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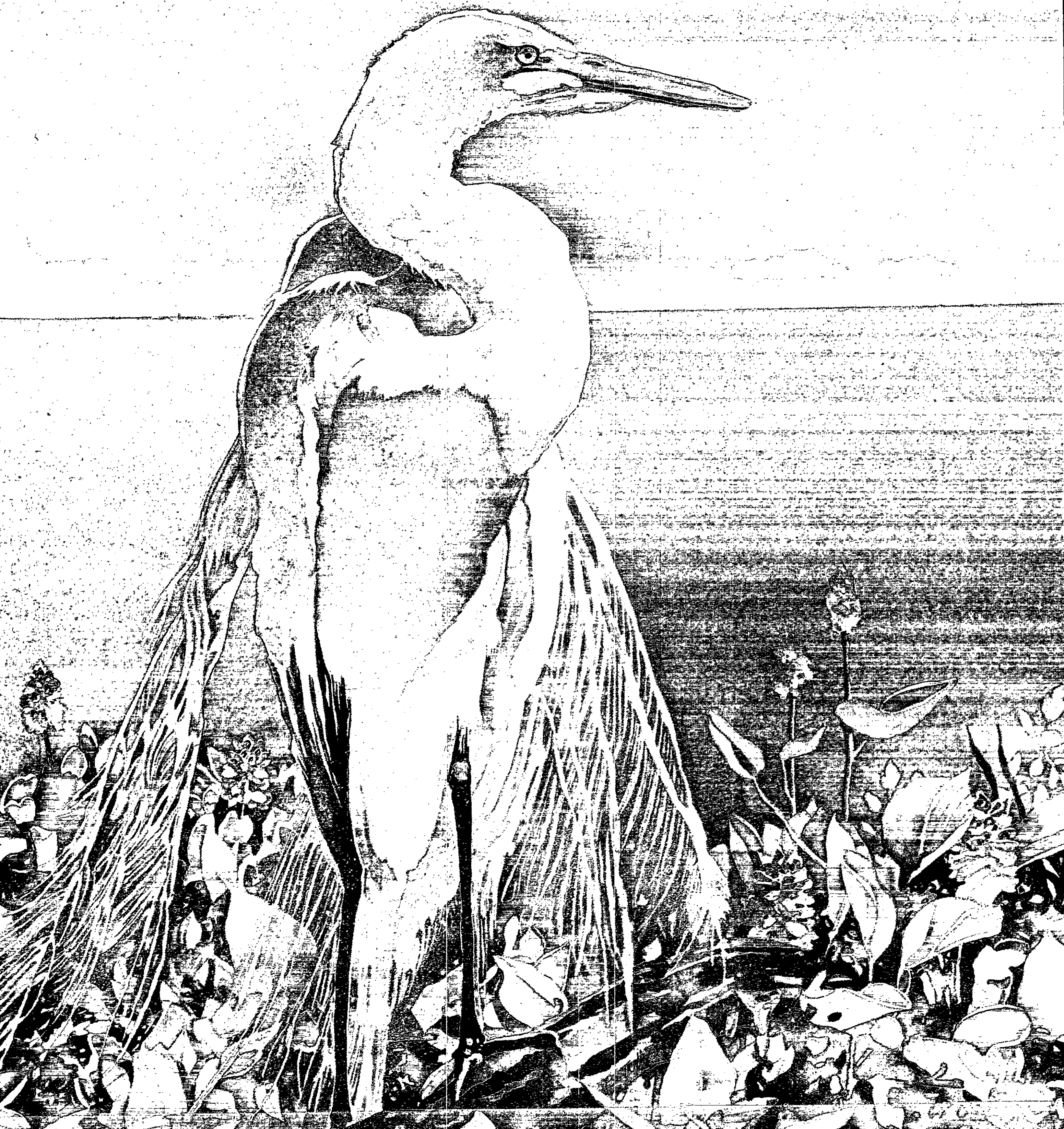
Environmental Progress and Challenges: EPA's Update



ENVIRONMENTAL PROGRESS AND CHALLENGES:

EPA'S UPDATE

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United States Department of Agriculture
Jessie Cohen, National Zoological Park, Smithsonian Institution
Steve Delaney
Rick Newton

