, the Superfund program had made enough progress in the last two years to convince both Congress and the Administration that the program should be given a longer chance to work.

It is clear that the reauthorization was not intended as a message that all is well. Almost everyone believes that substantial obstacles to success remain. Many believe that the program cannot succeed as currently structured. There is, in other words, plenty of fertile ground both for debate and improvement before the next reauthorization.

The Problem: What Is Success?

In December 1990, EPA published a 10-year review of Superfund in which it argued it has achieved "success on all fronts." This is an overstatement based upon a failure to understand, articulate, and analyze what real success would be. Ironically, this failure may be depriving the Agency of credit for a major victory.

There undoubtedly has been progress with respect to the volume of work being performed. The Agency has steadily increased all of what I call "inputs" over the past three years: study starts, design and construction starts, remedies selected, dollars spent, and orders issued. EPA also claims success as measured by the sheer volume of waste it has dealt with. It has moved or burned, in its own terms, more than 5,000 football fields worth of contaminated soil.

What is not clear, however, is what all these inputs mean for protecting human health and the environment. In general, EPA presents its progress in

We need an enforcement strategy that is perceived as tough but equitable across-the-board.

cumulative terms. Unfortunately, a close look reveals that it will not be able to maintain its current pace. It is unlikely that the input successes of 1991 will even equal the 1990 numbers. In effect, the Agency has already milked the system. Over the past few years, very few new sites have been added to the National Priorities List (NPL), and, as a result of the Agency's (and the statute's) strong focus on getting work started, the long-term clean-up pipeline is filling. Of the roughly 1,200 NPL sites, 272 have long-term cleanups underway, and remedies have been selected for 264 others. The input numbers, therefore, will tail off as the pipeline is addressed.

Another area of success cited by the Agency is its "enforcement first" strategy, which favors settling with potentially responsible parties (PRPs) over financing actions with Superfund. This strategy has dramatically increased the settlements with PRPs and the dollars obtained from the private sector. However, it has also angered the responsible party community by what they regard as a return to soaking the "deep pockets."

If EPA continues to measure success in these terms, the outlook for the program over the next few years is not promising.

In the absence of a fairly radical restructuring of how program funds are distributed, it is highly unlikely that more than 100 additional sites will have construction completed and be deleted from the NPL by the end of 1992. Since deletions are still the primary measure of success that most observers use, the least charitable assessment (the one Superfund usually receives) will show that we will have spent nearly $15 billion and eliminated only 10 percent of the country's worst hazardous waste sites.

Unfortunately, unless the program is altered, this picture doesn't change dramatically even when we look out to the end of the decade. Our best guess is that, under current rules, fewer than 500 sites will be deleted from the existing NPL by the year 2000. Considering that as many as 700 new sites are expected to be added to the NPL over the same period, we will still have 1,500 most dangerous hazardous waste sites to clean up, or 200 more than we now have. And that will be a full 20 years into the Superfund program.

In other words, the program will have declining input success, with no concomitant increase in commonly understood output success. Further, the number of cleanups underway and their cost will continue to rise. This will be the worst of all worlds. It is happening because we have not thought through what success is and what strategies have to be put in place to optimize progress at *all* the critical stages—identification, enforcement/settlement, remedy selection, construction, and site deletion.

A Strategic Plan For Superfund

In the early years of the Superfund program, the emphasis was on private-party support and on the technologies to be applied to sites. While these issues are still important, I would argue that improving the remedy selection process and focusing on reductions in risk to human health and the environment and on the perceived competence and consistency of the government are at least as important. I would also argue that transaction costs, the great bugaboo of Superfund, would decline enormously if greater attention were paid to the managerial and scientific elements of the program.

With the program now entering maturity, the emphasis should change. EPA should cash in on its accomplishments to date and move ahead with a program that ensures cleanups are effective in the long term and adequate funds are available from the private sector to maintain momentum. This will require the combination of an elemental

By Tom Meyer. Copyright. San Francisco Chronicle. Reprinted by permission.

management approach to defining and achieving success and an analysis of the long-term scientific and technical needs of the program.

There are five imperatives to any Superfund strategic plan that are essential to success:

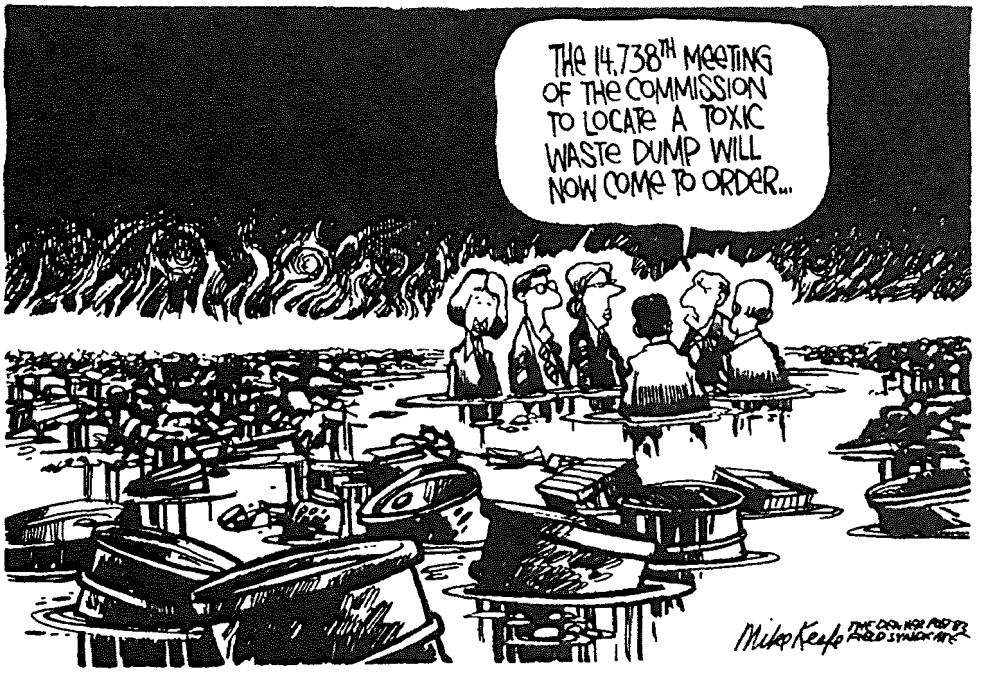
- Clearly define success.
- Implement an equitable enforcement program.
- Focus remedy selection around objective-setting and interaction with stakeholders.
- Invest in long-term research and development.
- Develop consistent administrative procedures.

We must do a better job of defining, measuring, and publicizing success. The critical success measure, upon which deletion from the NPL should be based, is protection of human health and the environment. In this context, it is important to note that EPA has made great strides in eradicating the worst threats that were posed by hazardous waste sites when the program began 11 years ago.

At the outset, I said that EPA may already have succeeded in large measure. Its removal program has probably eliminated most of the *immediate* health risks posed by abandoned hazardous waste sites. We need to discover whether this is true, document it, and use the information to help EPA focus on risk reduction in its remedial efforts. To date, little credit has been given to EPA for the risk reduction these removal actions achieve.

The main reason for this lack of recognition is that the current construction-management approach to cleanup focuses on the application of technology to hazardous waste problems. It does not characterize, sufficiently, what is to be achieved from the standpoint of human health and the environment. As a result, the public and the Agency never know when the health and environmental "mark" has been achieved.

The Agency needs to think much more about the end of the game at the beginning of the process. Over the next two years, each and every NPL site *needs to have its "objectives"—both* qualitative and quantitative—spelled out in detail. As part of this process, explicit plans should be laid for



Mike Keefe cartoon. Reprinted by permission.

expending the necessary resources right through deletion from the NPL. Right now, EPA has a strategy for getting a lot of balls in the air, but not for getting them down.

We need an enforcement strategy that is perceived as tough but equitable across the board. An "enforcement-first" strategy that relies too heavily on unilateral administrative orders directed at traditional deep pockets will result in a progressively declining program. A more successful strategy would demand a mix of negotiated settlements, unilateral orders, damage suits against recalcitrant parties, and a really active potentially-responsible-party search program.

This strategy would require full use of the provisions that Congress included in the 1986 Superfund amendments but which have not yet been seriously implemented, including: *de minimis* buyouts, in which PRPs with limited liability could pay cash up front to be released from future involvement in a cleanup; non-binding allocations of responsibility (NBARs) issued by EPA to assist in the organization of PRP groups; and mixed funding, in which EPA would share the initial cost of cleanup with firms that step forward to perform the work in anticipation of recovering costs at a future date from recalcitrant parties. The strategy's cornerstone, negotiating settlements with PRPs, must be based on policies governing standard consent decrees that are stringent enough to bring in sufficient clean-up dollars, but not so one-sided in character that they push companies away from seeking settlements.

We must put into place a remedy selection process that emphasizes objective-setting, clearly defined criteria, and dramatically increased communication and dialogue among all parties. Remedy selection is the linchpin of the Superfund program. It determines the level of protection for citizens living and working near sites, the level of restoration of the land, and the cost to the responsible parties or to the Superfund trust fund.

Clean Sites conducted a year-long project that examined the current approach to selecting remedies. This project brought together more than 100 experts representing diverse interests. A major finding was that the current remedy selection process works backwards—EPA explores in depth all the alternative clean-up methods it plans to consider before determining the level of protection it is seeking or the potential future uses of the site. We found that no consensus exists on what constitutes "protection of health and the environment"—the law's overarching mandate for cleanup and *remedies—and that levels of protection* vary from site to site. We also found that definitions for other statutory criteria—permanence, long-term

effectiveness, cost-effectiveness, and treatment—are ambiguous and applied inconsistently.

We issued a report recommending an alternate process in which EPA, with input from all stakeholders, would set explicit objectives for each site based on the site's expected future land and resource use. These objectives would be based on a target for an acceptable amount of residual health risk that is uniform for all sites. EPA then would explore only those clean-up methods that meet the site's objectives. Under the process we suggest, EPA would define a permanent remedy as one that will endure indefinitely and would develop at least one permanent alternative for each site. EPA would select the remedy that will endure the longest for the least cost.

This process would require that EPA give uniform definitions to statutory criteria and apply them explicitly and consistently in the process, that citizens and states be given all technical information as it becomes available, and that EPA elicit and respond to citizens', states', and responsible parties' comments *before* selecting a "preferred alternative."

We need to prompt public investment in long-term research and development in hazardous waste science and technology. We must make the investments in research and development that are necessary to improve both our fundamental understanding of the most commonly seen chemicals, as well as develop the knowledge needed for making risk assessments. While our inadequacies in exposure assessment are important to all areas of environmental policy, the economic impact of our current lack of knowledge in the area of risk assessment is most evident in the hazardous waste arena. We simply must improve the data that underpin exposure assumptions if we want EPA decision makers to rely upon risk assessment in making decisions.

The investment is warranted. The amount of potential cleanup facing the nation is staggering. The cost of cleaning up the existing 1,200 sites on the NPL is expected to approach $40 billion. Federal facilities, ranging from those under the aegis of the Departments of Interior and Defense to the Department of Energy, could cost as much as $200 billion. And while no one yet has reliable estimates of what the costs of RCRA corrective action cleanups might be, many knowledgeable persons both in industry and in government believe that RCRA responsibilities could easily dwarf expenditures in Superfund! Beyond these federally controlled sites are an estimated 28,000 sites under the authority of state regulation, and the spending on these sites also continues to rise. In sum, it is not too much to say that we will be spending between $10 billion and $20 billion per year in hazardous waste cleanup by the year 2000 and that this will represent 10 to 20 percent of all pollution control expenditures in the Unites States.

It is not too much to say that we will be spending between $10 billion and $20 billion per year in hazardous waste cleanup by the year 2000 . . .

This situation is a far cry from what was envisioned when Congress passed Superfund in 1980. Then, hazardous waste cleanup—or at least abandoned hazardous waste site cleanup—was to be a quick mop-up of a few sites. With that emergency response scenario in mind, it is unsurprising that little thought was given to building a scientific and technical infrastructure to support the program.

Our current situation should lead us to reassess the importance of science as a critical element for successful cleanups. Not only is the problem of a magnitude to warrant major investment in making our programs more effective, but also, for better or worse, we now know that we have the time for science to play a significant role—even if it takes a decade to produce results.

A serious focus also needs to be placed on removing the impediments to improving the application of new technology. Thus far, EPA's Superfund Innovative Technology Evaluation (SITE) program has not succeeded in energizing either vendors or users in the private sector to use existing technology in new ways or to use new technology at actual sites. Perhaps the regulatory liability obstacles are key, but it seems to us that EPA could still play a role in fostering more cooperation between engineers and scientists in the private sector and their counterparts in government. The Defense Department, and particularly the Department of Energy, also are thrashing about trying to deal with the development of remediation technologies. What is needed is a "guild" of scientists and engineers that knows no institutional bounds and has the ability to produce creative solutions to very difficult problems.

An administrative process is needed that places a premium on consistency and competent regional project managers, supported by adequate teams of program and contract personnel, and guided by teams of headquarters/regional personnel. EPA made the decision in 1988 to delegate all site-specific decisions to the 10 regions. While this decision was appropriate to speeding decision making, it has left the Agency without a central nervous system and regional personnel without sufficient direct headquarters guidance. The solution is not to redelegate back to headquarters but to build a greater level of consistency and support into the program. EPA headquarters can achieve greater consistency by ensuring adherence to uniform program guidance and uniform definitions for clean-up criteria and by building a number of highly experienced headquarters/regional teams to work intensively in specific program areas with the regions.

Conclusion

In the final analysis, even in the best situation, with well defined success measures, an agreed-upon relationship between risk and remedy, and a highly competent administrative force, many people would still not be happy with Superfund. Over the last four years, the Superfund program has become better managed at both the political and administrative levels. If it is to sustain public support, however, it must take some very hard steps or run the risk of being the White Elephant of the environment and discrediting the rest of the nation's environmental protection efforts. □

Three to six million barrels of oil went up in smoke each day.

While the fires blaze, a Kuwaiti oil field worker pauses for midday prayers. Torched by retreating Iraqi soldiers, many wells are still burning.

Responding to Eco-Terrorism

by Roy Popkin

Early this year, Iraq committed ecological terrorism in Kuwait. It deliberately spilled millions of barrels of oil into the Persian Gulf. It torched and sabotaged more than 500 Kuwaiti oil wells, storage tanks, and refineries.

The January oil spill was the largest ever: an estimated six million barrels of oil, 25 times the 250,000 barrels from the Exxon *Valdez* that fouled Alaska's Prince William Sound.

The oil fires started in mid-February were the worst the world has ever suffered: From three to six million barrels of oil went up in smoke each day at the peak of the fires.

Thick black oily clouds rose thousands of feet, occasionally turning midday into midnight in Kuwait City and in Saudi Arabian cities just south of the border. Said EPA Administrator William K. Reilly, after visiting the area in May: "If Hell had a national park, it would be those burning oil fires." Reilly also noted: "I have never seen any one place before where there was so much compressed environmental degradation."

The potential environmental disaster was enormous. U.S. and international teams quickly formed to help Kuwait, Saudi Arabia, and other Gulf nations

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deal with the threats to public health—including the health of coalition armed forces and diplomatic personnel—and to the region's ecology. EPA staff members took part in this multinational campaign to cope with Iraq's environmental atrocities. Herewith, some highlights of what followed.

The Oil Spill

The U.S. interagency assistance team (USIAT), including EPA staffers, arrived in Saudi Arabia January 28 in the thick of the war. It was soon joined by experts from the United Kingdom, Spain, Norway, and The Netherlands. A fundamental precept of environmental emergency response—to stop the spill at its source, then clean up—could not be followed, for the source of the spill was in Iraqi-held Kuwait. Thus, the priorities were:

- To keep the oil away from desalination plants, including the world's largest at Jubayl, which produces more than 200 million gallons of fresh water daily and provides 80 percent of Riyadh's water
- To remove the oil from the surface quickly, before it settled to the bottom near the plant intakes and became part of the ocean water inflow system
- To recover oil offshore to minimize environmental impacts
- To protect environmentally sensitive areas and key shoreline facilities.

The U.S. team, headed by the Coast Guard, helped develop a plan to divert oil away from desalting plant intakes. Containment booms were put in place and oil recovery skimmers put to work. In the months since the spill, about one million barrels of pure oil have been recovered, along with more than one million barrels of mixed oil and water. Some oil has coagulated on the ocean floor. Some has stained beaches and wetlands, and some has evaporated.

Although Saudi Arabia and Aramco, its national company, had experienced oil spills before, no one was prepared for the unprecedented six-million barrel spill that covered about 600

Persian Gulf oil spillage is many times that from the EXXON *Valdez:*

EXXON *VALDEZ*

PERSIAN GULF

Mines Under The Oil Slick

Bob Caron, an on-site coordinator who works out of EPA's Region 3 office in Philadelphia, was the first EPA staff member to go to the Gulf after the oil spill. He served as an observer on Coast Guard, Navy, and Saudi flights that tracked and mapped the oil slick's movements. The flights were often over active war zones. On the day of the first coalition assault on an occupied border town, Caron flew over the village less than an hour before the shooting started.

A veteran of the Exxon *Valdez* spill (he was not working for EPA at the time), Caron recalls that the flights were often frustrating. "We knew how to deal with oil spills," he says, "but we also knew we couldn't apply many of the techniques we used in Prince William Sound because there were Iraqi mines somewhere under that oil slick, and we didn't want the crews of the skimmers or those placing booms to be the ones to find them."

Caron also helped train Saudi personnel in various aspects of oil spill containment. He's now back on the job on the home front.

Wide World photo.

The wartime oil spills in the Persian Gulf have posed a massive threat to marine life.

square miles of water and blackened about 300 miles of shoreline. The oil poured into a warm, shallow, contained area that takes five years to exchange waters with the nearby Indian Ocean. In contrast, Prince William Sound takes weeks to months to exchange waters with the Gulf of Alaska. Oil went as far as 20 miles inland and fouled wetland salt marshes and desert shore.

Sadly, the shortage of equipment and the remoteness of some areas made it impossible to protect some of the environmentally sensitive wetlands and mangrove swamps in the intertidal zones that provide habitat and nesting areas for many migratory and native birds, including the flamingo and the Socotra cormorant, an endangered species found only in the Arabian Gulf. Thousands of birds died. A wildlife rescue project funded by the Saudi Royal Commission and staffed by volunteers did save several hundred birds.

At last report the Saudis were considering using bioremediation techniques similar to those employed by EPA in Prince William Sound to help rid beaches and wetlands of their black viscous covering. The oil spills stopped when the war ended, but the cleanup will continue for years.

They Delivered

When the U.S. team arrived in the Gulf to assess the air pollution dangers from the oil well fires, it found that Kuwait's air monitoring system had been destroyed by the war. To supplement the equipment the team had carried in, EPA ordered a dozen PM-10 particulate monitors from the manufacturer in Oregon—and had them sent by Federal Express to the Gulf. Nine were installed in Kuwait, the rest in Saudi Arabia and Bahrain. The PM-10s are the squat, Tin Woodman-like monitors that have become a familiar part of state and local air pollution monitoring systems in the United States.

The team trained local environmental technicians to collect and analyze the data. Air monitoring and health data for the past several years were available, so baseline information could be compared with data since the fires began.

NOAA members of the team focused on rebuilding the meteorological networks destroyed by the war. NOAA supplied 15 solar-powered weather stations with built-in communications to provide surface observations from remote areas of Kuwait. NOAA also worked with other agencies, including EPA and NASA, on airborne monitoring of the smoke from the oil fires.

The Oil Fires

On March 10, an EPA-led interagency air monitoring team went to the Gulf, under State Department auspices. The team included seven EPA staffers and experts from the National Oceanic and Atmospheric Administration (NOAA), the Centers for Disease Control, and the Department of Energy. They carried with them as much field monitoring equipment as they could.

Jim Makris, director of EPA's Chemical Emergency Preparedness and Prevention Office, headed the team. He recalls: "We needed to find out if there was a health emergency—were people going to die because of the polluted smoke? And we needed to determine if

the urgency of the situation necessitated evacuating the local population, the coalition forces, the dependents of U.S. and other foreign embassy personnel."

Early and subsequent monitoring found insignificant quantities of sulfur dioxide and hydrogen sulfide, the key ingredients of the killer smogs that hit Donora, Pennsylvania, in 1948, London in 1953, and the New York metropolitan area in 1953 and 1961. It's not known if the expected sulfur pollutants were and are being incinerated by the intense fires.

Natural background particulate levels in the area are relatively high; particulate levels found by the team were not high enough to cause concern.

Although people in the area have been exposed to an increased health risk, the extent of that risk is still undetermined and may not be known for years. Most at risk from air pollution are people with asthma or other chronic lung ailments. Admissions to Kuwait's clinics and hospitals showed no increase in patients with respiratory problems. The same was true for coalition troops. An extensive report issued recently by two teams of scientists that went to the area under the auspices of the National Science Foundation confirmed the interagency team's early findings.

Experts from the Centers for Disease Control in Atlanta and other Department of Health and Human Services agencies have been working with Kuwaiti and military medical personnel to spot any immediate health effects. They also are assembling baseline health data on residents and on U.S. troops and diplomatic personnel and their families. They will continue to watch the health of those people.

As this issue of *EPA Journal* went to press, fire-fighting teams had gotten some 249 oil well fires in Kuwait under control. But hundreds more continue to burn. Officials estimate that they will have all but 100 of the fires extinguished by December but that it will take at least a year to put out the remaining fires and to cap the burning and other damaged wells that are leaking oil. Priority is being given to the smokiest fires and those closest to hospitals and urban areas.

Fires shoot flames like blowtorches hundreds of feet into the air. Dense smoke clouds the skies to heights of thousands of feet. The plume of smoke extends for hundreds of miles. Transposed over the United States, the plume would reach from New England to Florida (see map). In some areas around the fires, the desert is covered with a black crust. Lakes of oil have formed near many of the damaged wells, posing a threat of ground-level fires and pollution of underground water.

In addition to the dense smoke and black oily rain from the oil well fires, emergency teams trying to monitor the pollution from the fires—and the fire-fighting teams—also had to cope with unexploded land mines, bombs, and shells. The lack of adequate technology, compounded by shortages of water, electric power, and locally available equipment, made it impossible to extinguish the fires quickly. For all involved, it was indeed Hell's national park.

What's Ahead

Fortunately, recent assessments by EPA and the National Science Foundation show that initial fears about devastating effects of Iraq's ecoterrorism may not have been warranted. Despite those reassuring findings, monitoring will continue for years—of the people, air, water, soil; of the total environment. Medical follow-ups and meteorological and air monitoring, in the Gulf and around the world, could uncover as yet undetected pollution problems or latent human health effects. The long-term impacts of the spill and the fires simply are not yet known.

With help from EPA and others, the Gulf governments are installing permanent monitoring systems and early warning networks. Kuwait and Saudi Arabia intend to monitor water supplies for contamination from leaking oil and airborne pollutants. They intend to study the long-range environmental effects of the oil spill and the fires.

For EPA itself, the reaction to the oil spill and oil well fires demonstrated that the Agency can respond quickly to environmental emergencies, even as far away as the Persian Gulf. Says EPA's Jim Makris: "The U.S. government brought good environmental science and good operational capability immediately to the scene in the Gulf." □

How a Cleanup Works

Chicken carcasses had been doused with paint thinner.

by Doug Cordell

To drive through the rural countryside of Howell Township in central New Jersey is to pass through the kind of verdant landscape that harried city dwellers like to fantasize about. The smell of green grass. Crisp, fresh air bathed by generous trees. Horses grazing lazily in pastoral corrals. Those are the natural amenities that greet a visitor here.

But up until last year another, less natural element greeted visitors as well. It was an odor decidedly out of context in this sylvan setting, something residents described as a chemically sweet smell, like perfume.

Alice Schildknecht, the first to complain about the smell back in 1974, suggested to local health officials at the time that it was coming from the small Bog Creek Farm across the brook that ran behind her property. She thought that the owners of the farm might be using deodorants in the stalls they rented to horse owners.

"You couldn't go to bed with your windows open, it was so bad," she remembers. "People just driving through the area would stop and ask, 'What is that smell?' But back then it never occurred to us ...," she says, her voice trailing off.

In the years that followed, the smells grew worse, and Alice Schildknecht and others intensified their complaints.

Town officials ultimately visited the site, and even interviewed the man, Fred Barry, who had bought the farm at about the time the smells were first reported. They found that Mr. Barry, a self-described chicken farmer, had been dumping chicken carcasses in a ditch on the north end of his property, where it sloped up to Squankum Brook. He said he had been dousing the carcasses with paint thinner and other solvents to discourage animals from scavenging.

As investigations of the site grew more intense, Barry decided to bulldoze over the trenches. When concerns about the nature of the chemicals buried underground would not go away, he dug up some of the material and carted it off to a hazardous waste landfill.

But the smells persisted, as did the town's curiosity about just what was buried at Bog Creek.