Cover Illustration

Bobbi Tull

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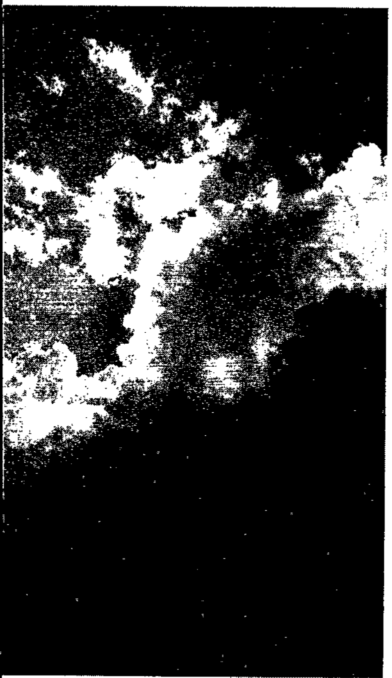
PREFACE

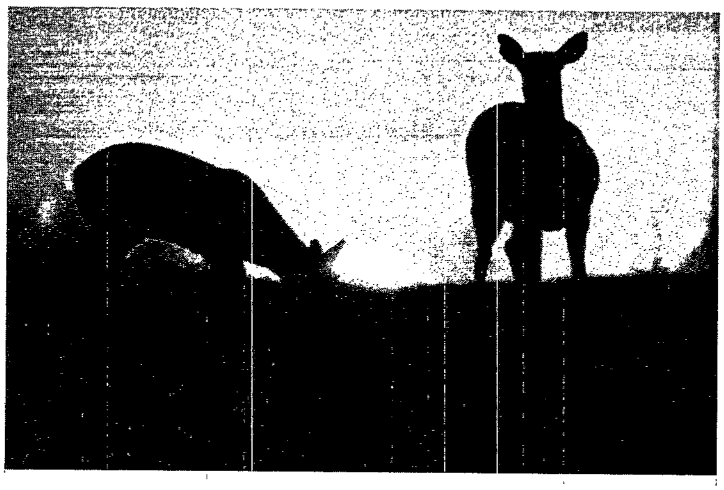


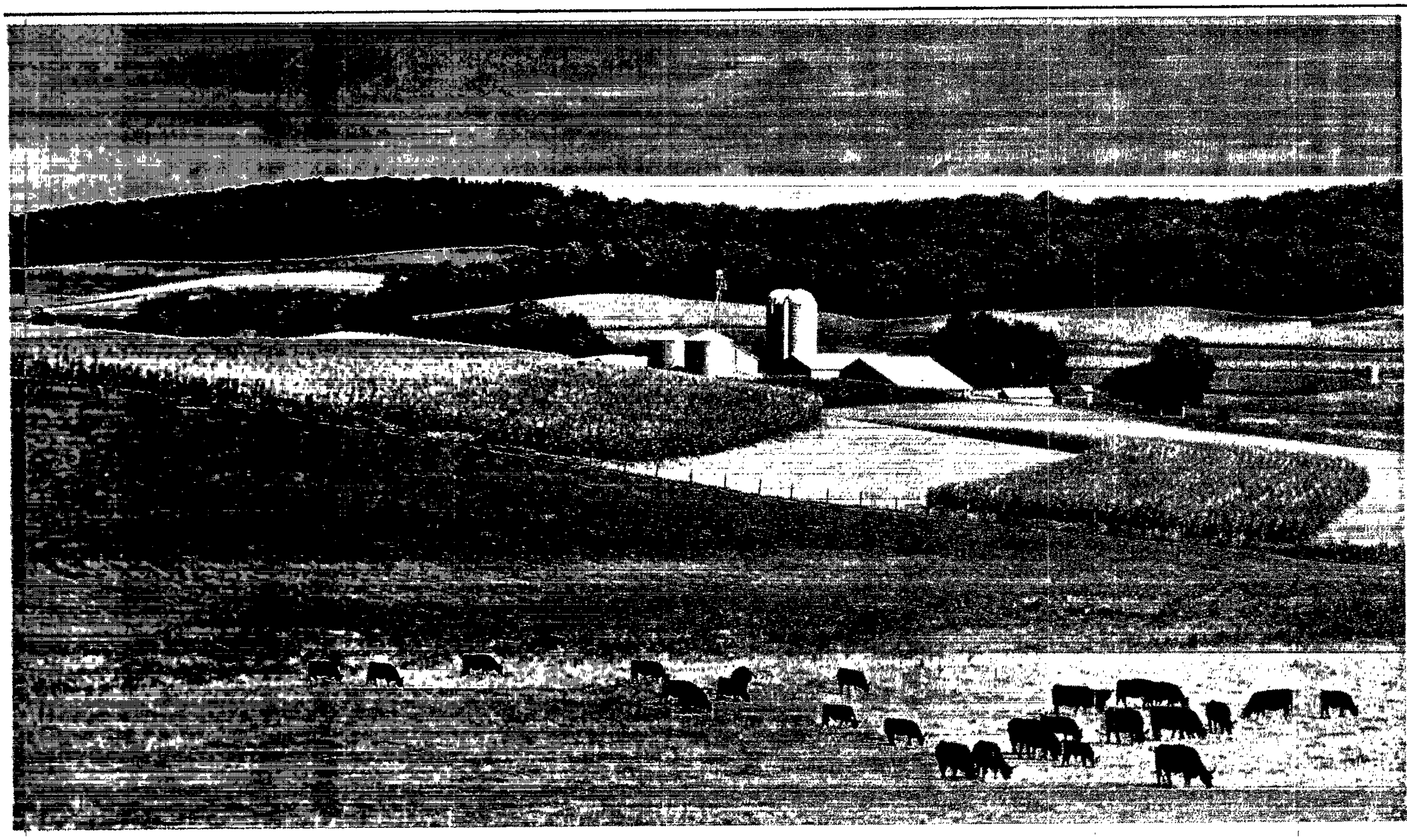
Every so often we need to inform the public about the work of the Environmental Protection Agency and the environmental challenges we face. This report presents EPA's assessment of the progress we have made as a nation in improving the quality of the air we breathe, the water we depend on, and the land where we live. It presents EPA's agenda for restoring and protecting these resources from past and future environmental hazards.

This report is largely an update of our 1984 report titled, *Environmental Progress and Challenges: An EPA Perspective.* Over the past four years EPA has progressed and made many changes. New programs have been created, such as wetlands and marine and estuarine protection. New legislation and reauthorizations of acts have created many changes in existing programs. Several important examples include: the Superfund Amendments and Reauthorization Act, the Clean Water Act, the Safe Drinking Water Act, and the Hazardous and Solid Waste Act. Many new and emerging environmental problems, including indoor air pollution, radon, global warming, and stratospheric ozone depletion are receiving increased EPA attention.

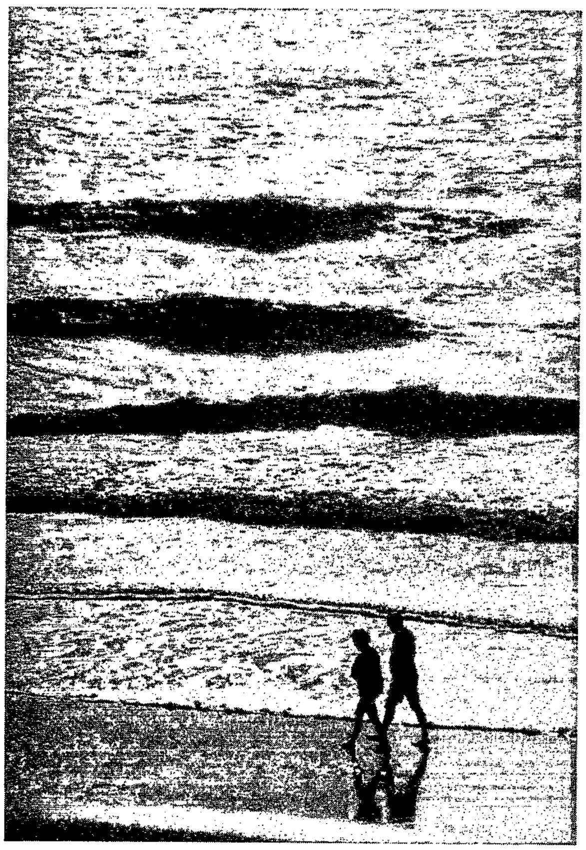
The report begins with an overview outlining the Agency's major priorities. These priorities, such as responding to risk, encouraging public involvement, and preventing future environmental problems are emphasized throughout the report. The overview is followed by chapters on Air, Water, Land, and Toxics. Each chapter is divided into sections that focus on the most important environmental issues.