Then, in March 1977, a fish kill was reported in the Manasquan River, downstream from Squankum Brook. The Manasquan is an active spot for fishing, swimming, and boating in the area, and it feeds into the Allaire Reservoir, near Allaire State Park. The fish kill caught more people's attention and generated growing pressure for a state investigation of Bog Creek.

(Cordell is a Writer-Editor in EPA's Region 2 office in New York City.)

The New Jersey Department of Environmental Protection (DEP) decided to send a team to the site. While they were not able to make a conclusive link between the fish kill and the dumping at the site, DEP investigators opted to dig test pits and cutoff trenches to begin assessing the contamination at the farm.

In the meantime, Fred Barry defaulted on his mortgage payments and, with the Federal Housing Authority moving to foreclose on his property, he abandoned any further efforts to comply with investigators or clean up the contaminants. The state then posted warning signs at the site and installed ground-water monitoring wells.

Two years later, Barry lost title to the farm through foreclosure. At that point, the federal government was brought in at the state's request.

By the end of 1982, EPA had placed Bog Creek on the National Priorities List (NPL) of the newly legislated "Superfund" program to clean up abandoned hazardous waste sites.

With Bog Creek on the NPL, EPA began the step-by-step process to measure the full environmental and health threats posed by the site and to decide what, if any, long-term clean-up actions were needed. Short-term emergency removal actions were ruled out since, while the on-site pollution was serious, it did not threaten drinking water wells in the area.

The first step in the process was a series of public outreach sessions conducted by EPA staffers to familiarize residents with the Superfund program.

Following that, a combined remedial investigation and feasibility study (RI/FS) was begun to determine the full extent of contamination on-site and to assess clean-up alternatives. Extensive sampling and lab analyses were done

A rotary kiln incinerator, assembled at the Bog Creek Farm site, burned 20 tons of soil per hour for three months.

to collect better information on the types and quantities of wastes at the site, the type of soil involved, and water drainage patterns.

The RI/FS, completed in 1984, indicated that soil near the waste trench was highly contaminated with volatile chemical products Barry had buried there. It seems that Barry had at one time been involved with an electroplating concern and a paint-mixing business and had dumped wastes from these operations at his farm. The types of chemicals in the wastes included volatile organic compounds, and heavy metals—all highly hazardous both to human health and the environment. The pond and the bog were also found to be highly contaminated with chemicals that had migrated from the trench soil.

The RI/FS also discussed a number of clean-up alternatives—weighing their potential effectiveness and their long-term costs—and made recommendations accordingly.

In compliance with the law, the RI/FS was well publicized in the Howell Township area, and citizens were given several weeks to comment on the recommended clean-up plan. Public meetings were held by EPA and local health officials to give people the opportunity to offer comments in person. EPA was then required to provide written answers to any questions or comments and include these in a "responsiveness summary" as part of its final Record of Decision (ROD) on the clean-up plan selected.

The ROD, signed in September 1985, selected excavation and incineration to get rid of the contaminated material; it also recommended further studies of possible on-site ground water contamination.

Over the next couple of years, as work began at the site, EPA staffers continued to keep Howell Township residents updated on the progress of the cleanup through periodic press releases and public outreach sessions.

In 1988, a supplemental RI/FS confirmed suspicions that high levels of organic contaminants had leached from the disposal trenches into the ground water and the sediments in a portion of Squankum Brook.

As with the initial RI/FS in 1984, residents were given a chance at public meetings to respond to the recommended actions to clean up the additional contaminants. Again, the proposed clean-up plan generated no public opposition, and a supplemental ROD was signed in 1989.

The first phase of work at the site included excavation of some 15,500 cubic yards of contaminated material.

That same year, the U.S. Army Corps of Engineers, charged with overseeing work at the site, awarded Chemical Waste Management a $14.2 million contract for incineration of the contaminated material. Soon, dozens of flatbed trucks were arriving at Bog Creek carrying components of the incinerator to be assembled on site.

During the next several months, EPA worked with New Jersey officials on guidelines for conducting what would be the first Superfund incineration in the state.

In January 1990, EPA sent a letter to about 120 people living within a 3/4-mile radius of the site explaining the awarding of the contract, the harmless odors they could expect during the remediation, and emergency plans for evacuation. It was the word "evacuation," however, that caught people's attention and caused a minor furor.

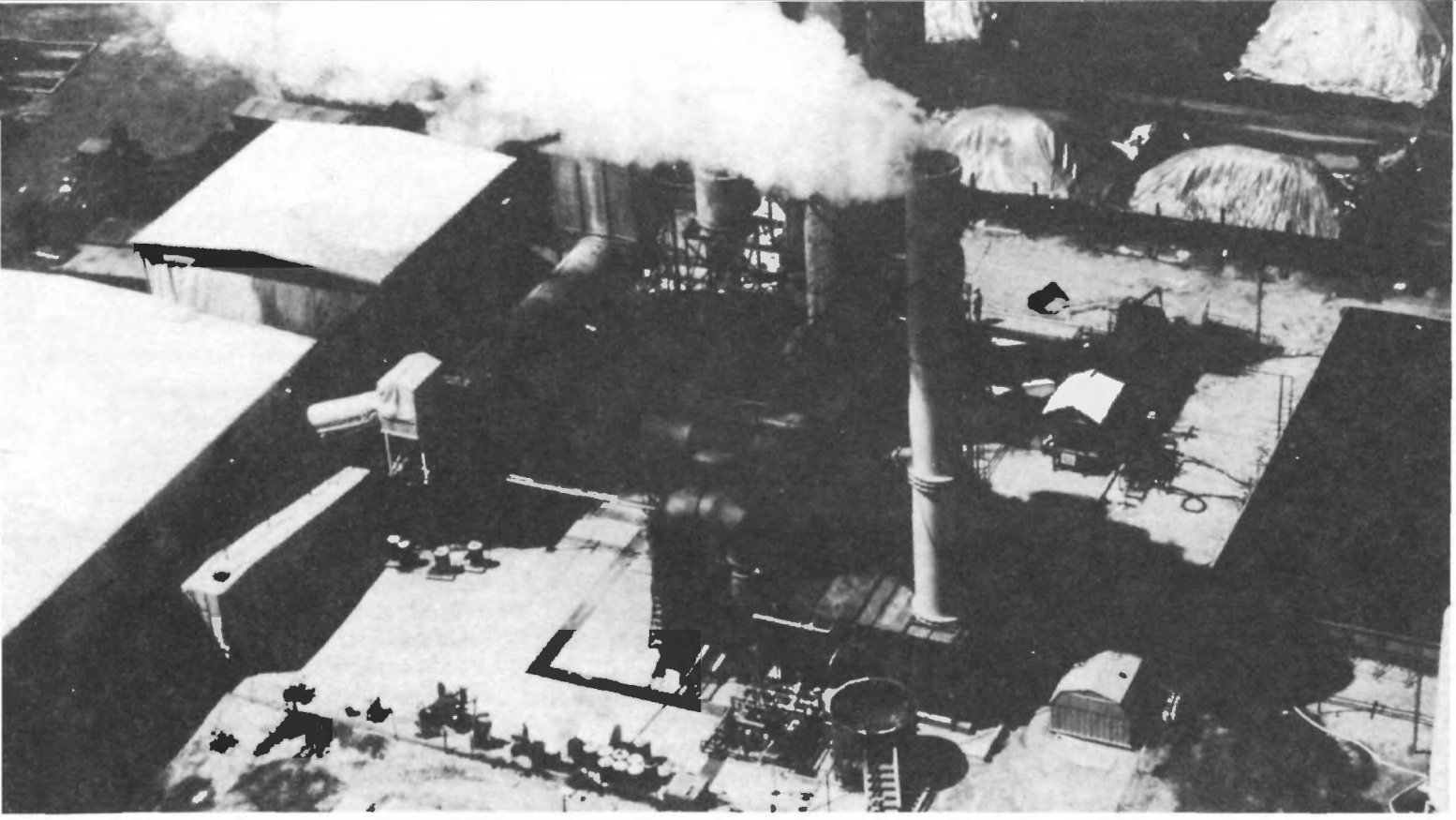
With residents clamoring for an explanation, EPA scheduled a public meeting for March of that year. By all accounts, that meeting was a tense one. A small group of local activists, the Concerned Citizens Organized to Protect the Environment, or CCOPE, challenged EPA to verify the safety of incineration at the site and demanded to know how the town could manage an orderly evacuation in the event of an accident.

In the face of these suspicions, EPA invited five of CCOPE's members to come on-site for a meeting with the Mayor of Howell Township, EPA officials, and representatives of Chemical Waste Management. They were given a full tour of the site and a thorough explanation of the machinery involved. A videotape of the tour was also made and distributed through CCOPE to interested residents.

The meeting seemed to satisfy CCOPE's concerns. In addition, at CCOPE's request EPA agreed to install a warning siren on-site to augment the town's evacuation procedures.

With residents fully on board now, EPA prepared to go ahead with incineration. But three days before the incinerator was to be fired up, another hitch developed. An elderly woman who lived a quarter-mile from the site, and who had had her larynx removed for cancer some years before, was worried that dust from excavation of the soil would irritate her exposed throat.

While federal health officials contacted about the case maintained that the excavation would not aggravate the woman's condition, EPA decided to err on the side of caution. At the government's expense, she was relocated to a rented home outside the



EPA photo

area for the duration of construction at Bog Creek.

The cleanup then moved into full gear.

EPA had selected a two-phase approach to address the two kinds of contamination found at the site. Some of the chemicals dumped at the farm were the kind that adhere to soil particles and resist moving in the ground water. These non-mobile compounds generally remain concentrated near the disposal area and are best removed by excavating the contaminated soil. The first phase of the cleanup was designed with these contaminants in mind.

Other chemicals found on the site tended to migrate in the ground water, forming a contaminant plume. These compounds are more effectively removed by pumping the contaminated ground water to the surface and treating it. This describes the second, more long-term phase of the cleanup.

The first phase of work at the site included excavation of some 15,500 cubic yards of contaminated material. Sheet piling was driven around the perimeter of the trench, bog, and pond excavations to reduce water flow to those areas and keep the soil dry for excavation. The rest of the water was collected by a series of wells and fed into an aqueous waste treatment system that removed metals and volatile organic compounds.

After a trial burn to test the safety and efficiency of the process, the excavated materials were reduced to ash in the on-site incinerator. Other work included the temporary relocation of the north branch of Squankum Brook so that contaminated sediments found there could be excavated and incinerated.

The incinerator was operated for three months. At a rate of 20 tons per hour, soil was loaded into a rotary kiln incinerator and burned at 1,800° Fahrenheit. From the kiln, the cleansed soil went into a "quench" system that cooled and minimized dust emissions. From there, the soil was moved to a storage area where it was sampled and tested before being backfilled in the excavation area. Gases from the incineration went through a "cyclone" that removed most soil particles and then through a series of absorbing chambers that removed harmful chemicals. The gases were then released to the air through a 72-foot stack.

The only wastes transported off-site were some large tree stumps and pieces of metal drums that were difficult to load into the incinerator. These were sent to out-of-state hazardous waste landfills.

At the conclusion of Phase One of the cleanup, the incinerator was dismantled and decontaminated for future use at other sites.

The aqueous waste treatment system remained on site for Phase Two. This aspect of the cleanup involves flushing the remaining contaminants from the soil by pumping and treating the ground water and reinjecting the treated water into the former trench area. It is a laborious process that is expected to take up to 10 years.

Meanwhile, however, the most serious long-term threat—the source of the contamination at the site—has been removed. And, 17 years after she first complained of strange odors coming from Bog Creek Farm, Alice Schildknecht is relieved.

"There were a lot of years of aggravation, and I sometimes wondered why all these studies and delays were necessary. But today I'm very grateful. We haven't had any odors since the incineration was completed. My husband's also looking to retire now and we have our house on the market, and I know we could never have sold it without the cleanup."

As for Fred Barry, he is now a fugitive. If, and when, he is found, EPA plans to sue him—and any other responsible parties—for the $20 million the U.S. government has already spent to clean up the Bog Creek site. □

On the Scene

Chemicals were destroyed with dynamite.

by Nikkii L. Childs

The scene is Midvale, Utah, 1990, a couple of weeks before Christmas. A Region 8 field crew is checking the old Midvale Slag site for vandalism. A perimeter fence is being installed to prevent children from trespassing, and the buildings are being secured. Midvale is one of roughly 1,200 hazardous waste sites on EPA's National Priority List for Superfund cleanup. Removal action is underway as part of the Agency's "Make Sites Safe" initiative.

As the crew goes through the final stages of securing the site, they discover an abandoned laboratory in one of the buildings. Numerous containers filled with unknown chemicals can be seen through a window. The situation, if not handled properly, could be hazardous to the community.

The field crew immediately secures the site and notifies an on-scene coordinator to be in Utah the next day with his crew. Before dawn, Steve Hawthorn is on a plane to Utah—a four-hour trip from Denver, Colorado.

As the on-scene coordinator, Steve will manage the cleanup. He will be responsible for complying with all state, federal, and local regulations and for keeping the community informed of what actions he intends to take.

Fortunately for him, Steve enjoys traveling. His region encompasses North and South Dakota, Utah, Wyoming, Montana, and Colorado. He may be called to travel to any number of sites within the same day.

His job is to respond to spills or other environmental emergencies that require immediate attention. He may work alone or with a crew of 20 or 30. He may be called to a site in the middle of a city or to a rural dumping ground. Every day is an adventure.

A quick assessment at the Midvale laboratory, made shortly before Steve arrived, revealed 2,500 containers filled with flammable compounds, oxidizers, acids, bases, cyanide solution, and low-level radioactive substances. Barrels of cyanide and acid were sitting side by side. If mixed, they would produce a gas similar to that used in gas chambers. Other chemicals, whose containers dated back to 1940, had crystallized. Many containers were unlabeled.

Arriving at a "raw" site, Steve's first concern is health and safety. "I first think about what we have to do to protect the community and the people who do the site assessment work," he says. As for his own safety: "The dangers are minimized if you take the proper precautions." However, "... there are always unknown dangers until the site is characterized."

For one thing, proper precautions while assessing a site include wearing a protective uniform. Like all on-scene coordinators, Steve has a four-level wardrobe: Level "A" gear is most protective, level "D" the least. Steve chooses the level according to the chemical contamination at the site. At Midvale, he chose level "C" (the most commonly worn uniform) which included an air-purifying respirator and chemical-resistant clothing. A hard hat, gloves, and steel-toe boots are part of every level.

At Midvale, emergency removal and disposal took several weeks. Some of the chemicals—sodium peroxide, yellow phosphorus, concentrated hydrogen peroxide, picric acid, butyl ether, glycerin and ether methyl alcohol—were so unstable as to be sensitive to shock. Transporting them on the highway would risk explosion enroute.

"It was decided that the best way to destroy the chemicals was by detonation," Steve said. They were placed in a shallow pit in the earth and ignited by dynamite to induce complete combustion. They were thereby destroyed much like they would be in an incinerator. The explosions were carried out in small increments to keep the noise level down and to prevent excessive vibration, which could shatter windows in nearby houses.

The remaining chemicals were packed in sawdust in 55-gallon drums and shipped to an approved facility, where they were disposed of according to local, state, and federal requirements.

In general, a site assessment can cost anywhere from a couple of hundred to a couple of thousand dollars. Once the site has been assessed as hazardous or uncontrolled, a removal action may be initiated. There are three types of removals—"classic" emergency, time-critical, or non-time critical.

An emergency removal is deemed necessary when there are observable health effects or potential exposure of the public to hazardous materials. Removal expenditures are limited to $2 million, unless unusual circumstances exist. Midvale Slag was an emergency removal.

To initiate the site cleanup, Steve utilized the on-scene coordinator's authority to approve expenditures up to $50,000. The authority is granted in the National Contingency Plan. In the end, the total response cost was approximately $160,000.

Steve is an Oklahoma State University graduate who received a bachelors degree in zoology, with a minor in chemistry. He's been with EPA for three years and enjoys his job. "What I like best is being able to respond to a problem, taking care of the problem, and cutting through all the bureaucracy. I also like the support the Agency provides." □

(Childs, an English major at the University of Maryland, is an intern with EPA Journal.)

A Concerned Community

Plutonium had migrated hundreds of feet.

by Nancy Powell

The Maxey Flats Low Level Radioactive Waste Disposal Site is a 280-acre radioactive waste landfill that sits, nestled among gently rolling Kentucky hills and well-tended dairy farms, on a plateau some 320 feet above surrounding valleys. Maxey Flats is approximately 17 miles west of Flemingsburg, a small town in Fleming County, where I have lived all my life. This is the eastern Bluegrass region of Kentucky. Flemingsburg, population 2,700, is the county's largest town and is also the county seat.

In 1962, land for the Maxey Flats site was secretly purchased; construction was inconspicuously completed, and by 1963 the second commercial low-level radioactive waste site in the United States—and the largest in the free world—quietly began operating.

How was our area chosen as the site of this operation? The idea of locating the site in our state took form when Kentucky policy makers believed that a radioactive waste landfill would attract nuclear energy industrial facilities and ensure that Kentucky would get in on the ground floor of this newly emerging industry. However, the planned-for economic boom did not materialize. Not one nuclear-related industry ever located in our area. Instead, Maxey Flats became the state's biggest environmental nightmare.

Maxey Flats became the state's biggest environmental nightmare.

The site contains a major inventory of cancer-causing, long-lived radionuclides brought there from research laboratories, electric utilities, government and health care facilities, manufacturing companies, and nuclear power plants throughout the United States. This hazardous refuse was buried in 51 trenches that measured up to 650 feet long, 70 feet wide, and 30 feet deep. Some of the waste matter was buried in wooden crates, cardboard boxes, paper bags, metal drums, and concrete containers; some was buried uncontained.

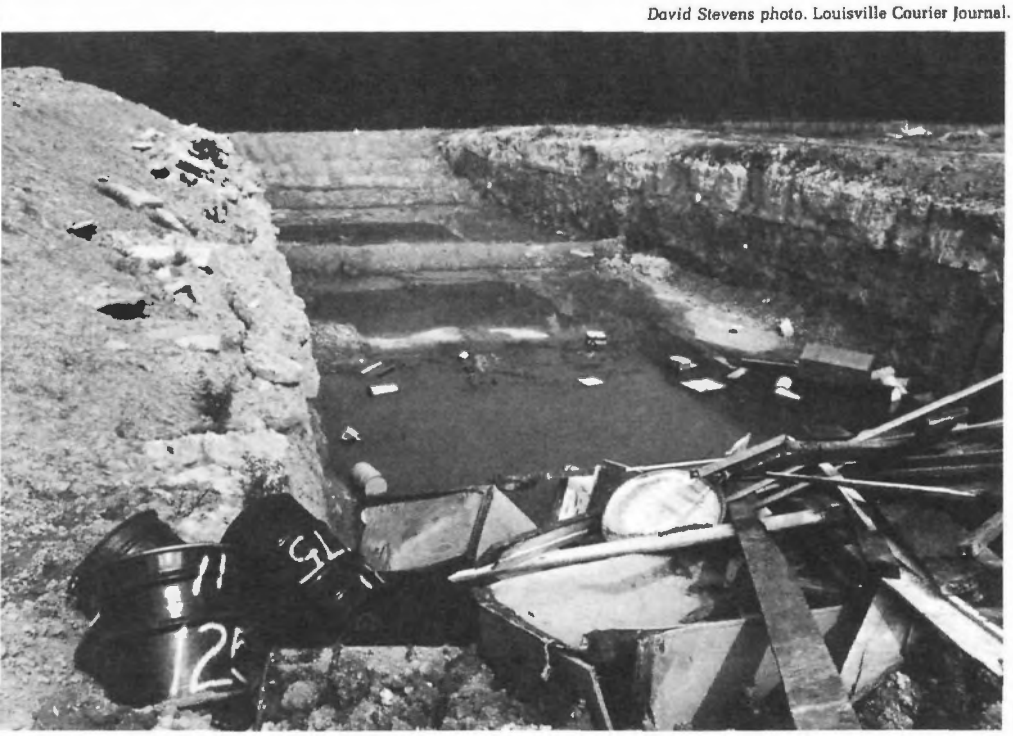
According to Nuclear Regulatory Commission recommendations, 10 feet of material (soil, shale, and rock) should have been used to cover the unlined burial trenches. In fact, there were instances where the cover material ranged in depth from five inches to six feet of soil.

In the 14 years that the site operated, an estimated 4.75 million cubic feet of radioactive waste were disposed of there.

As early as 1972, community people were hearing shocking stories of improper operational procedures and incidents of serious safety violations from frightened employees at the site. One ex-worker told how he had occasionally seen "hot" liquid material being dumped over the hillside and how liquid waste containing plutonium-239 was accidentally spilled and eventually drained out of the restricted area. It was also rumored that some employees had salvaged contaminated watches, tools, and other small items sent to the site for burial and had either sold them or given them away.

By 1974, stories like these prompted worried Fleming County residents to form the Maxey Flats Radiation Protection Association. The purpose of this group of concerned citizens was to persuade state officials to close the site. They met with the governor and key legislative leaders; they testified before the newly formed "Special Advisory Committee on Nuclear

David Stevens photo. Louisville Courier Journal.



Citizen concern led to the closure of and clean-up plans for the Maxey Flats low level radioactive waste site in Kentucky. Starting in 1963, nuclear waste had been buried in 51 trenches like this one.

Issues"; and they took their story to the media. Gaining widespread public support for their cause through national TV and press coverage, they obtained a promise from Kentucky's governor that he would close the site "at the first evidence that it could not be contained."

This evidence came in August 1977, when state monitoring reports confirmed unequivocally that radioactive leachate was migrating from the burial trenches out of the restricted area. In December 1977, state officials ordered the site closed, after three intense, frustrating years of dedicated work by the Maxey Flats Radiation Protection Association.

In the years between 1977, when Maxey Flats was officially closed, and 1986, when EPA placed it on the National Priorities List (NPL), millions of dollars in state funds were spent on maintaining and stabilizing the site. Also during that time, the first Maxey Flats citizens group, feeling secure in the knowledge that the site was permanently closed, decided to disband.

Being an NPL site made Maxey Flats eligible for clean-up operations under the federally funded Superfund program. An important part of this program is citizen involvement at the local level in decision making that relates to the clean-up actions. To help the public participate in an informed manner, EPA has Technical Assistance Grants (TAG) available—one grant per site—for a qualifying community group in the area impacted by a Superfund site.

The TAG program provides up to $50,000 for a qualifying group, which is to be used to hire a technical advisor to review and interpret site-related information for them.

In 1986, when the TAG program was established, the Kentucky Environmental Quality Commission (a citizens advisory board) worked with our state representative to form a citizens group that would be eligible to apply for one of the $50,000 grants.

I was not active in the Maxey Flats citizens group of the early 1970s, but because of my interest in the site and my activities on other state environmental problems, I was asked by my state representative to serve on the executive committee and was elected treasurer of the new group. Four former members of the first Maxey Flats group also serve on the executive committee, along with two biologists from a local community college and a state university.

Applying for the grant was a lengthy and involved process. We started laying the groundwork in January 1988 and gave our group the name Maxey Flats Concerned Citizens (MFCC). We drafted bylaws and filed the proper papers to become incorporated. By September 1988, we were off and running, ready to submit our grant application to EPA.

The secrecy that shrouded Maxey Flats for so many years has been cleared.

One of the basic TAG requirements is for the eligible group to provide a 35-percent match of the grant funds. Since we knew it would be next to impossible for us to come up with that much money, we requested, and were granted, a waiver of the 35-percent match. We did, however, have to reapply and agree to a 15-percent in-kind match. On January 13, 1989, our application was approved, and MFCC became the first citizens group in EPA Region 4—and the second in the United States—to receive a TAG.

We hired Dr. Marvin Resnikoff, a prominent nuclear physicist from New York, to act as our Technical Advisor. Dr. Resnikoff analyzes the documents generated during the Remedial Investigation and Feasibility Study (RI/FS). He reviews and summarizes the risk assessments and remediation work plans. In addition, he closely checks and evaluates the monthly monitoring reports conducted by the state, investigates and examines the various problems that continually arise at the site, and then relays all this information to us each month in a formal report.

Conferring regularly with EPA and state officials concerning on-site related activities, he assists us in preparing public fact sheets and represents our group at public hearings.

At a public meeting on June 13th of this year, EPA's proposed clean-up plans were revealed to the public. Eighteen potential remedial alternatives were developed and evaluated. Of these, EPA's choice was natural stabilization.