The Environmental Results Branch of the Office of Policy, Planning and Evaluation prepared this report with the assistance of virtually every office in EPA. We gratefully appreciate the valuable contributions that our colleagues throughout EPA have given us in preparing and critiquing this update.





ADMINISTRATOR'S OVERVIEW



For the past 20 years, the American people have been involved in a great social movement known broadly as "environmentalism." We have been concerned with the quality of the air we breathe, the water we drink, and the land on which we live and work. This concern has focused on the wise use of our natural resources and the preservation of natural and historical treasures. It has addressed the survival of endangered plants and animals, and the health of the global ecology. In short, environmentalism has sought to improve the quality of life in this country and around the world. In so doing, it has changed many of the fundamental assumptions that help to define our national well-being.

It was not long ago that the quality of life in America was measured almost exclusively in terms of economic growth and prosperity. Calvin Coolidge immortalized this focus when he observed that the "business" of America was just that — business. Our nation was blessed with seemingly endless resources, hard-working people, and unlimited opportunity.

Our natural resources were exploited indiscriminately. Waterways served as industrial pollution sinks; skies dispersed smoke from factories and powerplants; and the land proved to be a cheap and convenient place to dump industrial and urban wastes. Industrial growth during the period following World War II was unparalleled in the history of the nation. We enjoyed a prosperity never before known. Unfortunately, we also were accumulating an environmental debt of staggering proportions.

By the late 1960s, Americans began to recognize an emerging crisis. We had witnessed serious environmental degradation in every medium. The air in many industrial cities was deemed unhealthy; Lake Erie lay on its deathbed; the Cuyahoga River erupted in flames; pesticides like DDT took their toll on wildlife. In response to the environmental crisis, the Environmental Protection Agency was created in 1970. Over the next decade and a half Congress passed a series of far-reaching laws that prescribed needed changes in the way the nation conducted its business. Slowly, a process was built that today incorporates environmental considerations into the basic decisionmaking of government and industry.

Our society is now more aware of the environment and the need to protect it. While economic growth and prosperity are still important goals, opinion polls show overwhelming public support for pollution controls and a pronounced willingness to pay for them. This latter point, perhaps the ultimate measure of commitment, has been borne out over the last two decades as Americans spent billions of dollars for cleaner air, water, and land.

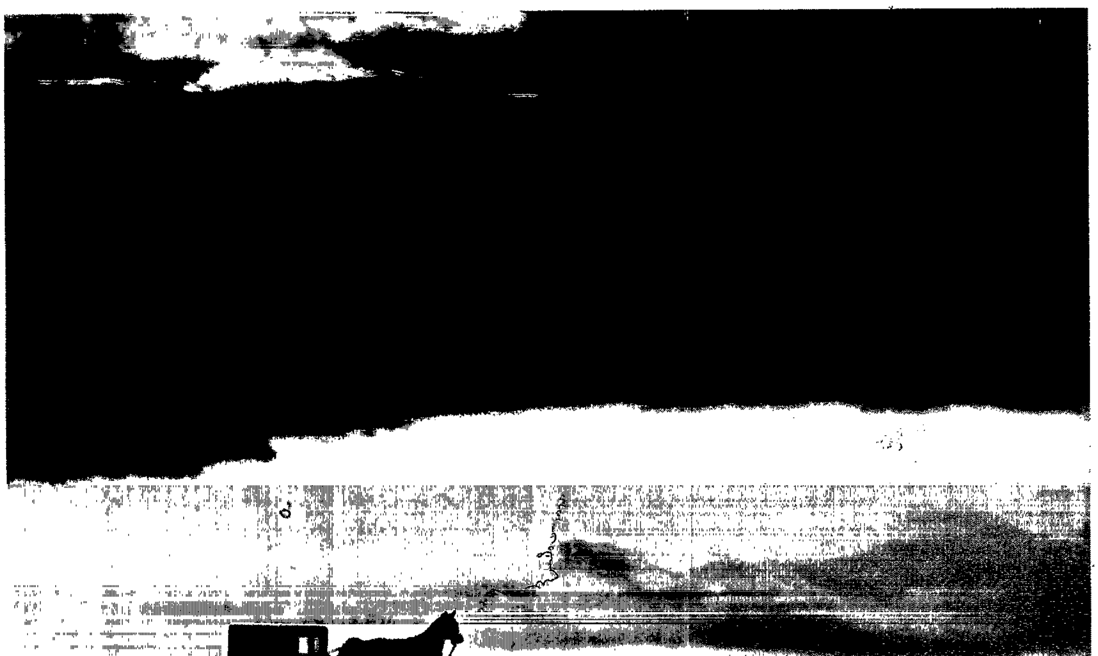
What have we gotten for these expenditures? Our accomplishments are impressive. There is no question that the air in most of our cities today is far cleaner and healthier than it was in the 1960s. Thousands of miles of rivers and streams, and thousands of acres of lakes, have been restored and protected for