We have been very pleased with the cooperation and consideration we received from the staff at EPA's Region 4. We were surprised that they not only listened to our suggestions, but included some of them in their closure plans. Some of these suggestions are:

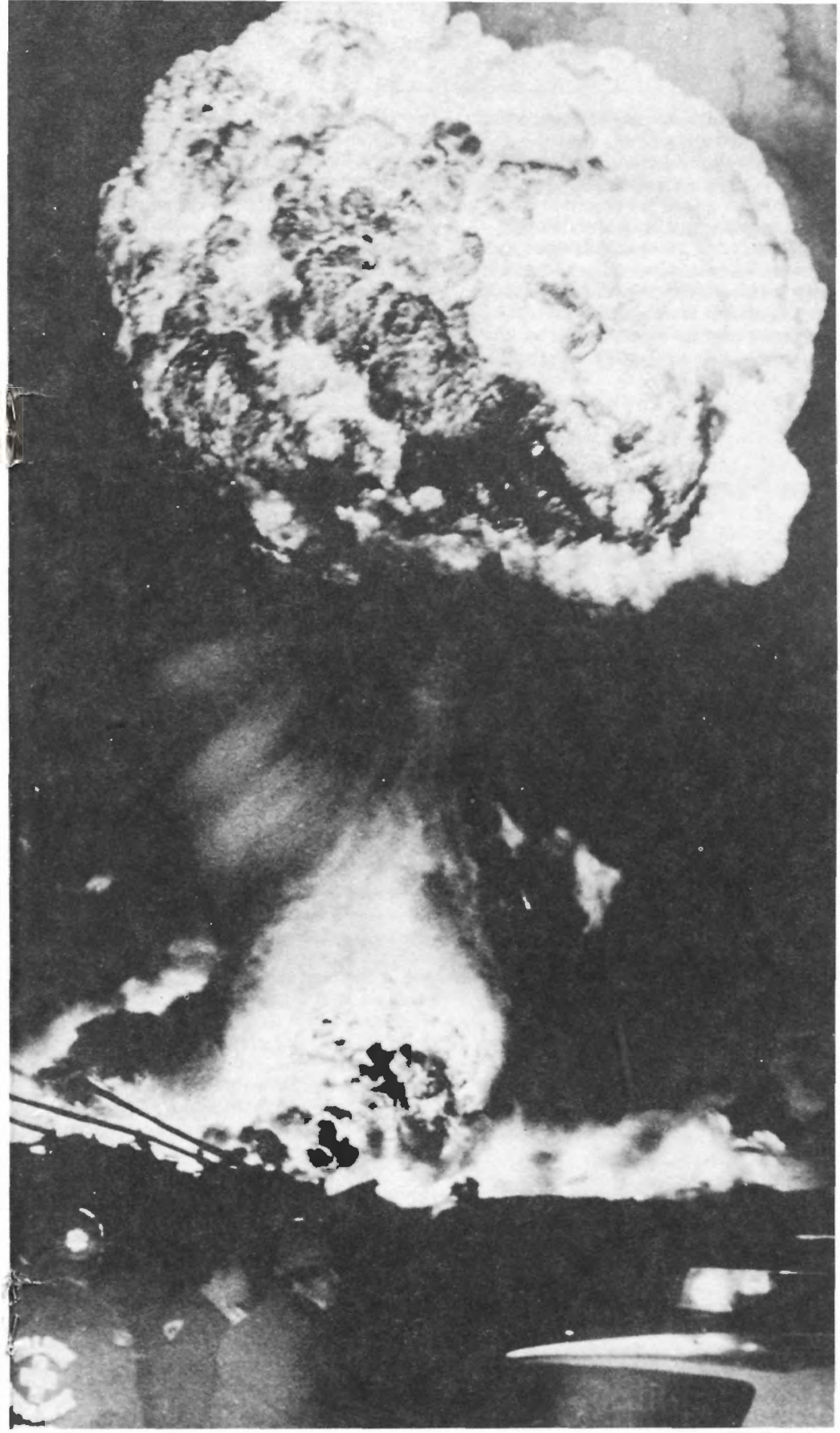
- The procurement of a buffer zone adjacent to the site property
- A reopener clause for future remedial construction
- Concrete horizontal barriers to be installed later if needed
- Remedial review performed every five years
- Leachate to be removed from present trenches, solidified, and disposed of in new trenches.

Some of the things that we think should be clarified in EPA's plan include institutional controls for future site security and adequate funding for a perpetual maintenance and monitoring plan.

We have the opportunity to address these and other issues during a 60-day public comment period. At the end of this period, EPA will answer questions and reply to the issues raised by the public in a Responsiveness Summary that will become an official part of the Agency's documented decision on the remedy. The final Record of Decision is expected to be issued in late 1991.

The secrecy that shrouded Maxey Flats for so many years has been cleared. We now have access to information and records concerning the site activities and remediation plans. However, the people of Fleming County know that, regardless of which plan is implemented, the public health and environmental threats that Maxey Flats poses will remain with us forever. □

(Powell is treasurer and board member of Maxey Flats Concerned Citizens, Inc. She is also a member of Kentuckians for the Commonwealth, a statewide grassroots environmental organization; co-founder of Fleming County Concerned Citizens, a group opposing the import of out-of-state garbage by a local landfill; and a grandmother.)



Wide World photo.

Elizabeth, New Jersey, was the scene of this spectacular explosion and fire in April 1980 when storage drums at Chemical Control Corporation blew up. The incident helped persuade Congress to enact the Superfund law.

Who Should Pay?

On November 5, 1990, Congress reauthorized Superfund to operate through 1994. That, it would seem, should settle the matter for the time being: The party responsible for the waste pays to clean it up. However, the debate over liability continues.

Some argue that local governments that haul household garbage to Superfund sites should share in the cost of cleaning them up. Others, in the banking community, have objected to being held liable through their holding title, as lenders, to contaminated property. Some members of the insurance industry are suggesting that the current litigation-based system slows progress by diverting funds from clean-up work to liability determinations. They propose supporting Superfund through a surtax on commercial and industrial insurance premiums and repealing liability for "old" sites. Many in the environmental community believe the current law is sound but that it should be enforced more aggressively.

The debate likely will continue. As noted elsewhere in this issue, currently there are nearly 1,200 sites on the National Priorities List, and EPA expects to add 100 sites a year through the year 2000. The average site is taking six to eight years from the time it is first investigated until the time cleanup is completed, and at a cost of $26 million.

EPA Journal invited representatives of four parties to the debate over liability to contribute to the following forum focusing on the question, Who should pay? Their answers follow:

Ten years ago, the question of who should pay for cleaning up old hazardous waste sites was one of the core Superfund issues. Today, it is the wrong question.

After observing the decade-long gridlock induced by Superfund's existing liability-based funding system, we should no longer waste time asking who should pay to clean up *old* sites. Instead we should ask, "What will work?"

Support for the current system, to the extent it exists, is based on a number of myths about who pays and what results the system achieves. Once these myths are exploded, perhaps we can focus the debate on finding the best alternative.

- *Myth 1*: Polluters pay.

Not true. Under Superfund, to be held liable for clean-up costs, there is no requirement that the waste you contributed to a site must cause the environmental damage being remedied. Thus, even if you sent trace amounts of cadmium to a site and the Superfund remedy is addressing PCB-contaminated ground water, you could still be required to finance all or part of the cleanup. In other words, you would be cleaning up someone else's pollution.

Not only that, but you need not have done something wrong to be snared in the Superfund dragnet. Thus, even if you were ordered to send your waste to a state-permitted facility, you can still be liable under Superfund.

- *Myth 2*: The current system results in payments by potentially responsible parties (PRPs) proportional to their waste contributions.

Wrong again. The joint and several liability aspect of the liability system means that responsible parties at a Superfund site can be sued together or separately for 100 percent of the clean-up costs, or any one party who is held liable may be held responsible for the entire cleanup, regardless of the extent of the party's involvement at the site. This virtually guarantees that PRPs will pay in amounts unrelated to actual waste contribution.

In addition to being unfair, this joint and several liability system is one of the engines that drives the litigation train. Any company that is held liable will understandably seek contributions to the cleanup from as many other potentially responsible parties as possible. The result is third, fourth, and even fifth party contribution lawsuits.

- *Myth 3*: Superfund is working.

After 10 years and $10 billion spent or obligated, 63—or about 5 percent—of the nearly 1,200 sites on the Superfund NPL have been cleaned up. That's working? EPA says with pride that cleanups are ongoing at hundreds of sites. But since many sites are divided into "operable units," cleanup is actually going on only at portions of these sites. Cleanup of an entire site may still be years away. Moreover, even where cleanups are taking place, litigation over allocation of liability will likely go on for years.

- *Myth 4*: Citizens support Superfund.

Anyone who makes this claim has not talked to people who live near these sites. One example out of many: In Ashtabula, Ohio, local officials, businesses, and citizens are so disgusted with Superfund's failure to conduct even a single clean-up action in 10 years at the Fields Brook site that they have organized a group dedicated to, among other things, keeping the polluted Ashtabula River *off* the NPL. "If it ever gets on," said one citizen, "we'll never get it cleaned up." That is the legacy Superfund is leaving in its wake.

- *Myth 5*: Transaction costs will decrease in the future.

Everyone knows the stories about Superfund's staggering transaction costs. Many Superfund supporters dismiss this as a receding problem. It is probably true that EPA's transaction costs will decrease as it implements its new policy to force PRPs to perform more work through Unilateral Administrative Orders (UAOs). And undoubtedly, some PRP transaction costs will decline simply because frequently named PRPs become more experienced at resolving cost allocation disputes.

But transaction costs associated with contribution lawsuits will not go down at all. As John Dingell (D-Michigan), Chairman of the House Committee on Energy and Commerce, and other committeemen wrote to EPA recently: " . . . EPA's approach does not equate with the agency remaining neutral on allocation issues. On the contrary, EPA may have actually made things worse, because the agency has failed to recognize the impact of its approach on the allocation dynamics among PRPs. We are concerned that EPA's approach may be creating a series of disincentives to settlement at Superfund sites and may also be generating unnecessary litigation among PRPs." In other words, EPA's new policy simply redistributes transaction costs rather than reducing them in the aggregate.

- *Myth 6*: Superfund's liability system forces companies to handle waste responsibly.

There are absolutely no data to support this often stated benefit, but assume it to be true for the sake of argument. Under the alternative funding system the American International Group (AIG) has proposed, Superfund liability would remain for current and new sites. But it is illogical to suggest that the Superfund liability system influences behavior at sites which no longer operate. There is simply no behavior to influence. However, retaining Superfund liability for current and future waste disposal—coupled with other laws which impose tough penalties on those who mishandle hazardous wastes—would preserve incentives for sound waste management.

- *Myth 7*: EPA has turned the program around.

Things are probably working better. But when it comes to Superfund, it is wise to heed the counsel of the sage who declared that there are lies, damned lies, and statistics. Take one example: A chart based on EPA data and published in the *Washington Post* (June 19, 1991) indicates that Superfund cleanups have been completed or are ongoing at 1,139 sites! It doesn't take a rocket scientist to figure out quickly that something is askew. If the figures tell the whole story, then one would conclude that the vast majority of Superfund sites are at or near complete cleanup. And we know that to be far from the truth.

It is clear to AIG that the current approach to raising funds is not resulting in prompt, long-term cleanups. It is equally clear that no amount of tinkering with the system will produce the results the American people expected.

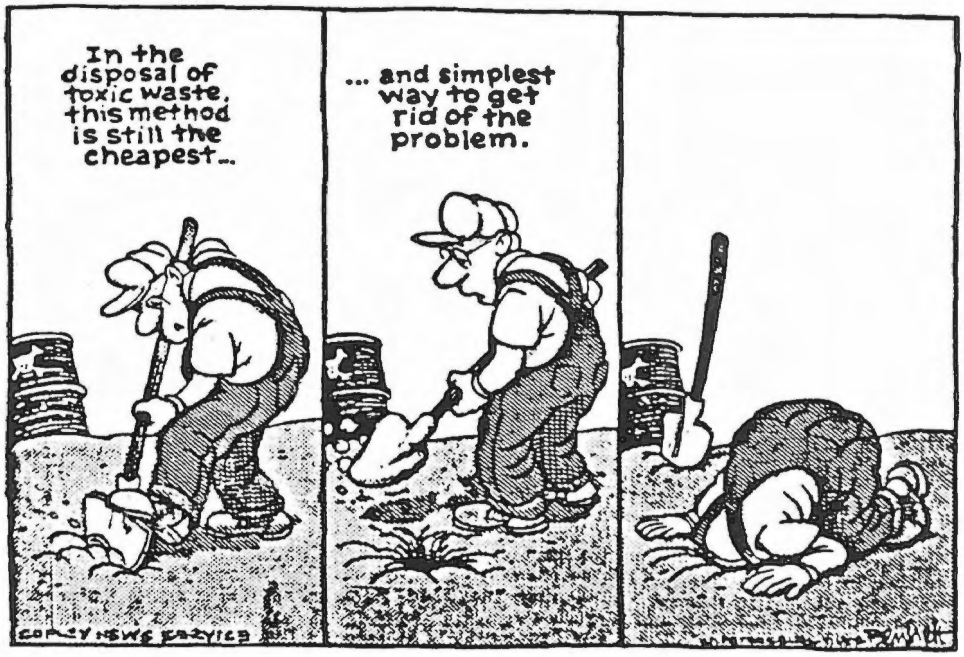
In our view, the current system has one enormous weakness: Site-specific fund-raising requires government and private parties to divert enormous resources, time, and money to identifying and negotiating (or litigating) with PRPs to raise clean-up funds. Inevitably, this legal warfare diverts attention from the primary goal of finding and implementing the best long-term clean-up remedy.

We believe the best way to clean up old sites is to abandon the point-the-finger features of the current system and move to a "no-fault" system which emphasizes cleanup rather than fund-raising. Although no system is perfect, a no-fault approach represents a practical solution to a festering problem. The simple truth is that business, insurers, environmentalists, and other stakeholders can all continue to stand on the same rickety soapboxes chanting their same old slogans—or we can try to find a better way.

To that end, AIG has proposed creation of a National Environmental Trust Fund (NETF) which would be much larger than the existing Superfund. It would be paid for by *all* economic sectors (including insurers) without regard to site-specific liability—and dedicated for EPA to use to clean up old Superfund sites. One possible funding approach would be adding a separate, earmarked fee to all commercial insurance premiums paid in the United States. A method of payment would also be established for self-insurers. Even a modest assessment of 2 percent of premiums and an equivalent amount for self-insureds would yield about $40 billion over the next decade, enough to clean up all the waste sites now on the NPL.

The fact is the current system is not working. And even if EPA's newly aggressive enforcement tactics reduce delays, the job will still take years to finish, and spending on transaction costs will be unacceptably high. We have discovered that the price of having a system which stresses retribution is enormously high, both in dollars and environmental stagnation. At some point, society's interest in completing the job of cleaning up old hazardous waste sites should guide our thinking. That time has come.

(Edelstein is Special Assistant to the Chairman of American International Group, Inc., a prominent U.S.-based international insurance organization and the nation's largest underwriter of commercial and industrial insurance coverages.)



Clay Bennett cartoon. Reprinted with permission.

M.L. (Mort) Mullins

It was a dark and stormy night. John and June Q. Public were climbing the stairs to watch the 11 o'clock news and retire when there came a knock on their door. John answered and was surprised to find standing there a representative of the regional EPA office. The visitor bore a notification saying that John and June had been named "potentially responsible parties" (PRPs) and were being ordered to clean up the town dump. This directive was based on their having sent various substances to the dump over the years that were on the list of Superfund "hazardous substances."

John and June were singled out in this instance because there was a clear record of their trash having been sent to the site and because of their ability to pay. They were assured, however, that they could, in turn, sue their neighbors who were not being served with an order. When they asked why this was happening, they were told that Congress wanted polluters to pay and be taught a lesson about proper waste management.

Sound far-fetched? This is merely an individualized version of what happens every day to businesses large and small across America that run afoul of the Superfund liability standard.

The severity of the Superfund liability standard may be gleaned from the following:

- It is imposed without any showing of fault or knowledge.
- It is retroactive for actions and practices that were legal, normal, and considered proper at the time.
- It is not related to whether the wastes treated or disposed of caused the conditions requiring cleanup.
- And finally, the standard is *joint and several*, which means that any one PRP can be required to pay the total cost of cleanup at a site regardless of his or her share of responsibility.

EPA, states, and some courts are stretching the standard even further to demand cleanup or payment in cases

where a firm's wastes were merely transshipped through a site; where drums bearing a firm's logo were found at a site (even though the wastes were not associated with the firm); and where firms had sent not wastes but raw materials to a site for processing.

On a national basis, almost $4 billion in clean-up costs or contributions have been paid or committed by PRPs. In addition, approximately $10 billion have been generated by special taxes on industry (the so-called "feedstock" and "corporate environmental taxes") and expended—through the "Superfund"—for Agency overhead, contractor administrative costs, and cleanup of sites where no responsible parties exist (the "orphan sites"). Thus, responsible parties—who, in many cases paid for disposal of wastes initially—pay again in the form of taxes and once more when assessed liability at a site.

Expenditures from the fund will almost double over the next five years. All of this has resulted in completion of only 5 percent of the sites (nearly 1,200) listed on the NPL, and entries on that list are expected by many to at least double in number.

In addition, the litigious nature of the program creates so-called transaction costs—largely legal expenses—which, for some sites, has equaled the actual clean-up cost. These excessive costs stem, in part, from the threat of the joint-and-several standard and the fact that any one PRP could be held liable for the entire cost of cleanup at a site, often an amount that could bankrupt many corporations. Thus, PRPs defend themselves vigorously in the face of this draconian potential, however theoretical.

Further, the Agency approaches the PRP community on an "enforcement first" basis, bristling with lawyers, orders, threats of treble damages, acting against selected "deep pocket" PRPs to avoid the burden of dealing with all parties, and limiting the opportunity for review to the official record: All of this results in a lawyer-laden process. A typical site confrontation consists not only of EPA and responsible parties (and their insurers) and all of their lawyers, but also the Departments of Justice and State and sometimes local officials and natural resource trustees (and all of their lawyers).

Beyond the inequity of the liability standard and the excessive transaction costs it creates, there is a serious question as to whether many, if not most, of these sites really pose any appreciable risk to human health or the environment. EPA's removal program is the first phase of the Superfund process, whereby immediate threats are mitigated and source materials (such as chemicals in drums or tanks) are removed. Removals clearly have been a success—so much so that the additional risk reduction attributable to cleanup beyond the initial removal is often difficult, if not impossible, to calculate or justify.

The cost of these initial removals was originally limited by the statute to less than $1 million (subsequently increased to $2 million). Complete cleanups, however, currently average $30 million and continue to escalate! Clearly, some sites justify remediation. But many clearly do not, either because of the low risk posed or the lack of a technical approach that will work. Many sites should, as applicable, be fenced, capped, and monitored—at least until we learn more about the risk or how an effective cleanup can be carried out.

When Superfund was enacted in 1980 and reauthorized in 1986 and 1990, the authors were relatively silent as to intended objectives. However, the legislative history suggests that protecting human health and the environment (i.e., timely and effective cleanup), modifying waste management behavior, and punishing or making the "polluter pay" were paramount in their minds (though not necessarily in that order). Further, the statute explicitly says that permanence and cost effectiveness of remedies are to be considered.

The outcome certainly achieves payment by responsible parties—to the point of being inequitable, damaging to the vitality of many businesses, and wasteful. Superfund liability—along with soaring waste management costs and community right-to-know reporting—has heightened awareness as to the incentives for responsible waste management and pollution prevention. This cultural change is in place, and it is questionable whether further "punishment" is equitable, necessary, or desirable.

Further, Superfund has demonstrated clearly that compliance with what is deemed responsible today will not necessarily avoid Superfund liability tomorrow. The program is certainly punitive, but the officers, owners, and shareholders of companies today are seldom those who were involved when yesterday's treatment or disposal sites were created. Those who were involved generally operated in the belief that practices then used were appropriate and responsible. In fact, a significant portion of the substances triggering liability resulted from air-pollution control sludges. The program, except for initial removals, is far from cost effective if risk reduction is the desired goal.

This leads one to observe that this program is inefficient, ineffective, and inequitable at best, and failed at worst. The current effort of the banks and other commercial lenders to escape the liability net, followed closely by municipalities, is indicative of the disruptive impacts the program is having on our economy.

So who *should* pay? Perhaps a better question is, "*how much* should we pay?" If this program were one of reasoned action proportional to risk, with emphasis on efficiency and effectiveness, the burden of the liability standard would be considerably reduced. Most PRPs are willing to step up to doing the right thing in a rational way.

In the 1986 amendments to the Superfund law, Congress sought to take advantage of this willingness on the part of PRPs by adding certain provisions intended to add flexibility to the liability standard (mixed funding, *de minimis* settlement provisions, and non-binding allocations). However, these tools are used sparingly, if at all; instead, the emphasis is increasingly on "enforcement first," with joint and several liability for "deep pocket" PRPs.

PRPs who have been at the forefront in trying to help make the program work are seeing more of their limited resources and goodwill consumed by conflict with other parties, program inefficiency, and unjustified remedies; a growing danger is that these firms may decide to join those who have chosen to "lie in the weeds" and let the program flounder.

Last year's reauthorization appropriately put off debate until the next Congress, but it's not too soon to begin a dialogue on how this program can be revitalized and made more cost-effective. Industry has accepted the responsibility to take appropriate action at hazardous sites which require remediation. If we're going to spend the money, however, let's get timely, cost-effective results. All three parts of the Superfund triad need strengthening: liability, selection of remedy, and project execution.

(Mullins is Vice President for Regulatory Affairs at the Chemical Manufacturers Association.)

Paul R. Portney

Everyone agrees that fairness, or equity, is a desirable attribute of any public policy proposal. Yet in debates about Superfund, both the proponents of a radical restructuring of the law and its most ardent defenders argue their respective cases largely on grounds of fairness. How can this be?

Like beauty, equity is in the eye of the beholder. The current Superfund law imposes retroactive, strict joint and several liability on those who generated hazardous substances in the past, as well as on those who owned or operated waste disposal sites or even transported wastes to those sites. Depending on one's conception of equity, both the current law *and* conceivable alternatives to it—including a "public works" approach that would eliminate liability altogether for at least some sites addressed by Superfund—could be defended on grounds of fairness. This paradox deserves explanation, and it makes sense to begin with a quick rundown of differing notions of fairness.

Let Me Count the Ways

Fairness can be interpreted in a number of ways. In the environmental arena, one popular interpretation is embodied in the so-called *polluter pays* principle, long a favorite of economists. Put bluntly, this principle says that if you create a problem, it's your job to clean it up.

A second conception of fairness relates to *ability to pay*. This is the familiar notion, reflected in our tax code, that the more economically advantaged among us should shoulder a proportionately larger share of the tax burden than the less fortunate. This sometimes enters into environmental policy in the form of "economic achievability" constraints on source-discharge standards (i.e., discharge standards must be "affordable," meaning that profitable firms and/or industries may be asked to do more than economic laggards).

A third conception of fairness is sometimes called the *benefit principle*; it holds that those who derive the benefit from a particular policy action ought to pay a healthy share of the costs.

The fourth and final conception of fairness I want to discuss is harder to hang a name on: Perhaps best described as *transitional equity*, it reflects the notion that sharp reversals in policy, particularly changes that apply retroactively, should be avoided whenever possible.

No doubt there are still other conceptions of fairness—for instance, ones related to decision-making procedures—but the four identified here are the most prominent. So how does Superfund—and possible alternatives to it—square up against these differing notions?

By its defenders, and many others as well, Superfund is seen as a polluter-pays statute in principle. When responsible parties can be identified, liability is imposed upon those whose activities contributed in one way or another to the creation of a problem site. In fact, where good records exist on "who disposed of what and where?" liability can be imposed *in proportion* to the volume and/or toxicity of each contribution. In this regard, then, Superfund seems consistent with the previous applications of polluter-pays that run throughout U.S. environmental policy.

In practice, however, the case for Superfund as a polluter-pays law is less clear. First, EPA has in some cases pursued a few wealthy, or "deep-pocketed," firms (against whom EPA felt it had a strong enforcement case) for a large share of clean-up costs while declining to pursue other parties believed to have also contributed to problem sites. Moreover, Superfund liability can apply to individuals or companies that acquired property from (or, in some cases, even lent money to) those upon whom initial liability was assigned. Thus, some "responsible parties" clearly had no role whatsoever in the creation of problem sites.

Similarly, municipalities that owned and operated their own dumpsites, or contributed wastes to privately owned sites, occasionally find themselves on the hook for clean-up costs—despite the fact that citizen-taxpayers do not like to think of themselves as polluters. Finally, that portion of the trust fund that comes from the tax on chemical and petroleum feedstocks and the corporate profits tax has no necessary connection to the creation over the past century or so of abandoned waste sites.

This raises the question whether the present Superfund really does get at those who benefitted from the overly casual waste disposal practices of the past. In one sense, we who purchased the products made by companies now being held liable for clean-up costs derived some benefit because we paid less than we would have if present disposal standards had been in place. The same goes for stockholders in those companies since they presumably enjoyed greater returns than they would otherwise have earned. Finally, with respect to municipal involvement, residents of the communities benefitted since they paid less in property and income taxes as a result of lax disposal practices. In other words, to paraphrase Pogo, in part "the enemy is us." This complicates judgments about the applicability of the polluter-pays principle.

What about Superfund and the ability-to-pay principle? If, as some critics allege, Superfund has become a hunt for "deep pockets," this may strike others as justifiable on ability-to-pay grounds. This would be especially true if EPA began using joint and several liability more aggressively by focussing its efforts at each site on one or two profitable corporations (regardless of their contribution to the problem), forcing them in turn to recover funds from other responsible parties through court actions.

Yet such an approach should set off at least one red warning light. If hazardous substance policy comes to be directed mainly at the most profitable companies, it will create a powerful disincentive to competitive success. Do we really want to establish the precedent that inefficient, unprofitable companies will be asked to do little in the way of site cleanups, while their more successful counterparts will be assigned disproportionately large shares of these costs? I think not, and we must keep this potentially perverse incentive in mind as we ponder the future of Superfund.

How does Superfund look when measured against the beneficiary-pays conception of equity? Not very good, but for a very sound reason: There was never any intention in Superfund to make those living around waste sites bear the clean-up burden (although in some cases, states pay for 10 percent of the cost of cleanups within their borders). Thus, it is not surprising that Superfund does not do well in terms of the beneficiary-pays approach.

Superfund does most poorly perhaps when evaluated against norms of transitional equity. Because the 1980 law explicitly imposed retroactive liability on firms and individuals, it rankles many. This is particularly true for those who felt they had been exercising all due care in the past with respect to the wastes they were storing on site or sending to

landfills or other facilities. To be told in 1980 that actions taken decades earlier, perfectly legal at the time, were now grounds for substantial new liabilities struck them as quite unfair. Proponents recognized this, of course, but saw no way to raise the requisite off-budget revenues for cleanups without retroactive liability.

Alternative Approaches

What about other approaches to financing site cleanups, including those which would not rely so heavily on retroactive, strict joint and several liability? Could any of those satisfy all four conceptions of fairness described above?

It seems unlikely. Suppose, for instance, that *all* site cleanups had to be financed out of general revenues or with the proceeds from some kind of national tax designed to generate a trust fund. As soon as the fund cleaned up even one site that had been owned and operated continuously by a single company, it would probably be criticized as having violated the polluter-pays principle. In other words, a no-fault clean-up system is a direct departure from polluter-pays; this would be so even if the trust fund were generated by taxes on firms that generate *today's* hazardous substances, because these firms are not necessarily responsible for the problems of the past.

For reasons identified above, heavy reliance on ability-to-pay to generate a trust fund for site remediation would probably meet with resistance: Why should the burden fall most heavily on the most profitable corporations, especially if they were not involved in the creation of the problems? Similarly, asking those in the vicinity of Superfund sites to shoulder all the clean-up burden would seem unfair. After all, products produced in one location are often sold nationally. In a sense, then, consumers everywhere paid less than they would have if waste handling practices had been better in the past. Should they not contribute in part to the remediation of the Superfund legacy with which we are dealing?

Consider, finally, the implications for transitional equity of a fundamental redirection in Superfund. While the original imposition of retroactive liability struck many individuals, municipalities, and corporations as unfair, a great many of them have entered into agreements with EPA and begun to remediate sites—often at great expense. Would they not have a right to object to a shift toward a no-fault system if it did not reimburse them for expenses incurred under the current Superfund? Thus, even changes in a system with which everyone is unhappy may leave some feeling hard-done-by if they have made an effort to live with it while others have not.

Conclusion

My contribution to this forum has focused on fairness. But there are other criteria by which we judge environmental policies, some of which conflict with fairness or equity. My point is that if fairness were our *only* criterion in judging Superfund and possible alternatives to it, we would still have a very difficult job in deciding whether, if at all, to make fundamental changes in that law.

(Portney is Vice President and Senior Fellow at Resources for the Future.)

Bill Roberts

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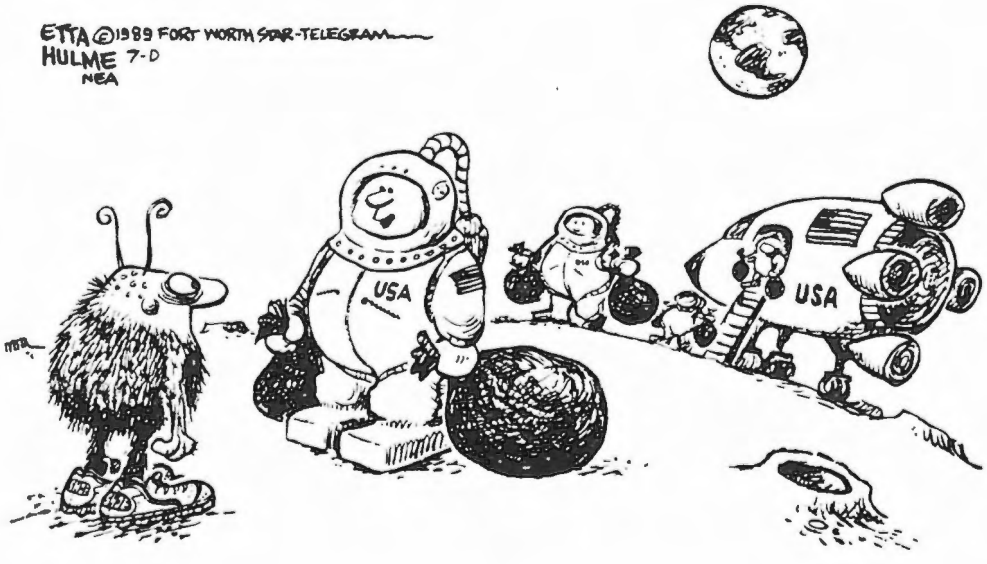
"Superfund is unquestionably the most effective and important environmental program on the books." That statement is not from an environmentalist or EPA official, but from a friend who has worked for years as a corporate lawyer handling transactions between businesses. He rarely contacts EPA, couldn't name an EPA contractor if you paid him, and has no real conception of the complex issues involving clean-up standards or EPA settlement policies.

So, why does this corporate lawyer have such a high regard for Superfund? In a phrase: strict joint and several liability.

Superfund is not nice to polluters. It is not a polluter bail-out program. It is not



"We come in peace. Where's the landfill?"

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a public works program. It was designed to operate on a very simple premise: The polluter should pay, not the taxpayer. And corporate America has gotten the message.

Across the country, businesses now scrutinize their waste management activities. They spend millions of dollars to carefully manage their wastes and, more importantly, to change their production practices to reduce the waste they generate in the first place.

They clean up old contamination on their property to make their businesses more attractive to potential purchasers and more dependable to financial institutions looking for reliable collateral. My corporate lawyer friend showed me a 60-page, single-spaced questionnaire prepared by his firm, to be completed by any company his clients may be interested in purchasing. An environmentalist could not have produced a more thorough audit. And all this goes on without a single EPA employee in sight.

This makes Superfund one of the least bureaucratic and most cost-effective federal environmental programs. Using Superfund liability as an incentive for environmentally sound conduct requires no new volumes to the Code of Federal Regulations, no EPA time devoted to regulatory development, and no lengthy delays in implementation.

It also gives industry the flexibility to find the least expensive measures to reduce the threat of contamination. If that means changes in production practices, fine. If it means cleaning a leaking landfill before hazardous substances migrate into ground water, fine. With Superfund cleanups costing an average of $20 to 30 million, the business community has worked hard to find lower cost methods to reduce pollution, lower the risk of contamination, and avoid expensive clean-up costs. The business community has found that it is cheaper to avoid creating a Love Canal in the first place than to clean it up afterwards. That's good for business and good for the environment.

How does Superfund's liability standard produce this kind of behavior? Essentially, Superfund closes the legal loopholes polluters could use to avoid paying clean-up costs. First, Superfund denies polluters the "I tried my best" defense. By adopting a strict liability standard, which means that polluters must pay without regard to fault, Congress invoked a well-established legal doctrine to force polluters to pay for cleanups.

Although it may seem like a tough test, strict liability is hardly novel. For centuries, the courts have applied this test to anyone involved in "ultra-hazardous" activities, such as handling dangerous explosives. In Congress' view, if a company generated hazardous substances, it should be prepared to pay for the consequences.

On a practical level, this standard also made it possible for EPA to avoid the cumbersome and oftentimes overwhelming task of proving that a polluter acted negligently in contaminating ground water or posing other threats to human health or the environment. And more importantly, it sent a signal to potential polluters that making "best efforts" would not be a defense if their wastes caused contamination.

Second, Superfund liability borrows another well-established legal principle by imposing liability jointly and severally among polluters. Congress recognized that many contaminated sites contained the commingled wastes of many companies and that it would be virtually impossible for EPA to prove who caused what. To avoid protracted legal fights between EPA and polluters and to speed clean-up activities, Congress allowed the imposition of liability as long as EPA could identify one or more of the responsible polluters.

Those identified by EPA have always been free to search out other responsible parties and, through legal action, compel them to pay their fair share of clean-up costs. But the time and cost of this litigation was borne by the polluters, not by taxpayers.

So why is a program that has accomplished so much with a minimum of command-and-control intervention been subjected to such harsh criticism?

Before answering this question, it's important to identify the critics. They don't seem to be in Congress. Congress passed Superfund with its "polluter pays" liability system in 1980, continued it in 1986, and reauthorized it for another five years in 1990.

The most active, current effort to amend the liability scheme in Superfund has been in the narrow area of lender liability. But, even the most vocal advocates of change in this area have made it clear that they have no interest in abandoning Superfund's current liability system altogether.

One can only conclude that the Administration feels the same way. Presidents Carter, Reagan, and Bush have each signed Superfund legislation that enacted and preserved the Superfund liability system.

Dozens of state governments have passed "mini" Superfund statutes that have similar liability programs. It would appear that legislators on the state level feel just as strongly as the federal government about forcing the polluters to pick up the clean-up tab.

And let's not forget the American people. In one public survey after another, the public rates the management of hazardous and toxic waste as one the nation's top environmental priorities. More importantly, a national survey conducted by the Environment Opinion Study, Inc., last year found that 70 percent of the public disapproves of the way industry and business have attempted to preserve and protect the environment. Clearly, the American people have not lessened their commitment to see the "polluter pay."

Sadly, but predictably, the critics of the Superfund liability program are the polluters themselves. They complain about high "transaction costs" and legal fees, even though no one has quantified those costs, much less compared them to taxpayers' savings under the current program.

They complain about the potential reach of joint and several liability but find it hard to present data to show real instances of unfairness.

They assert that a tax-based public works program should replace the liability program, but we hear only silence when we ask who will support a sufficient tax (i.e., the "T" word).

And they complain that Superfund's retroactive liability makes business pay for mismanagement which occurred years ago, although they don't explain why the taxpayers should pay to clean up industry's old Superfund sites.

When the dust settles on this issue, we still face the challenging task of cleaning up our soils and ground water to make them safe for our families and our children. It's a costly, time-consuming, and difficult task. And, although Superfund is hardly a perfect program, its liability system will help us clean up these sites more quickly, discourage the creation of future sites, and keep taxpayer costs to a minimum. □

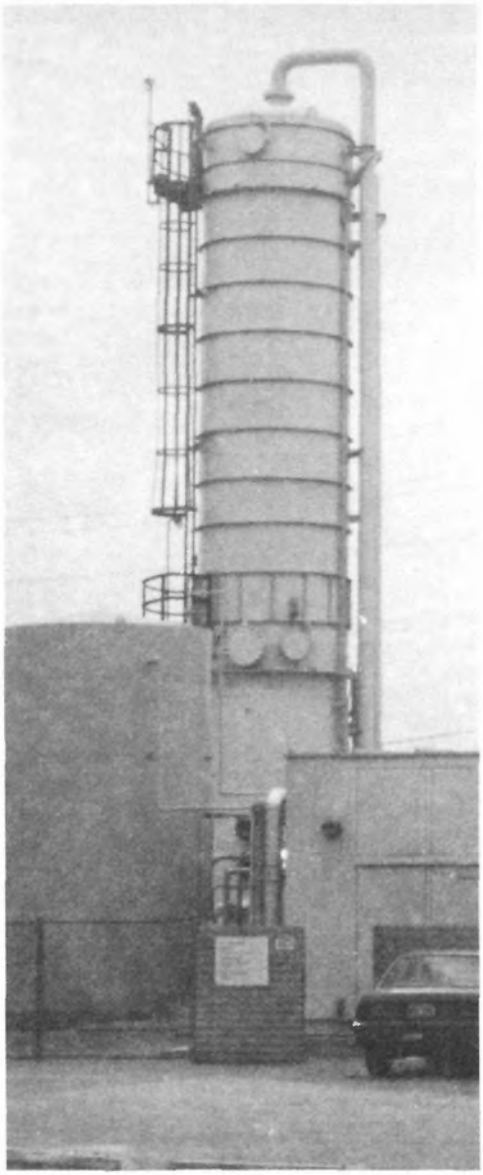
(Roberts is Legislative Director for the Environmental Defense Fund in Washington, DC.)

Innovations in the Clean-up Battle

The toxic shell game has given way to treatment in place.

AOSTRA-SoilTech Anaerobic Thermal Processor (ATP): Rotary kiln desorbs organics from soil and sludges in four separate thermal zones. Reagents sprayed on contaminated soil break down chlorinated compounds (such as PCBs) during process.

by John H. Skinner



AWD AquaDetox/SVE System: Simultaneously treats ground water and soil gas in closed loop system that eliminates air emissions. Proprietary moderate-vacuum steam stripping tower removes organics from ground water; soil vapor extraction (SVE) system removes soil gas for subsequent treatment with granular activated carbon beds.

In 1980, when the Superfund program began, the technologies available to clean up hazardous waste sites involved either reburial or containment of the waste on-site or shipment of the waste off-site to an incinerator or landfill. The authors of the original Superfund law must have believed these technologies were adequate to do the job because they rejected proposals to include research and development provisions in the legislation. Consequently, there was little attempt to develop better solutions.

This was very shortsighted, as early experience showed. For the first six years, the Superfund program struggled to apply limited and often inadequate technologies to some very complex and difficult clean-up problems.

The 1986 amendments to Superfund changed this picture and allowed EPA to develop the Superfund Innovative Technology Evaluation (SITE) Program. The objective of the SITE Program is to stimulate development and use of innovative clean-up technologies that destroy or detoxify wastes or permanently reduce their volume or mobility. The program has helped widen the range of available technologies for site cleanup, resulting in the application of environmentally better, cost effective solutions.

The Early Years: "Hold'em or Run'em"

Anyone who has attempted to seal a leaky basement at home can understand the frustrations of attempting to block the flow of liquids through soil. In the early 1980s, a widely used clean-up method involved trying to hold hazardous wastes on site through the use of various containment devices. Slit trenches were dug around the contaminated areas and filled with cement-like material to form slurry walls or grout curtains to block contaminant spread. Ground water was redirected by installing wells which would be pumped counter to the flow direction. Wastes were excavated and reburied on liners composed of compacted soil or plastic membranes. Caps or covers were placed over wastes to prevent rainwater infiltration.

These containment devices are often very difficult to install properly in the field. Sometimes they impede contaminant flow only temporarily. Over time they can break down, or the contaminants can simply find an alternate route around or under them. While these techniques are still used today, they require long-term monitoring and maintenance to ensure proper operation.

A second site clean-up method used in the early years involved shipping hazardous wastes off-site to other facilities. However, these facilities were often inadequately designed and operated because the hazardous waste regulatory program under the Resource Conservation and Recovery Act (RCRA) was not yet fully in place. Many of these facilities were closed down in later years because they could not meet the requirements necessary to receive a federal operating permit. This practice of running wastes off-site was labeled the "toxic shell game" by the press and often met hostile opposition from citizens in the receiving communities.

It was against this backdrop of waste management practices that Congress reconvened in the mid-1980s to consider the future of Superfund.

1986: Enter SARA and SITE

With new authority granted by the Superfund Amendments and Reauthorization Act of 1986, EPA established the SITE Program. The

(Dr. Skinner is EPA's Deputy Assistant Administrator for Research and Development.)

program works to accelerate the development, demonstration, and use of new treatment technologies for Superfund cleanup. Under the SITE Program, innovative waste-treatment technologies are evaluated and demonstrated at full scale at actual Superfund sites. The purpose is to obtain reliable data on the performance and costs of operating these technologies.

The SITE Program is a public-private partnership where the costs and monetary risks are shared by EPA and the technology developers. The technology developer pays for the design and construction of the technology and must bring it to the Superfund site, install it, and operate it during the demonstration period. EPA pays for the evaluation of the technology, including the collection and analysis of chemical samples. EPA also prepares the final evaluation report, which describes how well the technology worked and presents all of the data collected. This information is sent to EPA regional staff, who use it when selecting technologies at other sites.The SITE Program also supports the evaluation of emerging technologies that are not yet ready for full-scale demonstration by supporting tests at the bench-scale and pilot-plant level. Innovative methods for monitoring and taking measurements at Superfund sites are also evaluated. The program includes extensive technology transfer activities to disseminate data to environmental managers in governmental agencies, the engineering community, industry, and the public.

A Witch's Brew of Chemical Soup

Superfund sites contain complex chemical mixtures of hazardous substances in many different physical forms. Such wastes include, for example, lagoons or ponds filled with sludge and oils, large areas of soil that have been contaminated with heavy metals and solvents, contaminated ground water where wastes have leaked below the water table, and assorted debris such as old barrels and tanks that contain remnants of hazardous substances. The physical and chemical properties of these wastes vary considerably. Some bind tightly to soil particles. Others dissolve in ground water. Some volatilize into the air. Others sink to the bottom of underground aquifers.

Wastes at Superfund sites include both organic and inorganic toxic contaminants. Organic substances contain carbon molecules, often in combination with hydrogen, oxygen, and chlorine molecules linked together in long chains or ring structures. The resulting chemicals have intimidating names such as polychlorinated-biphenols (PCBs) and tetrachlorinated-dibenzo-dioxin (or more simply, dioxin). Inorganic substances include toxic heavy metals such as lead, mercury, and cadmium.

There are a number of technologies that can be used to treat Superfund wastes, depending on the contaminants present and the characteristics of the waste and the site. Often it is necessary to use these technologies in combination with each other in what are called "treatment trains" to deal with the mixtures of chemical substances present. For example, a waste mixture containing heavy metals and organic materials might be treated by first removing, concentrating, and recovering the metals and then degrading or destroying the organic matter. Sometimes the waste components need to be separated from each other before they can be properly treated. Therefore, it is very important to develop a full set of technologies and put together marriages that will deal with the different possibilities. Examples of some relatively new technology options are presented in the box accompanying this article.

For Information, Look in the ATTIC.

The heart of the SITE Program's technology transfer system is the Alternative Treatment Technology Information Center (ATTIC). ATTIC is an EPA-developed information retrieval network that provides up-to-date information on innovative treatment methods for hazardous wastes. ATTIC offers an online information system that is accessible

by any personal computer equipped with communications software and a modem. There is a telephone link to a hotline-system operator who can assist users who do not have access to a computer. There is also a reference library with hard copies of all reference material. ATTIC carries out a variety of outreach activities such as technical assistance, education and training, and dissemination of information packets and user bulletins.

The ATTIC database now holds over 1,500 records with information on innovative waste-treatment technologies. It not only contains all available reports from the SITE Program but considerable other information, including:

- Superfund Records of Decision—the recommended remedy for 465 site cleanups
- Removal actions—technologies used for 175 removal actions at Superfund sites
- U.S. Army data—90 records of innovative clean-up technologies used at Department of Defense sites
- State data—including 110 records from the California Treatment Technologies Program
- International information—including data from the NATO research program and reports from various international conferences
- Reports on innovative technologies from EPA's Office of Research and Development—delisting actions under RCRA that used innovative treatment, treatability study data, and other reports.

Since starting operation in January 1990, ATTIC has received over 4,500 calls either through the online computer link or the systems operator. ATTIC, currently averaging nearly 700 calls a month, has 625 registered users (25 percent from the federal government, 10 percent from state governments, and 65 percent from the private sector). Best of all, ATTIC is free. The system operator is available at (301)-816-9153, Monday through Friday, between 8:30 and 4:30 (Eastern time). Call often and share your innovative technology data and information.

The Bottom Line

Is the SITE Program meeting its goal of stimulating the development and commercialization of innovative waste treatment technology? Let's look at the data and see. There are currently 56 technologies in the SITE demonstration program, 30 technologies in the emerging pilot-scale evaluation program, and 15 technologies in the innovative monitoring and measurement program. A wide range of treatment technologies is being evaluated, some of which are thermal treatment, solidification and stabilization, bioremediation, chemical treatment, soil washing, *in-situ* extraction, and various combinations of other technologies. To date, 20 full-scale treatment technology demonstrations have been completed, and 18 more will be finished by the end of fiscal year 1991. This represents a tremendous amount of new information available on the performance and costs of innovative technologies.

The commercial accomplishments reported by technology developers participating in the program are an important measure of success of the SITE Program. Are SITE technologies actually being selected for clean-up jobs after they successfully complete the program? The answer clearly is yes. One developer of a vacuum extraction technology has reported over 100 new clean-up jobs after the SITE evaluation. The developers of the 20 SITE technologies who have completed demonstration projects have reported a total of 50 new clean-up jobs. These jobs are not only under Superfund but also under the RCRA program, the underground storage tank program, and state and private party-sponsored projects. The future business potential for SITE developers is also quite promising. The developers for the 20 completed SITE demonstrations have been invited to submit data for over 300 future clean-up projects.

I believe that the SITE Program has done much more than just provide business opportunities for its participants. It has acted as a catalyst that has stimulated innovative technology development and commercialization across the field. When a SITE project is successful, developers of similar technologies benefit from that success. Working with the results from SITE projects, EPA and state clean-up officials can ask the right questions and make decisions with more confidence. The Superfund program reports that, since the 1986 amendments were passed, innovative treatment technologies have been selected for nearly 50 percent of the clean-up jobs.

I believe the $65 million that has been invested to date in the SITE Program will have tremendous leverage. Decision making will be improved at thousands of sites in the United States and internationally. Billions of clean-up dollars will be better spent. Technology will advance through this small but wise investment in research. □

Innovative Clean-Up Technologies

Vacuum Extraction and Soil Washing

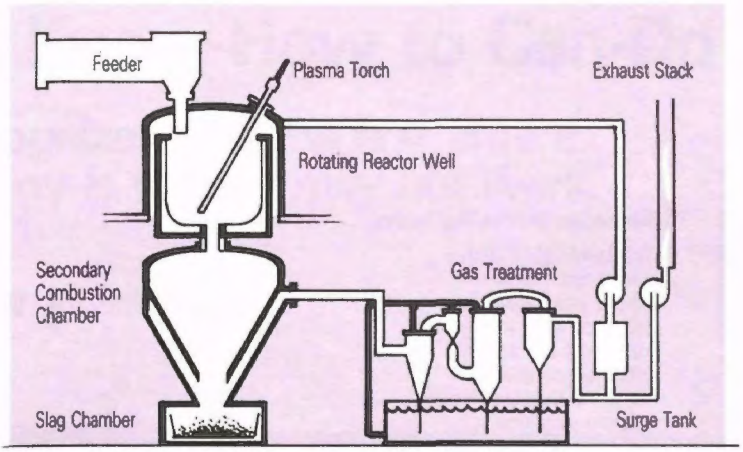
Vacuum extraction is a technique for removing volatile compounds (VOCs) from soils. This is carried out *in situ* (meaning that the soils are not excavated but treated in place). Extraction wells are installed in the contaminated soil with a vacuum-tight seal near the surface. A vacuum applied to the extraction wells sucks the volatile compounds from the soil. The contaminated air stream is then filtered through carbon before release to the atmosphere.

The process has been successfully applied to a variety of soils, silts, sand, and gravel. The process is more efficiently and easily applied to gravels and sands. The soil must be porous for vacuum extraction to work well. If the porosity of the soil is small, too little space will be available for air to flow, and the extraction process will not work.

The demonstration of vacuum extraction at the Groveland Wells Superfund site in Massachusetts removed nearly 600 kilograms of trichloroethylene, an industrial chemical, during a 56-day operational period.

Soil washing can be used to remove contaminants from soil with a washing fluid. Water, organic solvents, surfactants, acids, and bases have all been used to wash soils. The fluid is added to excavated soils, which are screened and washed in a series of rotating vessels. After washing, the washing fluid must be treated in a wastewater treatment facility.

Soil washing can remove heavy metals and organics from sandy soil. EPA has successfully used the solvent



Plasma Reactor Process

Contaminated soil enters through feeder. Plasma torch creates molten bath which detoxifies contaminants. Reactor well rotates to transfer heat evenly; centrifugal force holds material in well. Organics remaining in gases are destroyed in secondary chamber; acid gases and particulates are treated downstream.

ethylene-diamine-tetraacetic acid to remove lead from contaminated soil at Superfund sites. But soil washing is not as effective for clay soils. The clay bonds the contaminants more tenaciously, so they are much harder to remove.