fishing and swimming. In addition, we have taken extraordinary steps to improve the management of hazardous wastes, toxic chemicals, and pesticides.

Consider a few examples:

- Lead levels in urban air are down 87 percent from 1977. Sulfur dioxide levels have been reduced 37 percent and particulates are lower by 23 percent. Even the more intractable pollutants like ozone and carbon monoxide have been reduced by 13 percent and 32 percent, respectively.
- We have dramatically improved municipal sewage treatment. Today, more than 127 million Americans are served by adequate public sewage treatment systems, a significant increase from the 85 million people served in 1972.
- Comprehensive hazardous waste management regulations are in place. Many untreated wastes are being banned from land disposal and thousands of potentially hazardous sites around the country have been identified and are being evaluated to determine whether federal actions are necessary. We have begun over 1000 short term actions to address immediate threats, and we have initiated response activities at more than 700 sites on the National Priorities List.
- Before 1980, we neglected some of our most productive and valuable ecosystems—the Atlantic, Pacific and Gulf coastal waters. During the past eight years, EPA has been working with Maryland, Virginia, Pennsylvania and the District of Columbia to begin the restoration of the Chesapeake Bay. Now we are applying the experience we gained from this project to other estuaries, including Puget Sound, Albemarle-Pamlico Sound, Buzzards Bay, Narragansett Bay, Long Island Sound and San Francisco Bay—and we will be adding more coastal waters to our National Estuaries Program this year.
- Prior to 1972, severely degraded conditions were evident in the Great Lakes. Cooperative efforts between the U.S. and Canada have resulted in a major recovery in the Lakes' condition through construction of new sewage treatment facilities, phosphate bans in some areas and strict industrial wastewater controls.
- The use of many pesticides has been cancelled, suspended or restricted. Some pesticides have been replaced with substitutes that are less persistent in the environment. The resurgence of bald eagle, osprey, peregrin falcon and brown pelican is the result of EPA's ban on DDT. We are also seeing marked declines of DDT, dieldrin and aldrin in the tissues of fish and wildlife. Currently we are re-evaluating the risks of tens of thousands of pesticide products whose uses were approved prior to the 1972 amendments to the nation's pesticide law.

These accomplishments are impressive when seen in the context of the economic expansion and population growth that occurred during the same period. There are 25 percent more people in the United States now than 20 years ago; our gross national product has increased 500 percent. There are more cars on the road traveling more miles, and more manufacturing facilities producing a greater number of products. These statistics indicate that economic growth and environmental health are not mutually exclusive; indeed, there is an important linkage between them. Environmental protection itself has proven to be a wise investment and a growth industry.



THE CHALLENGES AHEAD

But the job is far from finished. More than 60 cities still do not meet federal air quality standards for ozone. Hundreds of communities are not in compliance with requirements for better treatment of municipal sewage. Our wetlands are disappearing at an alarming rate. Our oceans, estuaries, and near-coastal waters are victims of intensive coastal and upstream development and runoff from farms and cities. Many urban areas face a mounting crisis over municipal garbage disposal.

> "We must adopt a more integrated or *systems* approach to environmental protection."

Clearly, much work remains to be done. While we continue to pursue our existing air, water, waste, and toxics programs, we also recognize that new challenges await us. Because many of the solutions of the past decades merely transferred pollutants from the water to the air or from the air to the land, we must adopt a more integrated or "systems" approach to environmental protection. We can no longer think simply of clean air or clean water; we must work for a clean environment.