A pilot test of the soil washing system was conducted at the MacGillis and Gibbs Superfund site in Minnesota. A mobile pilot system removed 90 percent of the pentachlorophenol, a chemical used for wood preservation, from the contaminated soil.

Chemical Treatment: KPEG and BCD

Chemical treatment processes alter the chemical structure of the wastes to produce a residual that is less hazardous than the original waste. There are many examples of chemical treatment; two of the newest and most innovative were developed by researchers in EPA's Office of Research and Development and are referred to by the acronyms KPEG and BCD.

KPEG gets its name from the chemical reactant fluid that is used to treat the waste: potassium polyethylene glycolate (potassium's chemical symbol is K). The KPEG process involves mixing the waste and KPEG reactant in a heated reactor for up to five hours, depending on the type and concentration of the contaminants. When used on chlorinated wastes such as PCBs, dioxins, and chlorophenols, the KPEG process removes the chlorine molecules, making the waste less hazardous.

The KPEG technology was demonstrated on 20 tons of contaminated soil at a U.S. Navy site in Guam. The PCB concentrations in these soils were reduced from 3,000 parts per million (ppm) to 2 ppm (1 ppm means 1 gram of PCB contained in one million grams of soil). However, significant quantities of reactant had to be used, and this was expensive. Also the treatment took four to six hours and had to be repeated several times.

Base-catalyzed decomposition (BCD) is another technology for removing chlorine molecules from organic substances. While BCD is not yet commercially available, the preliminary research is very promising. Like the KPEG process, BCD requires the addition of a reagent to the contaminated soils and heating of the material for the reaction. Instead of large quantities of reagent, however, the BCD process requires only 1 to 5 percent reagent by weight. The reagent is also much less expensive than the KPEG reagent.

Laboratory and bench-scale tests have demonstrated the ability of this technology to reduce PCB concentrations from 4,000 ppm to less than 1 ppm. This year the U.S. Navy will be applying this technology at a site in Guam where one to two tons per hour of contaminated soil will be treated.

Thermal Treatment

Thermal treatment uses high temperatures to destroy hazardous wastes. Well-run thermal treatment processes can completely destroy organic waste in a matter of seconds. Several types of thermal-treatment technologies exist—the main differences being in the design of the primary combustion chamber.

Rotary kiln incinerators are slightly inclined cylinders in which wastes are injected at the top and tumble and burn as the kiln slowly rotates. Infrared furnaces pass electrical power through carbide heating elements to generate thermal radiation. A fluidized bed combustor uses a vessel containing a hot bed of inert sand-like material that is floated by high-velocity air. In all cases, high temperatures and thorough mixing improve the combustion process.

After exiting the primary chamber, combustion gases continue to burn in a second chamber in order to assure complete combustion. The gases then flow through scrubbers, filters, or other air-pollution control devices before being exhausted to the atmosphere.

Thermal treatment systems are widely available in the United States. Several years ago, EPA's Office of Research and Development built and operated a prototype mobile rotary kiln incinerator and demonstrated its feasibility. Today, several mobile thermal treatment units are commercially available.

Thermal destruction units will be less effective if the wastes to be treated have a high moisture content. Also high concentrations of halogenated compounds (chlorine, fluorine, or bromine) and metals (arsenic, mercury, or lead) will increase the air-pollution cleaning requirements. Properly operated thermal treatment processes can destroy or remove more than 99.99 percent of the toxic organic compounds in wastes.

Bioremediation

Waste-degrading microbes or microorganisms exist virtually everywhere in the natural environment. In fact, microorganisms are Mother Nature's own clean-up crew. When living species such as trees, plants, or people die, naturally occurring microorganisms degrade the organic matter into carbon dioxide and water. If it were not for microorganisms, the world would be cluttered with organic matter from the past. Bioremediation attempts to harness the waste-degrading capability of microorganisms and use it to destroy toxic organic substances found in hazardous waste.

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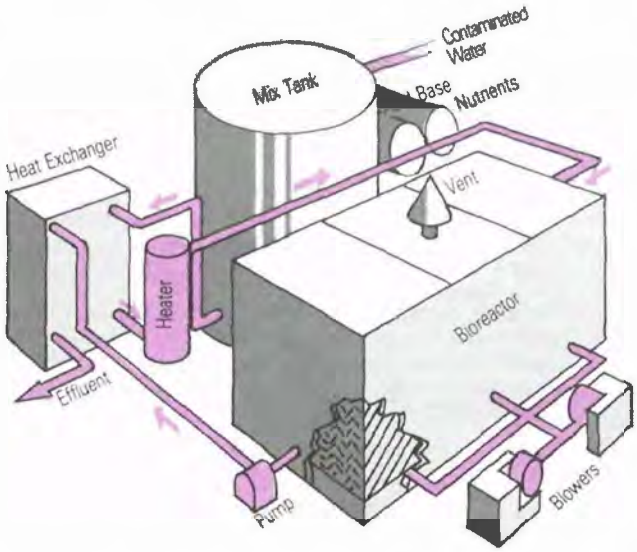


Bioreactor Processing System

Contaminated water enters mix tank where acid level is adjusted and inorganic nutrients are added. After heating, water flows to reactor where microorganisms degrade contaminants to carbon dioxide, water, and chloride ions. Effluent is then discharged.

Often, waste-degrading microorganisms exist right at a Superfund site. Their natural capabilities can be enhanced by adding oxygen, nutrients such as nitrogen or phosphorous, or other microorganisms cultured in a laboratory. If the waste is first excavated, it may be biodegraded in a reactor vessel. Alternatively, bioremediation may take place *in situ* to biodegrade contaminated soils and groundwater in place. *In situ* bioremediation is often used in conjunction with a ground-water pumping and reinjection system to circulate nutrients and oxygen through a contaminated aquifer and associated soils.

Biodegradation must occur within a very specific range of physical parameters. If the moisture content, temperature, oxygen content, nutrient content, or pH vary outside the range used by the target population of microorganisms, biodegradation will slow down or halt. In addition, sometimes the concentration of the contaminants in the soils will be toxic to the microorganisms, again stopping the treatment process. The need to regulate these parameters requires close monitoring of the treatment system.

Some very promising research is underway on adding methane gas as a supplement. When the microorganisms degrade the methane, the contaminants are degraded at the same time (microbiologists call this "co-metabolism").

Biological treatment systems have been used to treat soils contaminated with pentachlorophenol, creosote, oils, gasoline, and pesticides. A microbiological system tested at the MacGillis and Gibbs site in Minnesota successfully reduced 60- to 100-ppm levels of pentachlorophenol to less than 5 ppm in the treated water. Bioremediation was also successfully used in Prince William Sound, Alaska, to clean up over 100 miles of shoreline contaminated by the Exxon *Valdez* oil spill.

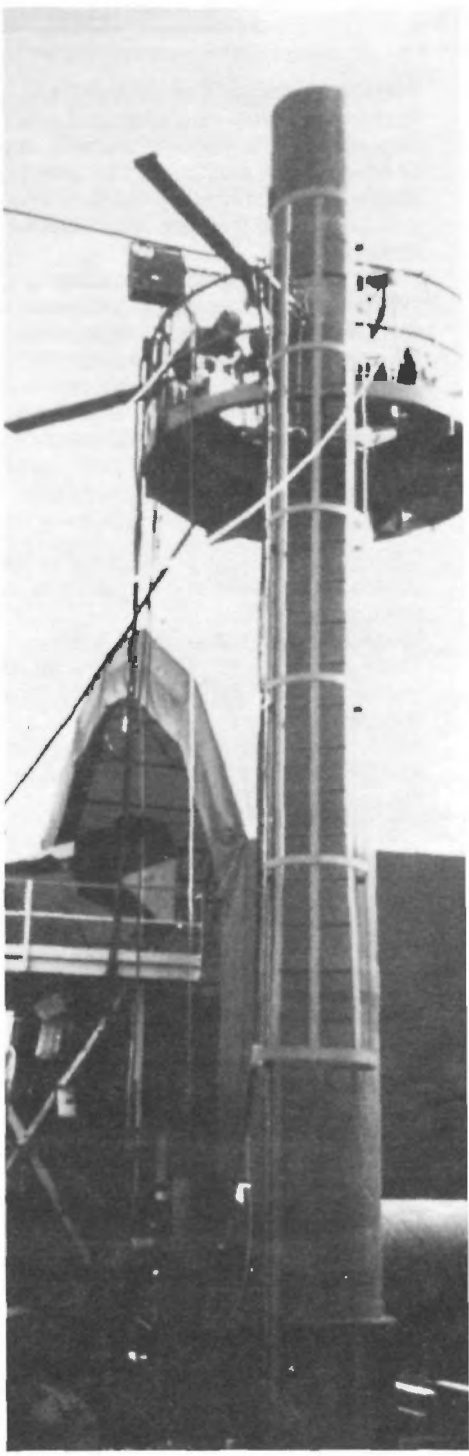
Solidification and Stabilization

Solidification and stabilization technologies treat wastes by reducing the mobility of the pollutants. The process either creates a solid mass (solidification) or chemically binds the contaminant to the solid particles (stabilization).

Solidification and stabilization can be performed in tanks and containers or *in situ*. When these procedures are performed in tanks, the wastes are mixed with water and cement-based reagents. The material is discharged into a mold and allowed to cure to form a solid. When the procedures are performed *in situ*, the reagents are mixed deep into the waste or soil, using an auger.

Solidification and stabilization technologies work best on wastes contaminated with cadmium, copper, chromium, lead, and zinc. This type of technology has been shown to reduce the mobility of these metals by 95 percent or more. High concentrations of organic materials, cyanides, sulfates, or oil and grease are likely to interfere with the bonding of the reagents to the soil particles.

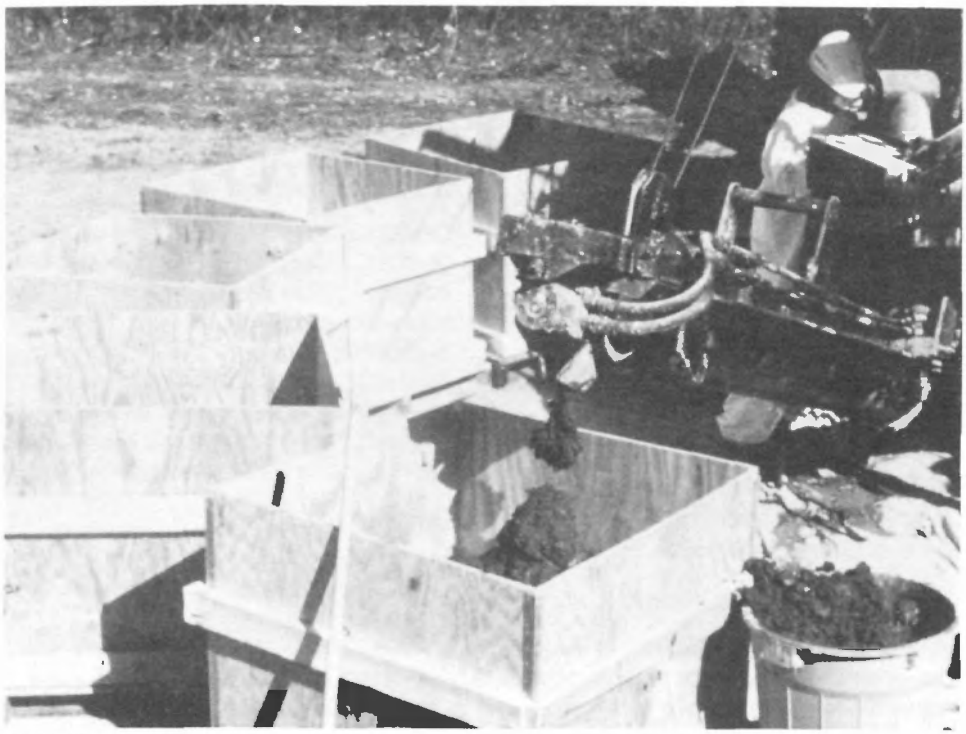
In-situ solidification and stabilization immobilized PCBs during a demonstration project in Florida. Also, using a reactor-based process at a site in Pennsylvania, soils with up to 25-percent organics were solidified and heavy metals (lead and zinc) were immobilized.



From Know-How to Can-Do

EPA recognizes that the first time a technology is tried, it may not work.

by Walter W. Kovalick, Jr.



HAZCON Solidification Process: Contaminated material is mixed with Portland cement, a patented additive, and water. Mixture hardens into a cohesive mass that immobilizes contaminants.

Shirco Infrared Incineration System: Organics are driven out of soil in primary combustion chamber, then burned in a secondary chamber. Unit uses electric-powered infrared heat-source in primary chamber.

(Dr. Kovalick is Director of EPA's Technology Innovation Office.)

As a member of the consulting engineering community noted at a recent symposium, "We've been building bridges and highways for 5,000 years and treating wastewater for 150 years, and we're still learning in each of those areas. We've been trying to clean up hazardous waste sites through applications of technology for a little more than 10 years." The point of his remark was that hazardous waste cleanup *is* a relatively young business. It is new from the standpoint of regulators, new from the standpoint of the engineering community, and new from the standpoint of developers of treatment technologies.

Despite successful demonstrations of new technologies through EPA's SITE Program (see article on page 40) and similar efforts in the states, the fact remains that the development and widespread application of technologies for the cleanup of abandoned waste sites and contaminated land are inadequate. There is a long, bumpy road between several weeks' operation of a pilot plant and the commercialization of new technologies.

The Technology Innovation Office (TIO) in EPA's Office of Solid Waste and Emergency Response (OSWER) was established to advocate innovation among EPA and state staffs, consulting engineering firms, American industry in general, and the vendors who develop these technologies. From our vantage point, we see three major hurdles—informational, regulatory, and legal and institutional—in the way of developing faster, better, cheaper, and more publicly acceptable treatment alternatives.

Information Barriers

The *developer* of new technology faces a fragmented market for soil and ground-water cleanup driven largely by industry response to regulatory programs such as Superfund. The variety of contaminants, soil types, hydrogeological settings, and other technical factors makes matching new ideas with definable market needs very difficult. Unlike marketing traditional products to first-time buyers, in the remediation field each solution is custom-built due to unique site circumstances. This uncertainty carries over to the financial community, which is reluctant to provide venture capital. Complicating this scenario for developers are the perceived and real business risks of dealing with hazardous substances and liability concerns.

In terms of the *commercialization* or routine field application of these

technologies, there are additional information barriers. Only seven of the 140 innovative technologies already selected in the federal Superfund program have been completed and used. An additional 21 are being installed or are operational. The balance are in the design and pre-design stage. The consulting engineers who design projects have no standard design documents to refer to; they lack cost and performance data with which they can assure their clients—American industry and the government overseers—of the efficacy of these remedies. In many cases, they are firms whose experience base consists of decades of wastewater treatment plant design. It is only in the past five to seven years that they have turned their attention to waste site clean-up problems. While their clients are used to guarantees of a certain level of performance, the designers are not empowered by the available information to give such guarantees. Having to deal with hazardous substances while still observing normal, conservative engineering practices, complicates the situation.

Regulatory Impediments

Hazardous waste technology development and its field application are unique in the world of technical advances. *Both* research and development *and* operational activities require a permit under the Resource Conservation and Recovery Act. Designed as it is to prevent unsafe releases when working with hazardous wastes, the law sets up a barrier to entrepreneurs unlike any other technology development arena. One could invent a new transportation system, a revolutionary machine tool, or a new manufacturing process in quiet studied contemplation; engineering flaws and rework would probably be necessary. But one cannot develop a new hazardous waste treatment process *and put hazardous waste through it* without a public permitting process, financial guarantees, and (perhaps more difficult for the developer) a wait for approval to test the equipment.

EPA has developed regulations for research and development permits and is encouraging states to include such permitting in their regulations. A federal exemption allows the testing of small quantities of waste to assist development.

The intergovernmental aspect of permitting can also impede research and development of treatment processes. Even in the most streamlined system, state and local governments can choose to exercise regulatory and permitting influence over proposed projects.

Institutional Impediments

In addition to the uncertainty faced by investors in these new technologies, mentioned earlier, the buyers (i.e., American industry) are faced with a new marketplace in which they must depend on advice mediated by others. Thus, even the technologies with good demonstration data must be understood well enough by an engineering firm for them to recommend the technologies in a proposed design, and they must then also be understood by the construction firm that is going to build this one-of-a-kind system for the client. Faced with this tenuous chain of experience and a desire not to pay twice—once for the innovative solution and then, when that doesn't work, for an established solution—there is an understandable reluctance by buyers to pursue innovation without demonstrable cost savings.

Added to these marketplace realities are extra layers of liability concern. Beyond the normal negligence concerns, with which the engineering profession is used to dealing, are the risks of designing a first-of-its-kind remedy and having it fail, as well as the potential third-party liabilities stemming from people claiming damage from an inadequately designed remedy years after it was applied.

A Brighter Outlook

Despite these multidimensional problems, progress is being made on several fronts. TIO and others in EPA are widely disseminating cost and performance data to the government, industry, and engineering communities. In the interest of adding certainty to the size and nature of the market, several new electronic data bases, regular newsletters, and an increasing frequency of demonstration results and studies are being targeted to users with the greatest need in the clean-up community.

To help lend more certainty to the engineers' world, professional engineering societies will be convened to take a snapshot of the state of technology development. TIO plans to convene private industries and federal agencies with clean-up problems to consider joint technology development.

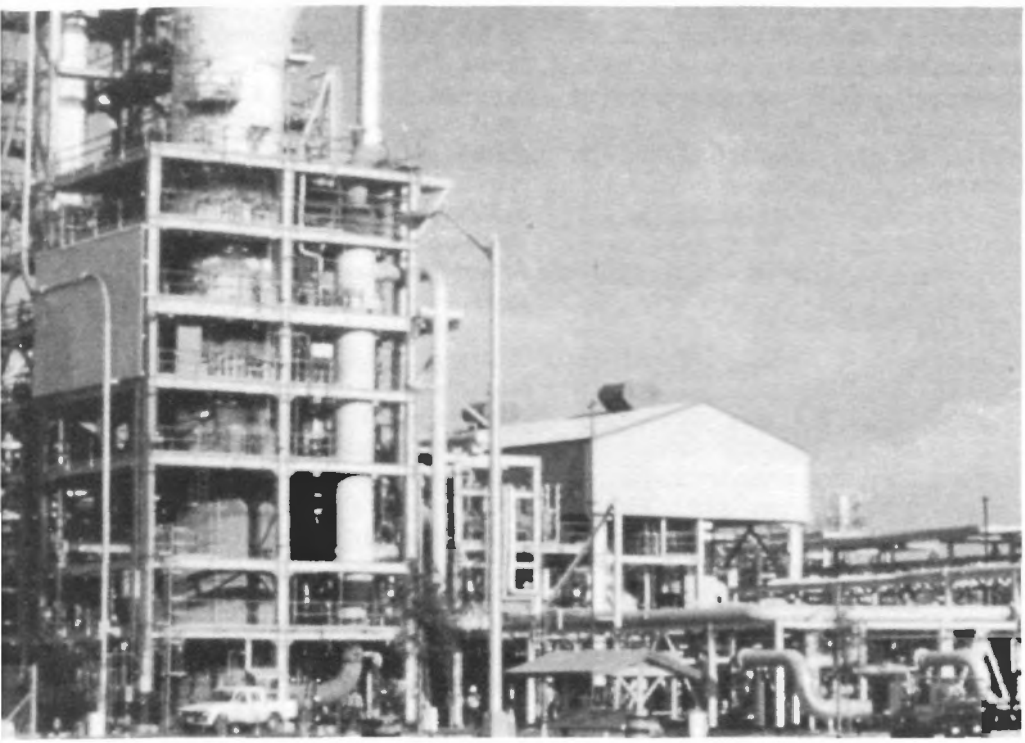
State leadership in permitting of new technology development is a promising arena because it affords the opportunity to deal comprehensively at the local level with needed permits. TIO is working with several states on such an initiative for site remediation technologies.

We are on the launch pad with a number of new technologies for site remediation. In three years, we should see a quantum leap in information on full-scale operation of some of these technologies. That will pave the way for articles on "second generation developments," rather than on barriers to beginning. □

Corrective Action: Task with a Big Future

Wastes were commonly dumped in the "back 40."

by Sylvia K. Lowrance



Wide World photo.

A petroleum refinery. A wide range of small and large industries treat, store, and dispose of hazardous wastes under RCRA regulations.

For more than 200 years, the industrial revolution has worked its changes on the social and economic fabric—and the landscape—of the United States. Vast networks of industrial facilities produce all the enormously varied products of the modern age. Inevitably, the production and distribution of these products have generated great quantities and varieties of chemical sludges, ashes, used solvents, and other industrial wastes.

Until very recently, these wastes were commonly dumped into unlined landfills and lagoons in the "back 40" of manufacturing facilities. Not surprisingly, many of these old industrial dumpsites have become major environmental problems.

Although Superfund has captured most of the public's attention regarding toxic waste cleanup in recent years, there are thousands of contaminated industrial facilities that are outside the jurisdiction of Superfund. (By its mandate, Superfund targets for long-term cleanup only those abandoned or uncontrolled sites that are on the National Priorities List, or NPL.) Cleaning up these contaminated industrial facilities has become largely the work of a new clean-up program under the Resource Conservation and Recovery Act (RCRA): the Corrective Action program. Still in its early stages, Corrective Action nevertheless is becoming increasingly visible in tackling a clean-up effort that approaches Superfund in scope and complexity.

(Lowrance is Director of EPA's Office of Solid Waste.)

Why Corrective Action?

Before the Hazardous and Solid Waste Amendments of 1984, RCRA was primarily a pollution prevention statute, mandating a comprehensive, stringent set of regulations prescribing how industry must manage its newly generated hazardous waste. In effect, the RCRA regulations were designed to prevent future Superfund sites from happening.

But the legacy of the past remained a problem in that contamination from previous waste management (or mismanagement) practices at these industrial facilities was largely beyond the reach of RCRA and EPA. The 1984 amendments changed this by giving EPA broad new authorities to require corrective action at facilities regulated under RCRA. As a result, RCRA is currently both a prevention and a clean-up program.

RCRA and Superfund Compared

The Superfund and RCRA Corrective Action programs are similar in a number of ways, but there are important differences. Both programs share the same fundamental clean-up objectives, and the progressive steps of the Corrective Action process are analogous to the steps followed in a Superfund cleanup. (See article by Jack Lewis on page 7.) However, rather than the abandoned or uncontrolled sites that are on the Superfund NPL, RCRA-regulated facilities are most often (but not always) properties with active, ongoing manufacturing operations. Unlike many Superfund sites, RCRA facilities have identifiable owners/operators.

The RCRA universe of facilities includes a wide spectrum of industrial operations that involve treating, storing, and disposing of hazardous wastes: petroleum refineries, iron and steel mills, chemical plants, automobile manufacturers, and many others. Owners/operators of RCRA facilities are often large Fortune 500 companies, but many others are small "mom and pop" operations. In addition, several hundred federal facilities, primarily Defense and Energy Department facilities, are regulated under RCRA.

One fundamental difference between the two clean-up programs has to do with funding. Under RCRA, financial responsibility for conducting technical investigations and taking corrective

action to clean up a facility falls to the facility owner/operator. Unlike Superfund, there is no government "fund" for financing cleanups under RCRA.

The role played by the states is another point of difference between RCRA and Superfund. Whereas Superfund is primarily a federally administered program, RCRA Corrective Action is designed to be substantially delegated to the individual states. To date, seven states—Minnesota, Utah, Colorado, Idaho, Illinois, Georgia, and Texas—have been formally authorized to run Corrective Action programs under RCRA; many more states conduct major aspects of the program under cooperative agreements with EPA.

As many as 4,000 RCRA-regulated hazardous waste management facilities may eventually need some type of corrective action. These facilities vary widely in the health and environmental hazards they pose. Many have relatively minor contamination problems, while a significant number may pose environmental risks comparable to major Superfund sites.

Status Report

Following the 1984 RCRA amendments, the exigencies of statutory deadlines consumed much of EPA's resources, and the Corrective Action program began slowly in its early years. Since the late 1980s, however, the program has swung into action. Extensive national guidance has been issued, and numerous facility investigations and cleanups are underway. To date, EPA and the states have assessed more than 2,000 facility sites for possible releases, and detailed analyses, including extensive monitoring for releases, have been completed at more than 100 facilities. An additional 100 facilities are now carrying out remedies prescribed by EPA; approximately a dozen remedies have been completed.

While these figures testify to the high level of activity within the Corrective Action program, they also show that the program is still in its early phases. For the most part, facilities are in the process of identifying and characterizing releases. Cleanup will take place in the future. EPA's challenges in administering this program, therefore, lie in moving facilities efficiently into the clean-up phase, streamlining the process so that facilities can move quickly toward acceptable goals, and focusing resources first on the sites that are of highest priority.

"Worst Sites First"

As with the Superfund program, one of the Agency's major goals in managing the Corrective Action program is to address the "worst sites first." This involves systematically surveying each facility in the RCRA universe, targeting old solid waste management units, and determining how much actual or potential environmental or human health risk is posed by each. EPA expects this survey effort to be completed within the next two to three years.

In view of the potential size of the program, EPA has developed a new computer-based system for assessing corrective action priorities. This system will enable us to group facilities into broad priority categories (high, medium, and low) and to target facilities first with the most serious environmental problems. Once a facility has been identified as a high priority for cleanup, EPA or the state will take steps to initiate the cleanup either by issuing an enforcement order or by requiring clean-up measures through the RCRA permitting process.

Despite various procedural and administrative differences between the RCRA and Superfund programs, the basic remedial approach—identifying and investigating releases, making decisions on appropriate remedial actions, and implementing those actions—is essentially the same under both programs. Even so, each facility poses different environmental and engineering challenges, and clean-up decisions are highly site specific, requiring considerable technical judgment on the part of EPA and state personnel. One of the long term goals of the RCRA program is to develop performance standards for site cleanups that will provide a more consistent, more streamlined framework for remedial decision making.

In addition to determining priorities for facility cleanups, the Corrective Action program is examining approaches to maximize environmental results at facilities, once contamination problems have been identified. Streamlining and focusing site studies is one measure being emphasized. Installing interim remedial measures to stabilize releases and prevent contamination problems from worsening is another. The point is to control, more quickly, the most serious environmental problems at a large number of facilities.

Corrective Action Rule Proposed

So far, EPA has conducted the Corrective Action program based on brief statutory language which provides it with authority to require studies and remediation. However, in July 1990 EPA issued proposed rules to formally define the process and clean-up goals for the RCRA Corrective Action program. The final rules are expected to be published in 1993.

In the meantime, the Office of Solid Waste is conducting a comprehensive analysis of the costs and economic impacts, and the environmental and economic benefits, of cleaning up RCRA facilities. The analysis will consider how specific regulatory provisions—and alternative approaches—may affect the overall costs and benefits of clean-up actions. These analyses will focus on issues such as the timing of cleanups, "points of compliance" (i.e., where cleanup must be achieved), how to establish protective clean-up levels for contaminants in ground water and other media, and other "how clean is clean" issues.

The results of this analysis, which will be published next summer, are expected to help shape Agency policy and the final Corrective Action rule. In the meantime, EPA's regions and the states are continuing to implement the program on a site-specific basis through statutory permitting and enforcement authorities.

Like Superfund, the RCRA Corrective Action program faces enormous challenges in the coming years. EPA and the states will be working with the regulated community and the public in making difficult clean-up decisions at thousands of facilities. It will be a long-term effort. And it will be the Agency's continuing responsibility to establish clear priorities for the program and to apply the lessons of both RCRA and Superfund as this important work continues into the next decade. □

Going Underground with UST

The goal is to have cleanup under way within 72 hours.

by June Taylor

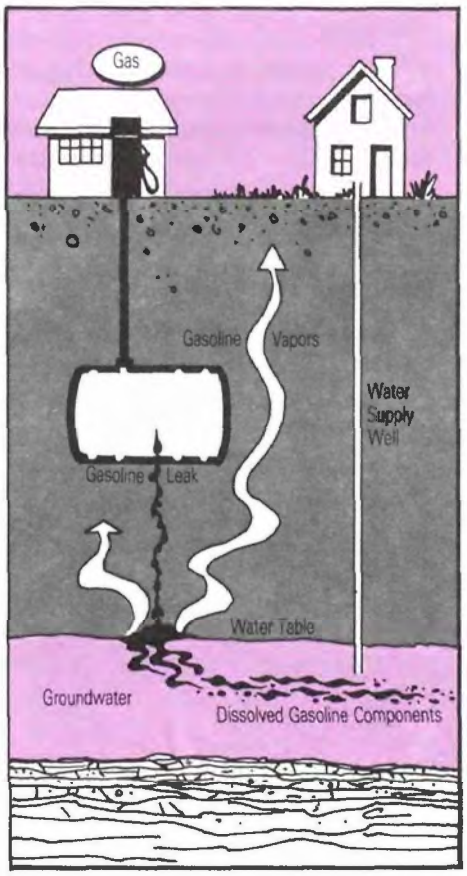
It seemed so innocent: We'd all have our own cars for convenient commuting and weekend escapes. And this country, inventor of the automobile assembly line, would prosper by selling advanced four-wheel designs to the rest of the world.

Alas, the dream didn't quite work out. Air pollution and gridlocked freeways have taken much of the romance out of driving, and a number of foreign manufacturers are out-competing Detroit. And there is still another cost of our protracted love affair with the automobile—cleaning up leaking underground storage tanks.

As the United States boomed in the post-war years, producing millions of cars and thousands of miles of freeways to drive them on, a nationwide network of service stations sprang up, requiring storage systems to fuel them. Millions of storage tanks were placed underground. This practice avoided dangers of fire and explosion, but it also had a disadvantage: It was hard to tell if these underground storage tanks, or USTs, were leaking.

A well-installed UST system generally lasts 20 years or more, so leakage problems, usually due to the slow corrosion of buried steel tanks or piping, took a while to materialize. But when they did, the result was often dramatic. Vapors from leaked gasoline can travel underground, accumulating in nearby basements to explosive levels. In New Brunswick, Canada, an entire city block was lost from the fire following such an explosion. An entire town's water supply can be contaminated by one leaking tank. Since half our population relies on underground supplies for drinking water, the potential threat is enormous.

(Taylor is a communications consultant who works for EPA's Office of Underground Storage Tanks.)



A rash of contamination incidents hit in the 1980s. These were delayed ramifications of the UST building boom two to three decades before; many of the systems installed 20 and 30 years earlier were corroded and leaking. In response to these incidents, Congress passed Amendments to the Resource Conservation and Recovery Act (RCRA) in 1984, mandating EPA to regulate most underground tanks storing motor fuels and hazardous chemicals. (Small farm tanks and all heating oil tanks were exempted from the federal law.)

The EPA's "Franchise" Approach

Congress handed EPA an enormous challenge. In the middle of the Reagan Administration, with its emphasis on deregulation and reduced federal spending, EPA was directed to set up a new program affecting an enormous number of businesses—some 750,000 facilities with approximately 1.8 million tanks.

Rather than trying to regulate millions of tanks directly from Washington, DC, or its 10 regional offices, EPA adopted an approach that built on state and local tank programs. Several states had active tank programs in place before Congress rewrote RCRA. For example, California, a perennial leader in developing environmental regulations, had already required double-walled tanks and piping to protect the environment; in Florida, where ground-water levels are so high that many tanks sit in drinking water supplies, several counties were moving toward requiring double walls; and many New England states were well underway with regulations somewhat less stringent than those in California or Florida. Many fire departments also had programs for permitting and inspecting tanks on installation or removal, although their concern focused specifically on fire and explosion dangers rather than on environmental hazards.

EPA decided its job was to provide a well-reasoned set of rules to define a nationwide minimum standard for protecting the environment from tank leaks, while giving states or counties with serious ground-water problems the flexibility to impose more stringent rules. EPA calls this the "franchise" approach. Just as the headquarters office of McDonald's or Century 21 does not sell hamburgers or houses, EPA's Office of Underground Storage

Tanks does not put its own people in the field to regulate tanks. And just as McDonald's and Century 21 set operating standards for an acceptable franchise and establish research, training, and advertising to foster their success, EPA does the same for state tank programs. In addition, EPA is able to offer the additional carrot of some federal grant money to help hire staff and administer programs.

The Federal Tank Rules

EPA researched the primary causes of UST leaks and spills and wrote rules addressing them. The federal rules took effect in 1988. Many parts were phased in to allow owners time to comply.

A majority of states have formally adopted or are moving to adopt rules that essentially mirror the federal regulations. The five key areas in the national rules are:

- Design and Construction: UST systems must be protected from corrosion.
- Leak Detection: All systems must have leak detectors, with extra requirements for piping (the source of most leaks).
- Spill and Overfill: All systems must have devices to prevent overfilling of the tank and catch basins to hold small spills from delivery hoses.
- Financial Responsibility: Tank owners must have insurance or some other way of paying potential clean-up costs and liability damages from a leak.
- Cleanup: A leak or spill in excess of 25 gallons must be reported; immediate action must be taken to prevent fires or explosions, and contaminated soils and ground water must be cleaned up.

Mike Gailliot photo, Midwest Research Institute.

Students at EPA's "Soil Vapor Boot Camp" sample and analyze gasoline tank leaks. The service station they are testing, on the University of Connecticut-Storrs campus, was the scene of an actual leak.

In most people's estimation, the first three items on this list of EPA's tank rules are reasonable without question. There is a general recognition that we need to improve tank systems, install leak detectors, and pay a lot more attention to the environmental consequences of fuel storage. The concerns center around the last two items. A big worry of bankers, insurance companies, and environmental agencies is how to deal with the potential costs of thousands upon thousands of cleanups.

The Clean-up Dilemma

In 1986 Congress created an UST Trust Fund to help with cleanups from the thousands of abandoned tanks at businesses that had failed during the oil crises or ensuing recessions. Through amendments to the Superfund law, a small tax (.01 cent per gallon) was put on gasoline to create this fund. Each state receives a portion of the fund to carry out cleanups where no owner or "responsible party" (RP) can be found or where the RP is insolvent. States also oversee cleanups where the owner/RP is taking action.

Now, in the 1990s, with leak detectors being installed nationwide, the phones are ringing in state tank offices. As of March 1991, states had accumulated almost 110,000 reports of "confirmed releases" or leaks, spills, and overfills that will require investigation and possibly a cleanup. The federal law covers about 1.8 million underground tank systems. EPA estimates some 15 to 20 percent of these may have leaks now or may leak in this decade. Tens of thousands of sites will need cleanups of varying magnitudes, some requiring significant

New Approaches to Cleanups

EPA is promoting alternatives to the traditional "pump and treat" clean-up approach in which contaminated ground water is pumped up, treated, and discharged. This method is slow and expensive and does little to remove the underlying source of much of the contamination: pockets of petroleum trapped in the soil. The Agency is also looking for faster ways to do site assessments—the sampling of soils and contaminants that determine what kind of cleanup is needed at a site.

Site Assessment Improvements

- *Vapor Survey*: Samples of soil vapors are taken on site by driving probes into the ground and extracting contaminated soil gas. Measuring the level of contaminants (which can be done on site) helps technicians understand the severity of the contamination and the direction in which it is spreading. This information is invaluable for clean-up strategy.

- *Lab-In-A-Bag* is a field measurement kit in which a small water sample or soil sample mixed with water is put in a plastic zip-lock bag connected to the kit's apparatus and stirred for a specified time to release the volatile contaminants. The contaminated air ("head space") in the bag can then be measured by a variety of devices (e.g., photo ionization detector, flame ionization detector, portable gas chromatograph, Draeger tube) for analysis.

Lab-In-A-Bag provides a standardized field procedure with high quality results for less time and money than laboratory procedures. Decisions can be made immediately on the safety of drinking water. These new kits, developed by In Situ through an agreement with EPA, will be available in late 1991.

Improved Cleanups

- *Vacuum Extraction* is a process of vacuuming contaminated vapors out of the ground for treatment. Often much less expensive than "pump and treat" and more effective at removing the source contamination, its use is sometimes limited by soil types and porosity. Shell Development Corporation, through an agreement with EPA, has produced an easy-to-use computer program to help decide if a site is a good candidate for vacuum extraction. EPA helped to evaluate the program and is now providing it to state personnel. It is currently available for Macintosh computers only.

- *Soil Gas Engine*: This form of vacuum extraction is now being used in California. It works by modifying a standard car engine to run on propane and setting it up at the site. The engine pulls contaminated soil vapors from underground as part of its air intake. Contaminants are burned along with the propane; a catalytic converter minimizes emissions.

- *Free Product Filters*: These are filters through which gasoline can pass, but not water. A monitoring well is lined with this filter. Then, instead of pumping up a mixture of free product (i.e., petroleum that is floating on the ground water, not trapped in or adhering to the soil) and contaminated water—which requires permits and treatment systems—the contractor pumps up nearly pure fuel which can be used or recycled. Says one contractor: "Sometimes we run our trucks on the stuff we pump up."

efforts to restore ground water.

These numbers appear staggering compared to the nearly 1,200 Superfund sites currently on the National Priority List or the roughly 4,000 RCRA hazardous waste sites needing cleanup. Compared to Superfund cleanups, UST actions are cheap, ranging from $50,000 to $1 million depending on the extent ofground-water contamination, whereas the typical Superfund site consumes $25 million. However, because of the vast numbers of leaking tank sites, costs could run in the billions of dollars unless we use faster, better, and cheaper clean-up methods.

Faster, Better, Cheaper

"FASTER, BETTER, CHEAPER Cleanup": This refrain has become a major theme for EPA's Office of Underground Storage Tanks, which is convinced the country can't afford to deal with tens of thousands of cleanups the old fashioned way. So what to do?

The first step is to make sure cleanups get underway quickly. Every day of delay allows contamination to spread, increasing the eventual clean-up costs. Everyone knows this, but often bureaucratic processes entangle us in a web of paperwork requirements that institutionalize delay. States sometimes require owners of a contaminated site to submit engineering and geology reports with core sampling and laboratory analysis of contaminant concentrations before cleanup can begin. This may take weeks or months; meanwhile the leak spreads.

One thing that makes an UST cleanup somewhat easier than a Superfund cleanup is that the contaminant is usually a known commodity. The product is usually petroleum, which tends to float on ground water and is easier to clean up than many chemicals. Though petroleum may be easier to find and "pull up" than many chemicals, it isn't always easy to dispose of. Some cleanups can require three different permits for treatment and discharge of

contaminants. Sometimes these permits must be obtained from three different agencies: one for discharge of dirty water pumped up from a site; one for the disposal of contaminated soils—"dirty dirt"; and one for any discharge to the air.

EPA believes that at many sites, cleanups feasibly can be underway within 72 hours of a leak report. Of course, the state should be notified, but state review should not be an excuse to delay action.

"Start your contractor cleaning up *today*," says Tom Schruben, EPA's clean-up expert. "The question for the states is 'How far should this cleanup go?', not 'Is it OK to start?'" says Schruben, who is working with states to streamline their administrative processes. "One-stop shopping" for all needed permits is an idea being tested. Concurrent review of items, rather than drawing the process out one step at a time, can save weeks. Another timesaver is pre-approving selected clean-up technologies so that no state review is needed to get started.

States have a big incentive to improve cleanups, not only for the thousands of tank owners who find themselves with leak problems, but because under the UST Trust Fund, states themselves are managing and paying for many cleanups. The pot of fund money is just not big enough to handle the projected need, so "faster, better, cheaper" means the states' limited federal dollars will also go further. Several states have developed their own clean-up funds, usually based (like the federal UST fund) on a small petroleum or gasoline tax. State agencies handling tank cleanups are equally concerned that their funds be used effectively.

In addition to administrative improvements, EPA sees great hope for innovative clean-up technologies and has several initiatives to spur their wider application. Among other initiatives, the Office of Underground Storage Tanks has cooperative agreements with private firms that are testing and marketing new techniques to provide extra training and equipment for state tank programs.

EPA favors field measurement techniques that enable on-site sampling and analysis of contamination rather than sending samples off to a lab, which is time consuming and expensive. Because petroleum volatizes, contaminants are continually released to the air as vapors. Therefore, laboratory analysis, which can take days or weeks, may not give as accurate results as those obtained fresh in the field. One such field technique is called vapor surveying (see box). EPA offers a hands-on course ("Soil Vapor Boot Camp") to learn this method which combines lecture, lab, and field work for state clean-up staffs and their contractors. The Agency is also developing videos, computer programs, and courses on improved clean-up technologies, such as vacuum extraction, that do a better job in less time for less money.

Although there is much positive movement, it is easy to be overwhelmed by the sheer numbers at stake—both dollars and numbers of leaking tank sites. "We are very concerned about the impact of cleanups on businesses, consumers, and society," says David Ziegele, Acting Director of EPA's Office of Underground Storage Tanks. "I am delighted to see some states making improvements in their administrative process and using new approaches in field clean-up work."

Additionally, says Ziegele, "States are taking the lead in developing alternative mechanisms to reduce the impacts of cleanup and compliance costs. For example, 43 states have passed legislation authorizing funds to help reduce the economic hardships of compliance with financial responsibility requirements and of paying for cleanups. And 13 states have assistance funds which help tank owners comply with technical standards."

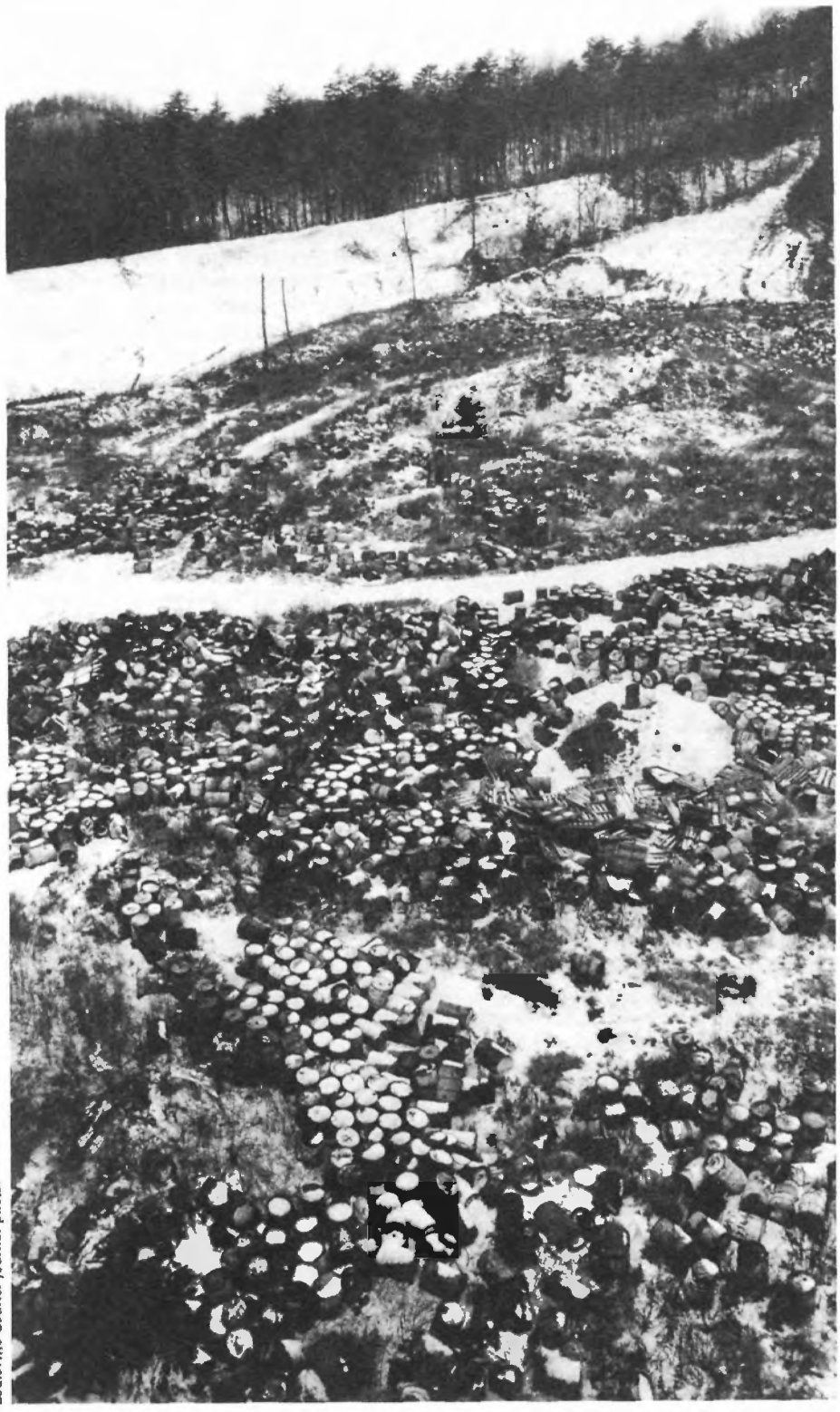
Ultimately, Ziegele, is upbeat: "I see all these related elements coming together at a time when we most need to improve the quality of cleanups, do them quickly—and at significantly reduced costs." □

Sites like Kentucky's Valley of the Drums brought the hazardous waste problem to the nation's attention.

A Forum:

Are We Conquering Hazardous Waste?

Hazardous waste is currently being regulated by preventive and remedial programs under the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund. But the real question is, Are we in fact getting our hazardous waste disposal problems under control? EPA Journal posed this question to eight experienced observers; their commentaries follow:



Louisville Courier Journal photo.

J. William Futrell

The United States is making solid progress in bringing its hazardous waste disposal problems under control. After focusing during the 1970s on the visible harm done by air and water pollution, people woke up to the threat to ground water posed by leaking hazardous waste sites. Since 1980, Americans have been playing catch-up after decades of neglect.

Several major programs are gathering momentum to get the job done. The Superfund program deals largely with abandoned waste sites and the problems of the past. Superfund is really two programs. The first, an emergency response program, calls for rapid government intervention to halt the leakage and threat to ground water and has been a great success in protecting the public health. The second, a remedial program aimed at restoring underground aquifers to a high level of cleanliness, is a very expensive long-range program that takes years and even decades for each site.

The RCRA and UST programs address the waste problems of ongoing operations. The costs of these programs will rise during coming years and add to the total cost of cleanup. Currently,

critics are having a field day complaining about the expense of clean-up programs. They forget how carefully Congress considered the cost of not controlling hazardous waste. Half the country's drinking water comes from ground-water sources. The only economically feasible way to protect our precious ground-water resource is to prevent its contamination. Pumping and treating after the fact entails astronomical costs.

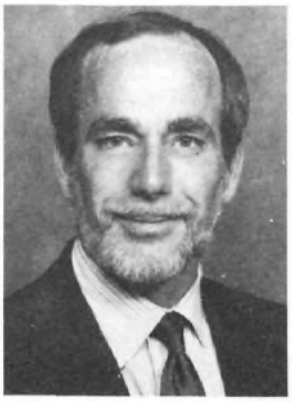
Blaming Superfund for America's hazardous waste bills is a bum rap. Hazardous waste management is proceeding in a workmanlike manner for such a large scale nationwide construction program. The public is getting its money's worth. Compare the annual costs of the Superfund program to the costs of other activities in the public and private sector. In a recent year, Superfund expenditures were equivalent to the expense of a Forrestal class aircraft carrier or, alternately, the development and production of a new model automobile in Detroit.

Effective waste management programs require a long haul, and they cost money. But Congress has listened hard and long on this topic and knows that this is an area where the American people want to go the course and are willing to pay the price.

In the long run, the price of these programs is going to decline because of private sector responsiveness. Effective waste management programs backed up by strong enforcement are transforming America's manufacturing practices. Industry and regulators are turning to pollution prevention and waste minimization. This would never have happened—and will not continue to happen—without the effective hazardous waste management programs so laboriously achieved during the last decade.

(Futrell is President of the Environmental Law Institute.)

William Yancey Brown



Management of hazardous pollutants in solid waste warrants a mixed report card. Three priorities head my list for progress:

- Foremost is to continue advances in pollution prevention. This is a well-recognized and often-discussed need, and I will not address it further here.
- A second priority is to establish a federal regime for the unregulated "orphan" wastes of the nation.
- A third priority is to resist following the path of short-term political expediency leading to restrictions on interstate shipments of waste.

According to EPA statistics, about 11 and a half billion tons of solid waste are generated each year in the United States (not counting another billion and a half tons of agricultural wastes). Translated into individual terms, this amounts to something more than 300 pounds of solid waste per day per person. This 300-pound total per person sorts out roughly as follows: assorted industrial wastes, 190 pounds; oil and gas wastes, 71 pounds; mining wastes, 35 pounds; formally designated "hazardous waste," 7 pounds; and municipal waste, otherwise known as trash, 4 pounds.

Formally defined "hazardous waste" is closely regulated under RCRA. Also, EPA has proposed a detailed regime for municipal waste, or trash, under RCRA which—I hope and presume—will be made final soon. However, these categories of waste make up a very small percentage of the total solid waste generated in this country.

Most of our solid waste is not currently being regulated under RCRA and is being disposed of without federal oversight: This includes so-called "nonhazardous" industrial waste, and mining, oil, and gas wastes. Although these waste streams are highly variable and diverse, many contain hazardous metals and organic chemicals.

The scope of these unregulated wastes is enormous. Industrial wastes, for example, are discharged into 15,000

What is "Hazardous Waste?" The RCRA Definition

To Be a Hazardous Waste, a Waste Must Be a "Solid Waste" . . .