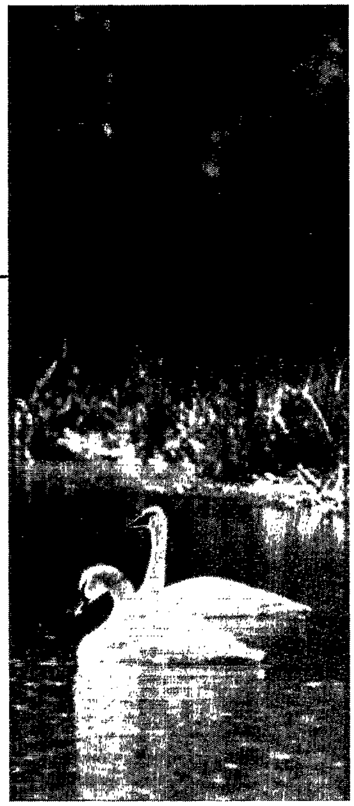
We need to work harder to prevent environmental problems by reducing the amount of wastes from our homes and from industry. We need to recycle more waste. Future waste management should prevent disposal problems by reducing the amount of waste as a first step.

We also must reassess our notion of "environmental safety." We now know that many of the things we do and chemicals we need to sustain our modern lifestyle pose some risk to people and to our ecosystem. We have to develop better ways to assess these risks and make the choices which balance the benefits with the risks. This may be one of our toughest missions in the next decade.

Increased public understanding of environmental problems, risks, and solutions will be even more critical to our success than in the past. The problems we deal with today are not primarily the large smokestack concerns of the 1970's. As these major sources of pollution are being controlled, Americans will have to recognize that our individual actions in our homes, the products we buy and how we choose to relax all can affect the quality of our environment. We will have to face choices in our daily lives to balance the risks of these actions with the benefits. EPA will have to play a large role in educating and involving the public in its decisions.

The responsibility for implementing our nation's environmental laws also is changing. Unlike the majority of issues in the 1970s, centralized pollution control efforts will not effectively address all of the major problems. State, local, and Indian tribal governments are now playing an ever more significant role in environmental protection. We need to discover how EPA can best assist and encourage an even stronger future role for these players. Finally, we now recognize through problems such as acid rain, global warming, and pollution of our oceans that the quality of the environment in America is also dependent on how the rest of the world treats our planet—just as our actions affect other nations. One of our biggest challenges will be to assist and educate other nations and actively negotiate multinational agreements to protect the global environment.

EPA'S FUTURE AGENDA



Our agenda should include several key components. It should take into account the problem of cross-media transfer of pollution. It should, to the extent possible, reflect priorities that are set on the basis of risk. It should encourage full involvement of the public in making tough choices in the future. It should promote an effective role for federal, state, local, and American Indian tribal governments. It should recognize the global nature of some issues. Finally, and perhaps most critically, it should strive to *prevent* pollution by reducing the amount of waste we produce, by recycling what we can, and by making other sound management approaches to avoid more costly cleanups in future years.

A Systems Approach

The environment is an integrated system. There is no such place as "away" where we can throw things. For example, when we remove pollutants from the air, we often inadvertently transfer them to the water or to the land. If we simply transfer the pollution, it likely will come to rest at the point of least regulation. The point of least regulation, however, may not be the point of least risk.

To meet the challenges of the 1990s and the next century, a more systematic approach to protecting the environment must be taken, one involving a coordinated strategy by EPA and other government programs for achieving the maximum affordable reduction of the most significant risks.

Reducing Risk

We cannot eliminate all toxic chemicals from the environment. Given the tens of thousands of chemicals used today, basic decisions must be made as to which ones should be controlled, to what levels, and at what cost. This requires an assessment of the risks to human health, welfare, and the environment that are posed by different pollutants in different locations. It requires decisions on how to reduce the most significant risks, taking into consideration the benefits and the costs, as well as other public concerns. It requires the establishment of priorities through risk-based decisionmaking.

EPA's challenge is to improve the way risk-based decisions are made in the future. To do this, we will need better risk information and better science.

Public Education And Involvement

EPA must share with the public its knowledge of the scope and severity of the environmental challenges before us. With improved information and an understanding of the reality of risk in an industrial society, the public can do a better job helping us establish our national environmental directions.