. . . defined in RCRA as "garbage, refuse, or sludge or any other waste material." According to RCRA, a solid waste can be a solid, a semi-solid, a liquid, or a contained gas.

. . . And It Must Meet These Criteria:

"Because of its quantity, concentration, or physical, chemical, or infectious characteristics, [it] may cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or pose a substantial present or potential hazard to human health and the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

Not Included in RCRA Hazardous Waste Regulations Are . . .

- Domestic sewage
- Irrigation waters or industrial discharges permitted under the Federal Water Pollution Control Act
- Certain nuclear material as defined by the Atomic Energy Act
- Household wastes, including toxic and hazardous waste
- Certain mining and petroleum industry wastes
- Agricultural wastes, excluding some pesticides
- Small quantity wastes (that is, wastes from businesses generating fewer than 220 pounds of hazardous waste per month).

waste ponds, 5,000 waste piles, 3,000 landfills, and 4,000 land application units of other kinds. Oil and gas wastes are sent to some 126,000 waste ponds. Collectively, these wastes go through the biggest hole in RCRA. RCRA is now being reviewed for reauthorization, and it is time to close the gap.

In the meantime, restrictions on interstate shipments of waste are being proposed from some quarters. Such restrictions are bad for the environment and for the economy. Each year, about 15 million tons of trash from 38 states move across a state political boundary before disposal. Communities must accept responsibility for managing their wastes, and shipments clear across the country should not be condoned. However, most interstate transport is the every-day, routine movement of trash from cities and rural counties located near state lines. The short-term effect of restricting interstate waste shipments would be purposeless disruption of this system.

More fundamentally, the long-term environmentally correct place for a landfill, a trash-to-energy plant, or any waste management facility has nothing to do with state political boundaries and everything to do with hydrogeology and other features of the site. Furthermore, the environment and taxpayers benefit from economies of scale found at larger facilities serving regional population centers. The environment benefits because of the better design and operation and the stronger inspection efforts that characterize larger facilities. As for cost, EPA estimates the full cost per ton of trash disposed of at a 25-ton-per-day landfill is more than three times the cost of disposal at a 1,500-ton-per-day landfill.

The reasons for supporting continued interstate shipments to large, regional municipal waste management facilities apply with even more force for hazardous wastes. Good location is even more critical, economies of scale are essential, and existing facilities are much fewer. Restriction of interstate shipments not only would harm the industries generating waste; it also could halt or retard the cleanup of Superfund sites and stand as an obstacle to accomplishing the mission of Superfund.

Government should stand against such restrictions on interstate shipments, just as it should intervene and bring the "orphan wastes" into its regulatory net.

(Dr. Brown is Director of Environmental Affairs for Waste Management, Inc., and Chairman of the company's Executive Environmental Committee.)

Senator John H. Chafee

After more than two decades and millions of dollars spent on clean-up measures, Love Canal still conjures disturbing images of a ghost town deserted by its inhabitants because of uncontrolled and unsafe handling of hazardous wastes.

In an effort to prevent incidents like Love Canal, Congress enacted RCRA in 1976, then amended and strengthened it significantly in 1984. As the federal statute primarily responsible for preventing the mishandling of hazardous waste, RCRA has undeniably revolutionized the way hazardous wastes are managed.

For hazardous waste that is so designated under the law, RCRA mandates a "cradle to grave" tracking system which follows wastes from their point of generation to ultimate disposal in order to assure their safe management. This tracking system—in combination with design and operation standards for waste facilities and restrictions on the types of wastes that can be disposed of on land—has brought results: the development of secure hazardous waste treatment and disposal facilities and the closure of over 1,100 substandard facilities.

Clearly, RCRA has significantly helped us gain control over our hazardous waste disposal problems. The once common, indiscriminate dumping of hazardous waste that produced sites like Love Canal is a thing of the past—an illegal and almost unimaginable practice today. However, gaps remain in RCRA's regulatory scheme.

Perhaps the most glaring gap is the law's failure to provide EPA with clear authority to regulate certain kinds of recycling activities. Although RCRA regulates the transfer, storage, treatment, and disposal of "hazardous waste" (see box on page 54), critics have pointed out that the law does not regulate certain recycling processes that use hazardous materials which are either excluded from the statutory definitions of solid and hazardous waste or not otherwise covered under the law.

Unfortunately, some recycling operations can, and often do, present the same risks that are posed by hazardous waste treatment or disposal operations. In fact, literally dozens of former recycling operations have been placed on the National Priorities List of highly contaminated sites slated for cleanup under Superfund. Let's not forget the hard-learned lessons of Love Canal and our past mismanagement of hazardous waste: These recycling operations need to be regulated where there is potential for environmental contamination.

Another gap in the current law is its failure to assure adequate regulation of so-called "nonhazardous" industrial waste. Of the 11-plus billion pounds of solid waste generated in the United States each year, about 7.5 billion tons consist of industrial waste (as compared, for example, to roughly 200 million tons of municipal trash and 300 million tons of "hazardous" waste).

Much of this huge industrial waste stream consists of truly nonhazardous material such as construction or demolition rubble; however, it does include small amounts of hazardous wastes that either are exempt from RCRA regulations or are currently being considered by EPA for hazardous waste regulation under RCRA.

Under RCRA, the regulation of facilities that handle only "nonhazardous" waste is left to the states. Some states have done a good job of regulating industrial wastes; others have not. An April 1990 report by the Government Accounting Office (*Nonhazardous Waste: Environmental Safeguards for Industrial Facilities Need to be Developed*) found that the lack of meaningful regulation of some so-called nonhazardous industrial waste has already resulted in ground-water contamination in several states.

Given the volume and the potential threat posed by some of these wastes, it is apparent that Congress needs to set minimum standards so that industrial wastes will be managed safely. With passage of legislation that has already been introduced to address these gaps, we can continue the outstanding progress already made in controlling our hazardous waste disposal problems.

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

Linda E. Greer

In 1978, the problem of hazardous waste could be characterized with a single site: Love Canal, a notorious situation in upstate New York which occupied the nation's headlines for weeks when leaking wastes were discovered and the neighborhood was evacuated to ensure safety. By 1980, with the passage of Superfund, the nation envisioned hazardous waste as a $1.5 billion problem, requiring no more than five years to put behind us. Problem sites were considered strictly a function of past activities, and Congress thought that a finite clean-up program would take care of them.

By 1984, ongoing management of hazardous waste was a recognized environmental problem; licensed leaking landfills were the focus of the reauthorization of RCRA, the law governing the treatment and disposal of hazardous waste as it is generated. Today, a little over a decade later, expenditures for hazardous waste cleanup dwarf all other environmental expenditures annually, and new sites are discovered more rapidly than others are cleaned up. Thus the question can be fairly asked, Is this nation getting its hazardous waste disposal problems under control?

Predictably, the answer is no. But the real problem lies not in the areas most commonly cited: the slow pace of hazardous waste site investigation and cleanup, the inadequate application of permanent clean-up technologies, the slow pace of RCRA hazardous waste facility permitting, etc. Where we fail to address these problems, we fail only in our attempt to cure an already established disease. Much more disturbing is the dearth of sustained effort to prevent disease—that is, to prevent the creation of future contaminated sites in need of cleanup.

There are two major gaps in the nation's hazardous-waste pollution prevention efforts to date. First, the definition of hazardous waste is woefully inadequate, and thus a large universe of toxic materials are disposed of in the environment outside of public view and without government safeguards. RCRA regulations cover only a small number of industries and a limited number of chemical wastes. For example, EPA has been sued by the environmental community for its failure to list waste streams from 12 industries identified as candidates for regulation by Congress in 1984, and these unregulated industries are likely just the tip of the iceberg. Through several important shortcomings in the RCRA program, this country is failing to regulate up front those materials it knows to be hazardous and knows to be causing contamination.

The other important gap in our pollution prevention effort is the minor attention given to source reduction, minimizing the generation of waste. The nation's hazardous waste policies must shift their major emphasis to reducing the generation of waste in the first place by phasing out the use of particular chemicals and making industrial operations as "chemically tight" as possible, rather than by treating at the "end of the pipe" wastes which result from inefficient operations. Only then will the problems resulting even from proper management of hazardous waste be behind us. To date, efforts at source reduction have consisted of little more than EPA requests to industry to voluntarily reduce the waste it generates and report back to EPA and the public.

The lack of focus on pollution prevention would be disturbing even if rapid cleanup of existing problem sites were well underway. But the backdrop of severe technical and administrative problems in this clean-up program makes our inattention to prevention utter folly. The only real solution for the nation's waste disposal problems is a sharp reduction in the generation of waste that can harm humans and the environment. Only in this way will we get our hazardous waste disposal problems under control.

(Dr. Greer is a Senior Scientist with the Natural Resources Defense Council in Washington, DC.)

Bruce W. Karrh

The framework is in place for getting our hazardous waste problems under control, but important issues of cost, equity, and priority-setting remain. In reality, there are *three* distinct but related hazardous waste disposal problems—and given limited resources, the solution to any one affects our ability to address the others.

The first and most visible is Superfund: cleaning up orphan disposal sites. Du Pont was among the original backers of Superfund. However, many of the reservations expressed by its critics turn out to have been well founded.

Superfund is litigious. Progress in actual remediation is painfully slow, though $11.2 billion has been spent or committed thus far. Estimates of transaction costs for some cleanups range from one-third to one-half for legal fees, multiple engineering studies, record-keeping, and other administrative costs. Both EPA and Congress are investigating Superfund expenditures.

Recently, the *New York Times* summed up the Superfund experience: "Long delays, regiments of lawyers, blizzards of documents, a widespread sense of being unfairly singled out to shoulder others' responsibilities—this is life in the clutches of [Superfund]. And that's when things are going smoothly ...."

What can be done? In my judgment, the problem is summed up in the title of the Superfund law: the Comprehensive Environmental Response, Compensation, and Liability Act. The Act tries to do too many things. The solution is to focus on the speedy, economical cleanup of genuine health hazards. This will require more reasonable standards of "clean," and it may mean more ready commitment of dollars from Superfund. Someone, somewhere, may get away with something (it won't be Du Pont), but we will all benefit by putting this problem behind us at far less cost than the present approach.

The second problem is the cleanup of hazardous waste sites that are owned by

identifiable, viable companies, such as Du Pont. RCRA ensures that cleanup will be done, but at costs to these companies estimated to range up to hundreds of billions of dollars.

With RCRA as with Superfund, there is the opportunity to achieve reasonable standards of "clean" at significantly less cost than the most stringent standards—and therefore to invest more of our environmental resources in reducing current and future emissions.

This brings me to the third and, in my judgment, most important waste disposal problem. What should be done on a forward-looking basis?

The EPA's answer is pollution prevention, and we agree. If hazardous waste is not generated, it doesn't have to be disposed of. For the long term, our objective should be waste-free processes. This will require industry to rethink its practices and retool its plants. The changes will be expensive and will take time. In the interim, there must be provision for hazardous waste disposal. Industry needs the assurance of adequate disposal capacity and the option to cross state lines to handle hazardous wastes in the most technically sound and efficient way.

Increasingly, industry is acting voluntarily to anticipate public expectations, do the right thing, and stay ahead of environmental compliance. Du Pont, for example, has voluntary programs to reduce waste and emissions. These voluntary actions need to be credited by federal and state environmental agencies, and they need to be encouraged by market mechanisms. To the extent that this happens, we will be able to address the issues remaining in hazardous waste disposal and get on with the job of environmental protection.

(Karrh is Vice President for Safety, Health, and Environmental Affairs for the Du Pont Company.)

Representative Allan B. Swift

Under Subtitle C of RCRA, the United States has one of the best—if not the best—hazardous waste management systems in the world. Until now, however, RCRA has concentrated primarily on the end of the "cradle to grave" continuum—treatment and disposal. During the RCRA reauthorization process in the 102nd Congress, it is our challenge to focus less on disposal and more on not creating the waste in the first place through waste minimization and recycling.

Perhaps the most important question a member of the industrial community must ask when it comes to RCRA is, "Am I regulated or not?" And the answer to that question is dependent on the answer to another—"When is a waste not a waste?"

Attempting to solve that riddle is not just an exercise in semantics or meaningless legalese; the answer can have enormous legal and financial implications under our hazardous waste regulatory system.

EPA attempted to solve the riddle in January, 1985, when it promulgated the current regulatory definition of solid waste. That "definition" is in reality an elaborate scheme that attempts to define which materials, when handled in certain ways, are wastes and which are commodities or products and thus not subject to RCRA regulation. Stated another way, the definition attempts to identify which recycling practices are really waste management, and should be regulated as such, and which recycling practices are so inextricably linked with the manufacturing process that they should not be subject to RCRA.

This confusing situation serves neither environmental nor business interests. The main problems, as I see them, are: how to distinguish between legitimate and sham recycling; and how to encourage legitimate recycling while at the same time ensuring the protection of human health and the environment.

"Sham recycling" is the situation in which a person claims he is not treating or disposing of hazardous waste, but instead is recycling secondary materials into a legitimate product in an attempt to avoid RCRA regulation. Without the protections afforded by RCRA, sham recycling operations can do significant environmental damage.

But it is also important to remember that even legitimate recycling is not necessarily benign. Some major environmental problems have been caused by recycling operations that produce truly useful and legitimate products, such as metals recovery. Evidence of this is the significant number of recycling sites on the Superfund National Priorities List. For this reason, many argue that even legitimate recycling activities need more regulation under Subtitle C, not less.

The key will be to strike the appropriate balance. A confusing regulatory scheme, or an overly burdensome one, may have environmentally counterproductive consequences if it serves to discourage legitimate recycling operations.

For example, if a manufacturer would like to recycle some of his waste stream into a useful product, but he isn't sure whether that recycling process would be a RCRA-regulated activity requiring a permit, he would probably be unwilling to invest in the recycling process only to find himself later in violation of the law.

On the other hand, a manufacturer who would like to recycle some of his waste stream but who is reasonably certain that that particular recycling process would be a RCRA-regulated activity, may choose to continue disposing of that waste rather than recycling it because he is unwilling to invest the significant time and money necessary to obtain a RCRA Part B permit for the management of hazardous wastes.

Our challenge is twofold. We must clarify RCRA to eliminate the sham recycling loophole and to distinguish between recycling processes which are regulated under Subtitle C and those which are not. For those recycling processes which are determined to be appropriately regulated under Subtitle C, we should examine ways to remove procedural and permitting barriers that act as disincentives to legitimate recycling, while we simultaneously ensure protection of human health and the environment.

How we encourage recycling and take advantage of its potential for waste minimization will be one of the most important public policy issues to be decided during the RCRA reauthorization process, and its impact will be felt for a long time to come.

(Swift (D-Washington) chairs the Transportation and Hazardous Materials Subcommittee of the Committee on Energy and Commerce.)

James M. Strock

The efforts of California—and our nation as a whole—to gain the upper hand on the hazardous waste leviathan are hampered by one recalcitrant non-complier.

This toxic waste producer has acceded to clean-up and compliance agreements for 17 federal Superfund sites with the State of California. Yet our state remains concerned that we may face other hazardous waste violations in the future. The reason: sovereign immunity.

These hazardous waste sites are U.S. military installations. They are among 141 Department of Defense sites with more than 2,000 suspected or confirmed areas of contamination in our state.

When the federal government asserts sovereign immunity, Californians have no assurance that these sites, or more than 2,000 other areas of confirmed or suspected contamination, will fully meet our stringent environmental standards. The problem is compounded by plans to shut down six military bases by 1995 and proposals to close more than a dozen other facilities in California. Meanwhile, clean-up schedules at military bases stretch beyond 2010—and earlier deadlines already have been broken or revised.

Governor Pete Wilson supports legislation—now pending in Congress—that would remove, once and for all, the cloak of sovereign immunity for the federal government's own hazardous waste violations. If the environmental law is good enough for the private sector, surely it is good enough for the federal government.

The need is critical, given plans to develop military base sites into residential and commercial developments, recreation areas, and other community projects. Our economic and environmental goals are intertwined. Sovereign immunity must not become a legal thicket into which federal officials can retreat to avoid safe uses of existing facilities and rapid cleanup of those that will close.

If the United States is to gain control of its hazardous waste problem, environmental enforcement must be applied without fear or favor. If California and other states are to protect the health and safety of their citizens, we must insist that the federal government live within our laws.

(Strock is Secretary for Environmental Protection for the State of California. From 1989 to 1991 he was EPA's Assistant Administrator for Enforcement.)

Milton Russell

The roller coaster phase of hazardous waste remediation is leveling off. During the 1970s and 1980s, each slow ascent as the country gained a measure of control over one hazardous waste problem was followed by a stomach-churning plummet as another problem took its place.

On a real roller coaster, the fear is acceptable because of confidence that all will come out all right if you just hang on. That same confidence is beginning to permeate reactions to the hazardous waste problem. In that sense, we are gaining control.

Control doesn't mean that the problems are behind us. Indeed, in the expensive, tough, slogging work of actually remediating sites, the effort is in the beginning stages. Confidence comes because the systems are largely in place to accomplish this work, and the dimensions of the work are becoming clearer. Further, the urgency of the task has diminished because immediate risks to health and the environment are now seen to be less than originally feared.

In the early days, the hazardous waste problem was thought to be limited to relatively few large sites and the clean-up task to be straightforward. A now laughably small Superfund program was passed in 1980 with the expectation that in five years most of the work would be done. Then came corrective action under the RCRA requirements for hazardous waste releases, the regulation of underground storage tanks, the problems at federal facilities, the regulatory gaps remaining to be filled by state and private action—and recognition that the Superfund task itself had been grossly underestimated.

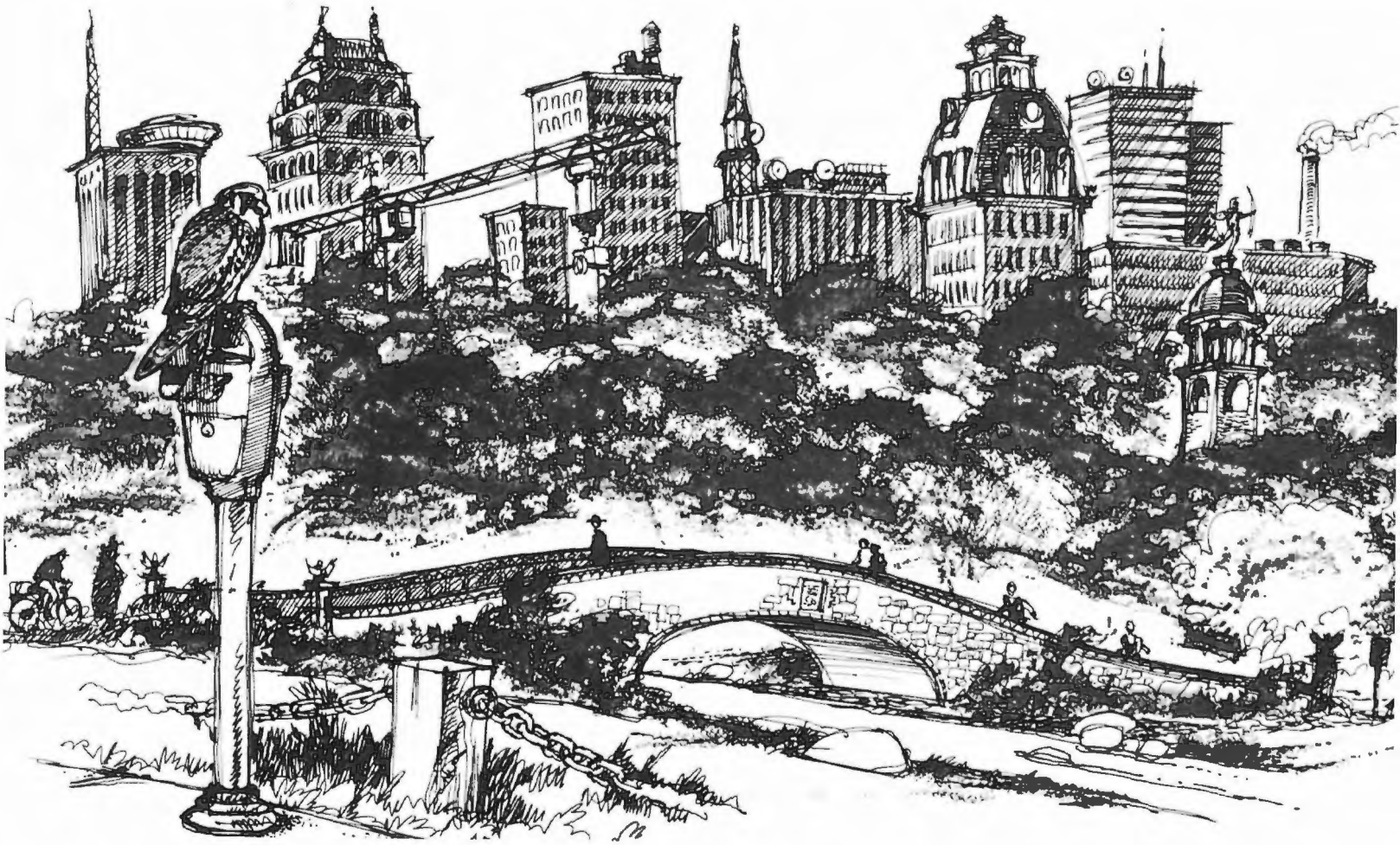
No wonder that to the riders the roller coaster seemed out of control! The original watchword was "do," and that proved impossible in the time projected. The catch phrase switched to "try harder," but even with trying harder, the goal of leaving to future generations an environment that was acceptably safe seemed always to recede.

Now, however, one by one the systems for remediation have come into place and the work is underway. Moreover, realization is growing that the country can declare success if the task is complete by, say, 2020 *as long as* any direct threats to health and the environment are promptly eliminated. A marathon is involved, not a 100-yard dash, so the guideline now can be "try smarter."

The magnitude of the task and the time available to do it make trying smarter both crucial and possible. A study underway at the University of Tennessee and Oak Ridge National Laboratory is estimating the total expenditures required under current policy and using existing technology. Final results will not be available until fall 1991, but it is already evident that annual costs, evenly spread over 30 years, will rival those spent for clean air—and that is just to clean up the legacy of wastes we inherited. Further investment in cheaper and more effective technology is clearly called for. It is also possible that policy and practice changes can be devised that will lower costs while still meeting environmental goals.

The end of the ride remains far down track. There are dips and turns ahead and lots of holding on yet to do. But the car now is getting under control. We may not enjoy the rest of the ride, but at least we can approach it with a level of confidence unmatched in the fearsome time that has passed. □

(Dr. Russell is a Collaborating Scientist at Oak Ridge National Laboratory and The University of Tennessee, Knoxville, where he is also a Professor of Economics and Senior Fellow in the Waste Management Remediation and Education Institute. From 1983 to 1987 he was EPA Assistant Administrator of the Office of Policy Planning and Evaluation.)



Greening America with Greenways

A Book Review by David Burwell

Stand aside, Trump Plaza. The social centerpiece of the community of the future will not be a glitzy hotel, gambling joint, shopping mall, theme park, or any other monument to conspicuous consumption. It will be the greenway.

In the 1600s, American communities were built around the town commons, which served as both pasture and meeting place. Over the next two centuries, other structures became the central pivots for organizing new American communities—churches, courthouses, schools, libraries, railroad stations, docks. It is a sad commentary on our times that so many communities in the late 20th century are built around theme parks and shopping malls. Mammon seems to have triumphed.

Enter the greenway. Part parkway, part greenbelt, part garden, the greenway is a relatively new term for an old idea: the linear park. Organizing communities around greenways was first championed by Frederick Law Olmsted, the father of landscape architecture and designer of Central Park in Manhattan, of Prospect Park in Brooklyn, and of the "emerald necklace," known as the Fenway, around Boston. The greenway is the new town commons. It is a ray of hope in our pell-mell run toward wall-to-wall commercialization.

The rise of the modern greenway movement is chronicled, championed, nurtured, and analyzed in *Greenways for America*, a new book by Charles E. Little, editor of *American Land Classics* and a life-long lover of the land. Mr. Little has done his homework, tracing the origins of the greenway idea to the English country garden and demonstrating how it

adapted to the rough, uncut American landscape.

While Olmsted is clearly the towering figure in Little's story, leaders of the broader conservation movement are intertwined throughout the saga. Aldo Leopold, Bob Marshall, and Benton MacKaye all play significant roles, as do Lewis Mumford, Ian McHarg, and the urbanologist William H. Whyte. Environmental scholars should read this book for a deeper understanding of the conservation movement; landscape architects, for a deeper understanding of their profession; the rest of us, for inspiration.

Greenways for America, published by the Johns Hopkins University Press, is more than a history lesson; it is a chronicle of hope in the otherwise barren landscape of American land conservation. One does not need to be a New Age proponent of the Gaia Hypothesis to appreciate the ongoing threats to the biological systems on which life depends and to the human communities that required centuries to build. Little does not dwell on ecological Armaggedon. Instead, he looks for ways out. More and more, he sees greenways as avenues of escape.

Little's text, accompanied by 24 pages of photography, explains how various greenway projects got started, how obstacles inevitably appeared, and how a little bit of courage and a lot of hard work carried the day. Some of the best projects are Olmsted dreams still struggling to become reality. These undertakings are arduous. They're not for couch potatoes.

Little divides greenways into five categories: urban rivers; paths and trails; ecological corridors; scenic byways; and networks. In other words, they connect. In the work of ecological planner Ian McHarg and landscape architect Philip Lewis, they also find a logical, even scientific, underpinning in the uncanny tendency of significant landscape features to cluster along "environmental corridors," as Lewis describes them.

There's the rub. Greenways are much more than full employment projects for landscape architects. They are the organizing principle for biological and human communities that work. They can be local, regional, or even national in scope.

Little points out that the Appalachian Trail as we know it is a mere shadow of its original silhouette in the fertile mind of Benton MacKaye, who envisioned not merely a trail but a wide swath of green all along the Eastern Seaboard with rivulets and eddies extending in all directions to provide a "dam and levee" system controlling future migration and settlement patterns. The effects of the Depression and a national highway program that subsidized development destroyed his vision. Now, with land prices easily 20 times what they were when MacKaye proposed his Appalachian Greenway, the opportunity appears gone forever.

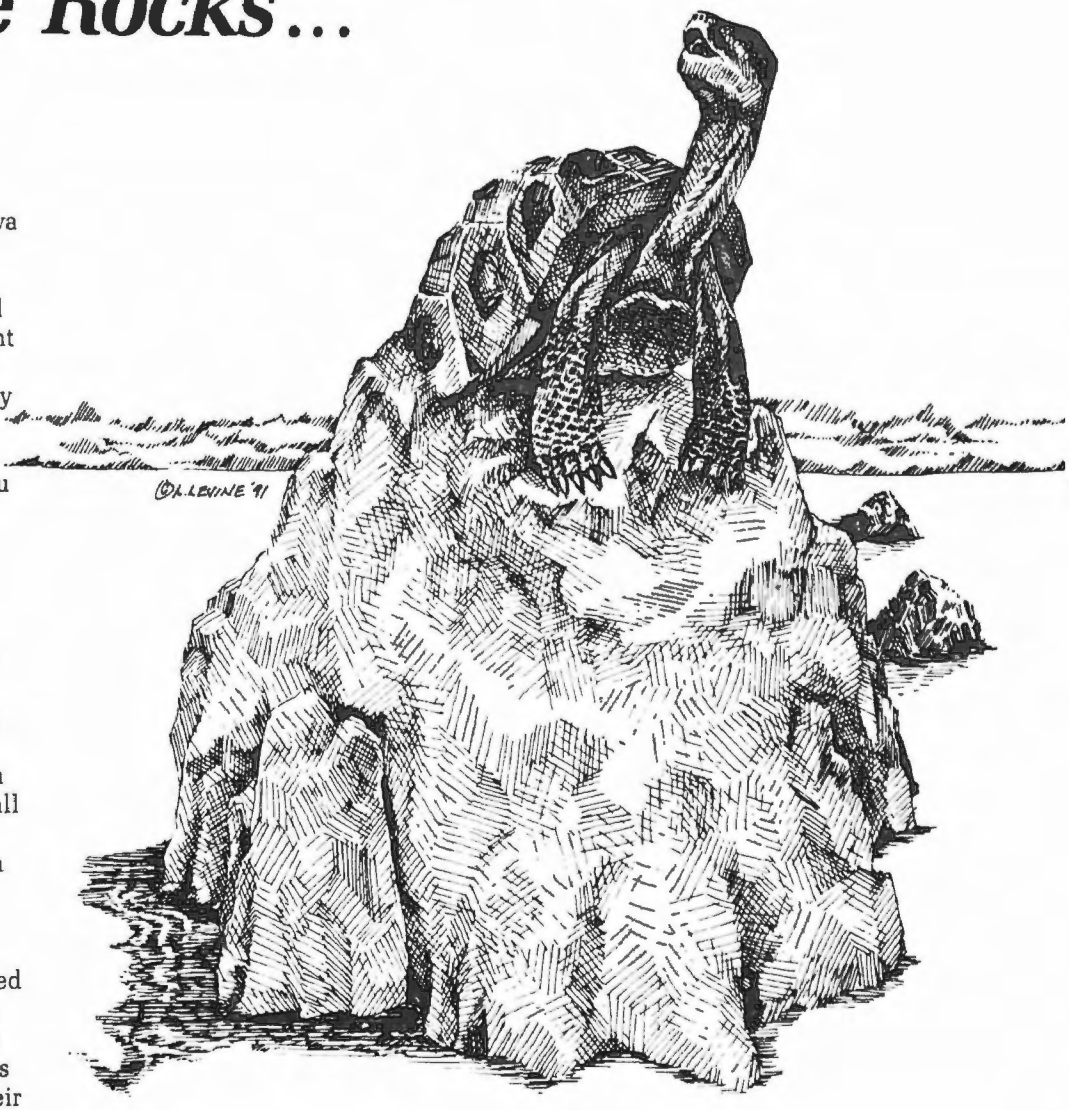
Greenways for America is part of a recent revival of the old land ethic. Little introduces us to the local leaders of this new drive to conserve land. Some are dreamers; others are social reformers. Still others are planners and professionals. Conservationists rub shoulders with outdoor enthusiasts. Together, they are the people moved by what Tony Hiss, in *The Experience of Place*, describes as "simultaneous perception"—that is, the need to create visual landscapes that make sense, that connect and beautify rather than fragment and scatter. More and more people, apparently, are feeling alienated from their physical environment, disoriented, and alone. The greenway movement is an attempt to fight back, to reconnect with their surroundings.

Similarly, in their recent books, social philosopher Richard Sennett and sociologist Ray Oldenburg have described this alienation as the loss of "the great, good place," the American equivalent of the sidewalk cafes of Paris or the neighborhood pubs of London, where people routinely meet informally and gain an understanding of themselves as functioning members of larger human communities. Whether the linkages are physical or social, greenways help build connections in a fragmented world. "To make a greenway," Little observes, "is to make a community." In essence, *Greenways for America* is a brief for hope. □

(Burwell, a lawyer, is president of the Rails-to-Trails Conservancy, which works at the national and grassroots levels to convert abandoned railbeds into linear parks for bicycling, jogging, strolling, horseback riding, and other pursuits.)

Life on the Rocks...

from Annie Dillard



The ice rolled up, the ice rolled back, and I knelt on a plain of lava boulders in the islands called Galápagos, stroking a giant tortoise's neck. The tortoise closed its eyes and stretched its neck to its greatest height and vulnerability. I rubbed that neck and when I pulled away my hand, my palm was green with a slick of single-celled algae. I stared at the algae, and at the tortoise, the way you stare at any life on a lava flow, and thought: Well—here we all are . . . .

It is worth flying to Guayaquil, Ecuador, and then to Baltra in the Galápagos just to see the rocks. But these rocks are animal gardens. They are home to a Hieronymus Bosch assortment of windblown, stowaway, castaway, flotsam and shipwrecked creatures. Most exist nowhere else on earth. These reptiles and insects, small mammals and birds, evolved unmolested on the various islands on which they were cast into unique species adapted to the boulder-wrecked shores, the cactus deserts of the lowlands, or the elevated jungles of the large islands' interiors. You come for the animals. You come to see the curious shapes soft proteins can take, to impress yourself with their reality, and to greet them . . . .

There is always some creature going about its beautiful business . . . .

The animals are tame. They have not been persecuted, and show no fear of man. You pass among them as though you were wind, spindrift, sunlight, leaves. The songbirds are tame. On Hood Island I sat beside a nesting waved albatross while a mockingbird scratched in my hair, another mockingbird jabbed at my fingernail, and a third mockingbird made an exquisite progression of pokes at my bare feet up the long series of eyelets in my basketball shoes . . . .

The wild hawk is tame. The Galápagos hawk is related to North America's Swainson's hawk; I have read that if you take pains, you can walk up and pat it. I never tried. We people don't walk up and pat each other; enough is enough. The animals' critical distance and mine tended to coincide, so we could enjoy an easy sociability without threat of violence or unwonted intimacy. The hawk, which is not notably sociable, nevertheless endures even a blundering approach, and is apparently as content to perch on a scrub tree at your shoulder as anyplace else.

In the Galápagos, even the flies are tame. Although most of the land is Ecuadorian national park, and as such rigidly protected, I confess I gave the evolutionary ball an offsides shove by dispatching every fly that bit me, marveling the while at its pristine ignorance, its blithe failure to register a flight trigger at the sweep of my descending hand—an insouciance that was almost, but not quite, disarming . . . .

We are strangers and sojourners, soft dots on the rocks. You have walked along the strand and seen where birds have landed, walked, and flown; their tracks begin in sand, and go, and suddenly end. Our tracks do that: but we go down. And stay down. While we're here, during the seasons our

tents are pitched in the light, we pass among each other crying "greetings" in a thousand tongues, and "welcome," and "good-bye." Inhabitants of uncrowded colonies tend to offer the stranger famously warm hospitality—and such are the Galápagos sea lions. Theirs is the greeting the first creatures must have given Adam—a hero's welcome, a universal and undeserved huzzah. Go, and be greeted by sea lions.

I was sitting with ship's naturalist Soames Summerhays on a sand beach under cliffs on uninhabited Hood Island. The white beach was a havoc of lava boulders black as clinkers, sleek with spray, and lambent as brass in the sinking sun. To our left a dozen sea lions were bodysurfing in the long green combers that rose, translucent, half a mile offshore. When the combers broke, the shoreline boulders rolled. I could feel the roar in the rough rock on which I sat; I could hear the grate inside each long backsweeping sea, the rumble of a rolled million rocks muffled in splashes and the seethe before the next wave's heave.

To our right, a sea lion slipped from the ocean. It was a young bull; in another few years he would be dangerous, bellowing at intruders and biting off great dirty chunks of the ones he caught. Now this young bull, which weighed maybe 120 pounds, sprawled silhouetted in the late light, slick as a drop of quicksilver, his glistening whiskers radii of gold like any crown. He hauled his packed hulk toward us up the long beach; he flung himself with an enormous surge of fur-clad muscle onto the boulder where I sat. "Soames," I said—very quietly, "he's here because *we're* here, isn't he?" The naturalist nodded. I felt water drip on my elbow behind me, then the fragile scrape of whiskers, and finally the wet warmth and weight of a muzzle, as the creature settled to sleep on my arm. I was catching on to sea lions.

Walk into the water. Instantly sea lions surround you, even if none has been in sight. To say that they come to play with you is not especially anthropomorphic. Animals play. The bull sea lions are off patrolling their territorial shores; these are the cows and young, which range freely. A five-foot sea lion peers intently into your face, then urges her muzzle gently against your underwater mask and searches your eyes without blinking. Next she rolls upside down and slides along the length of your floating body, rolls again, and casts a long glance back at your eyes. You are, I believe, supposed to follow, and think up something clever in return. You can play games with sea lions in the water using shells or bits of leaf, if you are willing. You can spin on your vertical axis and a sea lion will swim circles around you, keeping her face always six inches from yours, as though she were tethered. You can make a game of touching their back flippers, say, and the sea lions will understand at once; somersaulting conveniently before your clumsy hands, they will give you an excellent field of back flippers.

And when you leave the water, they follow. They don't want you to go. They porpoise to the shore, popping their heads up when they lose you and casting about, then speeding to your side and emitting a choked series of vocal notes. If you won't relent, they disappear, barking; but if you sit on the beach with so much as a foot in the water, two or three will station with you, floating on their backs and saying, Urr . . . .

Charles Darwin came to the Galápagos in 1835, on the *Beagle*; he was twenty-six. He threw the marine iguanas as far as he could into the water; he rode the tortoises and sampled their meat. He noticed that the tortoises' carapaces varied wildly from island to island; so also did the forms of various mockingbirds. He made collections. Nine years later he wrote in a letter, "I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable." In 1859 he published *On the Origin of Species*, and in 1871 *The Descent of Man*.

[Before Darwin] we were all crouched in a small room against the comforting back wall, awaiting the millennium which had been gathering impetus since Adam and Eve. Up there was a universe, and down here would be a small strip of man come and gone, created, taught, redeemed, and gathered up in a bright twinkling, like a sprinkling of confetti torn from colored papers, tossed from windows, and swept from the streets by morning.

The Darwinian revolution knocked out the back wall, revealing eerie lighted landscapes as far back as we can see. Almost at once, Albert Einstein and astronomers with reflector telescopes and radio telescopes knocked out the other walls and the ceiling, leaving us sunlit, exposed, and drifting—leaving us puckers, albeit evolving puckers, on the inbound curve of space-time . . . .

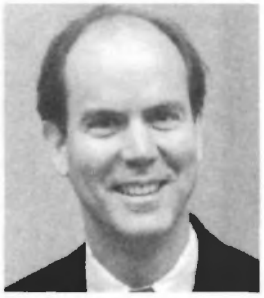
The mountains are no more fixed than the stars. Granite, for example, contains much oxygen and is relatively light. It "floats." When granite forms under the Earth's crust, great chunks of it bob up, I read somewhere, like dumplings. The continents themselves are beautiful pea-green boats. The Galápagos archipelago as a whole is surfing toward Ecuador; South America is sliding toward the Galápagos; North America, too, is sailing westward. We're on floating islands, shaky ground . . . .

The old ark's a moverin'. Each live thing wags its home waters, rumples the turf, rearranges the air . . . . Like boys on dolphins, the continents ride their crustal plates. New lands shoulder up from the waves, and old lands buckle under. The very landscapes heave; change burgeons into change. Gray granite bobs up, red clay compresses; yellow sandstone tilts, surging in forests, incised by streams. The mountains tremble, the ice rasps back and forth, and the protoplasm furls in shock waves, up the rock valleys and down, ramifying possibilities, riddling the mountains.

The planet spins, rapt inside its intricate mists. The galaxy is a flung thing, loose in the night, and our solar system is one of many dotted campfires ringed with tossed rocks.

What shall we sing, while the fire burns down? We can sing only specifics, time's rambling tune, the places we have seen, the faces we have known. I will sing you the Galápagos islands, the sea lions soft on the rocks. It's all still happening there, in real light, the cool currents upwelling, the finches falling on the wind . . . .

Guimond



Train

Esty

Olive

Holmes

Two new Deputy Assistant Administrators have been appointed in the Office of Solid Waste and Emergency Response: **Richard J. Guimond** and **Charles Bowdoin (Bowdy) Train.**

Guimond has served in a variety of different capacities since he joined EPA when it was created in 1971. From 1971 to 1978 and 1982 to 1990, Guimond worked in the Office of Radiation Programs, where he ultimately became Office Director in 1988. Guimond began his EPA career as a nuclear engineer in the Technology Assessment Division and then became a staff engineer and technical assistant to the Deputy Assistant Administrator for Radiation Programs. Guimond also served in the Criteria and Standards Division, where he was an assistant to the Director for Special Projects, an environmental project leader, and finally director from 1982 to 1986. In 1986, he was appointed Director of the Radon Division, a post which he held until 1988.

Guimond also worked in the Office of Toxic Substances from 1978 to 1982, serving as Chief Engineer to the Deputy Assistant Administrator, Chief of the Special Regulation Branch, Acting Deputy Director, and Chief of the Chemical Control Branch—all within the Chemical Control Division.

Guimond, a Commissioned Officer with the U.S. Public Health Service since 1970, was appointed in 1989 as an Assistant Surgeon General. With the rank of Rear Admiral, he is the most senior U.S. Public Health Service official in EPA.

Guimond is a 1969 graduate of the University of Notre Dame and earned a Master of Engineering degree from Rensselaer Polytechnic Institute in 1970 and a Master of Science degree in Environmental Health from Harvard University in 1973. He is the recipient of nearly a dozen EPA awards and honors, including several meritorious and superior service awards.

Train comes to EPA from the law firm of Shaw, Pittman, Potts, and Trowbridge in Washington, DC, where he has been an Associate Attorney since 1982. A corporate lawyer, he has concentrated on financial transactions, restructuring troubled investments, and general counsel representation for a wide spectrum of business interests.

During college, Train worked at the World Bank where he helped evaluate the environmental impacts of development projects funded by the bank. He also spent a short time in the office of Senator Charles McC. Mathias working on a variety of matters, including environmental issues.

Train received his B.A. degree from Trinity College in 1977, majoring in economics and environmental studies. He went on to earn his J.D. in 1982 from the Georgetown University Law Center, where he was Editor of the law review, *Tax Lawyer*.

The new Deputy Assistant Administrator for the Office of Policy, Planning, and Evaluation is **Daniel Esty.**

Esty joined EPA in 1989 as a Special Assistant to Administrator William K. Reilly. In 1990, he became Deputy Chief of Staff of the Agency. Prior to joining EPA, Esty practiced law with the Washington, DC, law firm of Arnold and Porter, where he worked on international law, administrative law, and environmental issues.

In 1981, Esty graduated from Harvard College, where he received a B.A. in economics. He later earned a B.A. in philosophy, politics, and economics from Balliol College at Oxford University in England. He continued his education at Yale Law School, where he received his J.D. in 1986.

Suzanne Olive has been named Acting Director of the Office of Civil Rights (OCR).

Olive has served as OCR's Deputy Director since 1988 and concurrently as the Associate Director for Discrimination Complaints and External Compliance since 1987. Olive began her career at EPA in 1983 as a senior equal opportunity specialist for External Compliance Programs. In 1985, she assumed responsibility for EPA's Discrimination Complaints Program and received the EPA Gold Medal for performance in 1987. Olive currently serves as the Data Analysis Work Group Leader on EPA's Cultural Diversity Task Force.

Before joining EPA, Olive worked for four years at the Equal Employment Opportunity Commission in the regulatory development and review process. She held various supervisory positions in the Office of Legal Counsel and the Office of Interagency Coordination from 1979 to 1983.

Olive began her career as a clerk-typist at the U.S. Department of Agriculture (USDA) in 1963. At USDA, she became a personnel staffing specialist in the Office of Management Services, Division of Personnel, in 1970. In 1972, she moved to the Office of Equal Opportunity, working with both the public and private sectors. In the Contract Compliance Division, she served as an equal opportunity specialist and became a supervisor in 1975. From 1976 to 1979, she was a supervisor in the Compliance and Enforcement Division.

Olive received her B.S. degree in zoology from the University of Maryland, College Park campus, in 1972.

The new Acting Assistant Administrator of the Office of Administration and Resource Management is **Christian R. Holmes.**

Holmes came to EPA in 1989 as the Principal Deputy Assistant Administrator in the Office of Solid Waste and Emergency Response.

In early 1991, Holmes became the first National Program Manager on federal facilities issues and was appointed as Deputy Assistant Administrator for Federal Facilities in the Office of Enforcement.

Prior to coming to EPA, Holmes held a number of senior public and private sector positions. He was Vice President and Corporate Secretary at the Cooper Development Company in Mountain View, California. He was also Vice President at The Cooper Companies in Menlo Park, California.

From 1981 until 1987 he served as Director of the U.S. Trade and Development Program for the International Development and Cooperation Agency in Washington, DC. He was also the Executive Director for the President's Task Force at the Agency for International Private Enterprise. Holmes served two years as Principal Deputy Assistant Secretary of State, for the Bureau of Refugees Program, at the Department of State, in Washington, DC.

In 1976, Holmes became Deputy Director of the Office of U.S. Foreign Disaster Assistance at the Agency for International Development (AID), where he started as Assistant to the Administrator for AID. Holmes was also the Administrative Assistant to Congressman William Mailliard.

Holmes received his B.A. degree in government at Wesleyan University, Connecticut. In 1982, Holmes received an Honorary M.A. degree from Wesleyan in

Ginsberg

White

Stahl

Reich

Ludwiszewski

recognition of his public service achievements. He is also the recipient of the Arthur S. Flemming award, the Presidential Meritorious Service award, EPA's Gold Medal, and the U.S. Army Soldiers Medal for Heroism.

Gail C. Ginsberg is the new Regional Counsel in Region 5 in the Office of the Assistant Administrator for Enforcement.

Previously, since 1979, Ginsberg served as an Assistant U.S. Attorney for the Northern District of Illinois. In that capacity, she handled civil litigation on behalf of numerous federal agencies. Ginsberg's case load included cases involving environmental issues, civil rights, employment discrimination, medical malpractice, and administrative law. She represented EPA in a variety of matters, including water and air enforcement cases, wetlands cases, a major RCRA subpoena challenge, and a number of pre-enforcement review cases.

Prior to her service in the U.S. Attorney's Office, Ginsberg worked as an attorney in EPA's Legal Support Section, Enforcement Division, Region 5, from 1974 to 1979. In 1977, she became chief of that section. Ginsburg also served as a public affairs officer for the Agency for International Development from 1966 to 1969.

Ginsburg graduated in 1966 from Pembroke College at Brown University, where she received her B.A. in political science. She obtained her J.D. in 1973 from the Washington College of Law at American University.

William A. White is the new Associate Enforcement Counsel for Superfund.

White came to EPA from the Washington, DC, office of the Philadelphia-based law firm of Dechert, Price, and Rhodes, which he joined in 1971; he became a partner in the firm in 1979 and was managing partner in Washington for two years. White focused his practice on federal environmental law, having been especially active in natural resources litigation. Most recently, he dealt extensively with Superfund issues, solid and hazardous waste regulation, as well as environmental permitting and enforcement matters.

White received both his B.A. and J.D. degrees from the University of Wisconsin at Madison in 1967 and 1971, respectively. While in law school, he was Editor of the University of Wisconsin Law Review and graduated with highest academic standing. He later went on to clerk for Judge Feikens of the U.S. District Court for Michigan's Eastern District.

Michael M. Stahl is the new Director of the Office of Compliance Monitoring, within the Office of Pesticides and Toxic Substances.

Prior to his current appointment, Stahl served for three years as a division director in the Office of Toxic Substances, managing the Agency's asbestos-in-buildings program, coordinating toxics programs with EPA regional offices and state agencies, and enhancing public participation in toxics programs.

From 1984 to 1987, he worked in EPA's Asbestos Action Program, becoming its Director in 1986. Stahl began his federal service in 1980 as a Presidential Management Intern at the Consumer Product Safety Commission, where he served as a special assistant to the Executive Director.

Stahl received his B.A. degree in criminal justice administration from the University of Missouri, St. Louis, in 1975. After working for three years in the Missouri Senate as an assistant to the majority floor leader, he obtained his M.A. in Public Administration from the University of Missouri, Columbia campus, in 1980.

Edward E. Reich is the new Acting Enforcement Chief. Reich joined EPA in 1970 as a program advisor for the Office of Air Programs.

His tenure in EPA's Enforcement Office began in 1971 as program advisor in the Office of Enforcement and General Counsel. In 1972, he became Chief of the Enforcement Proceedings Branch, within the same office, where he held the position for a total of five years during two periods of service. Reich left federal service and served as the Deputy General Counsel of Petroleum International Associates in Washington, DC, for one year between 1974 and 1975.

For the next 10 years, Reich was Director of the Stationary Source Compliance Division in the Office of Air and Radiation.

He returned in 1986 to the Office of Enforcement and Compliance Monitoring, where he was an Associate Enforcement Counsel for two years. Beginning in 1988, he held the position of Deputy Assistant Administrator for Enforcement and Compliance Monitoring until his previous appointment.

Reich is a graduate of Queens College in New York City, where he received a B.A. degree in political science. He also received a J.D. from Georgetown University Law Center in Washington, DC.

Raymond B. Ludwiszewski has been named Acting General Counsel.

Prior to this appointment, he held the position of Acting Assistant Administrator for the Office of Enforcement. Earlier, Ludwiszewski served as Deputy General Counsel and Chief of Staff to the Deputy Administrator from 1989 to 1990.

Before joining EPA, Ludwiszewski was associated, from 1988 to 1989, with the Washington law firm of Wilmer, Cutler, and Pickering in the litigation department, working on civil and criminal cases.

Previously, at the Justice Department, he served as the Associate Deputy Attorney General between 1987 and 1988.

From 1985 until 1986, Ludwiszewski was Special Counsel to the Assistant Attorney General in the Land and Natural Resources Division at the Justice Department.

From 1984 to 1985, he clerked for Judge Henry J. Friendly of the United States Court of Appeals for the Second Circuit located in New York City.

In 1984 Ludwiszewski graduated *magna cum laude* from Harvard Law School, where he served on the Harvard Law Review. Ludwiszewski is also a graduate of Northeastern University in Boston, Massachusetts, where he received a B.A. degree in political science, with concentrations in public administration and economics, in 1981. □

Workers inspect "cap" of clean sediment placed over a contaminated area in Puget Sound's Commencement Bay, a Superfund site. See news item on page 6. Photo by Michael G. Stoner of EPA.

Back Cover: Sampling air quality during cleanup of a central New Jersey Superfund site. Photo by Gabe Palmer for the Stock Market.