EPA must also help people to understand that they are part of the pollution problem and its solution. The attention of the last fifteen years has been on controlling large sources of pollution such as smokestack industries and municipal sewage disposal facilities. As we strive for further environmental improvements in the 1990's, the focus of the nation's pollution control efforts must also include small sources that are widespread throughout the country. For example, we need to pay greater attention to how each of us can recycle more of our household waste, properly use and dispose of lawn chemicals, or drive and maintain our cars to reduce air pollution. We cannot pass to someone else the responsibility for controlling pollution. Each of us must recognize the part that we play in environmental protection and become "part of the solution."

Further progress, therefore, will require lifestyle changes by the American people. All of us — individual homeowners, farmers, shopkeepers, automobile drivers — will have to make tough choices between convenience, the costs of goods and services, and a cleaner environment. EPA's job should grow from primarily "the enforcer" to include greater emphasis on helping citizens make informed choices in their daily lives.

"Each of us must recognize the part that we play in environmental protection and become *part of the solution.*"

State/EPA Partnership

EPA and the states need to continue to strive toward a proper balance in our working relationship. The challenges that face us now are not as amenable to centralized "command and control" approaches as past problems. EPA must further recognize the increasing capabilities and responsibilities of states—including Indian tribal governments and local governments—in protecting the environment.

EPA must provide better technical support to state governments as they assume more responsibility for environmental program funding and management. This means more training and technical assistance to help states assess and address risks. It means improving data management so that states and EPA have access to each other's information, and creating other ways for all of us to share our expertise. A true partnership also requires EPA to be more sensitive to the separate needs of the states. Risks are not distributed uniformly nationwide; EPA must look for new ways to address priorities that differ around the country and recognize the growing role of state, local and Indian tribal governments in shaping their own environmental agendas.

Although state and federal roles are changing, EPA will

Unfinished Business: EPA's Assessment of Major Environmental Risks

When the Environmental Protection Agency was established in 1970, the most pressing environmental problems were obvious. Important polluters and pollutants were the visible ones: soot and smoke from cars and smokestacks, and raw sewage and chemicals from municipal and industrial waste water.

The nation has done much to abate the most visible pollution, but there is still much unfinished business. "New" problems have been discovered, such as radon, global climatic change, acid precipitation, and hazardous waste. Many of these problems are difficult to evaluate because they involve slow, cumulative changes with potentially serious but uncertain effects. They often involve toxic chemicals that can cause cancer or birth defects at levels of exposure that are hard to detect. Other problems involve persistent contaminants that move from one environmental medium to another, causing further damage after initial controls have been applied.

The complexity and gravity of these issues make it particularly important that EPA apply its finite resources where they will have the greatest benefit. Thus, in 1986, Administrator Lee Thomas commissioned a special task force of senior agency managers and technical experts to compare the risks associated with major environmental problems. The findings would be combined with other important considerations in setting EPA's priorities.

The risk comparison was organized in four important ways. First, the universe of environmental problems was divided into 31 problem areas corresponding generally with program responsibilities or statutes. Second, four types of risk were considered separately for each problem area — cancer risks, non-cancer risks, ecological effects, and "welfare" effects, such as damage to crops, vegetation, or buildings. There was no attempt to compare the importance of one type of risk versus another. Third, the project did not *consider important factors such as the costs and availability of technologies to control the risks, benefits to society of activities that cause the environmental problems, or the legal authority of EPA to deal them. Finally, risks were assessed as they exist now — given the levels of control currently in place.*

The project ranked the 31 problems for each of the four types of risk. Among the findings:

- *No problems ranked relatively high in all four types of risk, or relatively low in all four risk areas. The "severity" of an environmental problem depends on whether one is specifically concerned with either human health, ecological impacts, or welfare effects.*
- *Problems that ranked relatively high in cancer and non-cancer health risks but low in ecological and welfare risks include: hazardous air pollutants; indoor radon; indoor air pollution other than radon; pesticide application; exposure to consumer products; and worker exposures to chemicals.*
- *Problems that ranked relatively high in ecological and welfare risks, but low in both health risks include: global warming; point and non-point sources of surface water pollution; physical alteration of aquatic habitats; and mining waste.*
- *Areas related to ground water consistently ranked medium or low, but the availability of data on ground water-related risks was very limited.*

The rankings by risk did not correspond well with EPA's 1987 program priorities. Many areas of relatively low risk, such as hazardous waste sites and Superfund, have received considerably more EPA attention than higher risk problems like indoor air pollution.

Overall, EPA's priorities appeared to be more closely aligned with public opinion, often expressed through Congressional mandates, than with estimated risk. Two of the agency's greatest challenges are to educate the American public about environmental risks, and to incorporate these considerations—along with considerations of cost, statutory authority, and other public concerns and policies—in establishing priorities for the national environmental effort.

continue to carry out its statutory responsibility for setting standards and ensuring compliance with them. Our challenge is to get this job done while also giving states enough flexibility to solve important local problems that are not national priorities.

Environmental Outlook: Global

In the largest sense, the earth is a single, integrated ecosystem shared by all the people living on it. As the world's population and economy continue to grow, that ecosystem is being strained in a number of ways. Chlorofluorocarbons are threatening the stratospheric ozone layer; global emissions of carbon dioxide are contributing to a gradual warming of the earth's atmosphere; species of flora and fauna are being lost worldwide at an accelerating rate. These kinds of changes to the global environment are of especially serious concern because they have the potential to affect the quality of life of literally everyone on earth.

Moreover, in a number of places natural resources shared by neighboring nations are being degraded. For example, acid rain is harming aquatic ecosystems in the northeastern United States, southeastern Canada, and Europe. Shared waterbodies like the Mediterranean Sea and the Gulf of Mexico are being polluted by the combined economic activities of the different countries that border them.

But whether these emerging environmental problems are global or regional, our response to them will entail international cooperation. Because pollution does not stop at international political boundaries, we are going to have to find new ways of cooperating with the community of nations to find shared solutions to shared problems.

International cooperation in this area will be complicated by the need to factor in the special economic circumstances of developing nations. Poorer countries often find it difficult to sustain their natural resource base in the face of immediate demands for food, fuel, and jobs. They have fewer resources to invest in waste disposal and pollution control. But as was proved by the recently signed Montreal Protocol to protect the stratosphere, nations are capable of resolving their economic and political differences in the interest of protecting a shared environment. We will have ample opportunity to put that lesson to work in the years ahead.

Preventing Future Environmental Problems

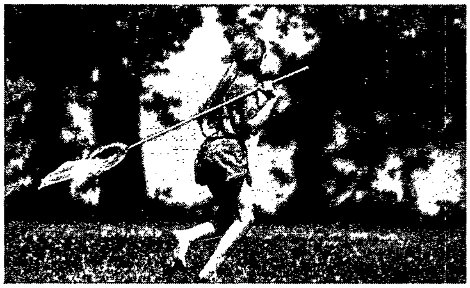
Environmental protection will be a never-ending battle against contaminated "hot spots" unless we take steps now to *prevent* them from developing. We are placing more emphasis on pollution prevention in all EPA programs. We need to do more of it, and so do state and local agencies as well as the private sector.

We as a nation can do many things to prevent environmental problems from developing in the first place. We should reduce the amount of waste from our homes and industries before that waste becomes a disposal problem. Municipal recycling and industrial waste reduction ease the economic and environmental burden of waste disposal. Source reduction and recycling should become the centerpiece of a progressive national waste management strategy.

We will continue to restrict the use of toxic chemicals in places where they might enter drinking water supplies or endanger fish and wildlife. We will continue to ban the disposal of untreated wastes on the land, where it threatens human health or the environment. We will continue to identify sensitive wetlands and restrict harmful development before irreparable damage is done. We will continue to promote better farming practices that will prevent agricultural chemicals from contaminating ground and surface waters. In short, we will do a better job of planning to prevent future problems. By so doing, we avoid costly cleanup later and we avoid the loss of irreplaceable resources. If we take precautions today, we will be making an important investment in a safer and cleaner environment tomorrow.

We have begun to do long-range planning at EPA. We are trying to determine what environmental results we want to see in the not-too-distant future, and the best strategies we can employ to achieve them. To do this well requires tremendous vision in establishing goals, taking into consideration the tough choices we and the American public need to make between environmental and other social goals. It requires creativity and hard-nosed realism in designing systematic, coordinated program strategies, and it requires dedication to follow through. This is EPA's ultimate challenge.

Lee M. Thomas



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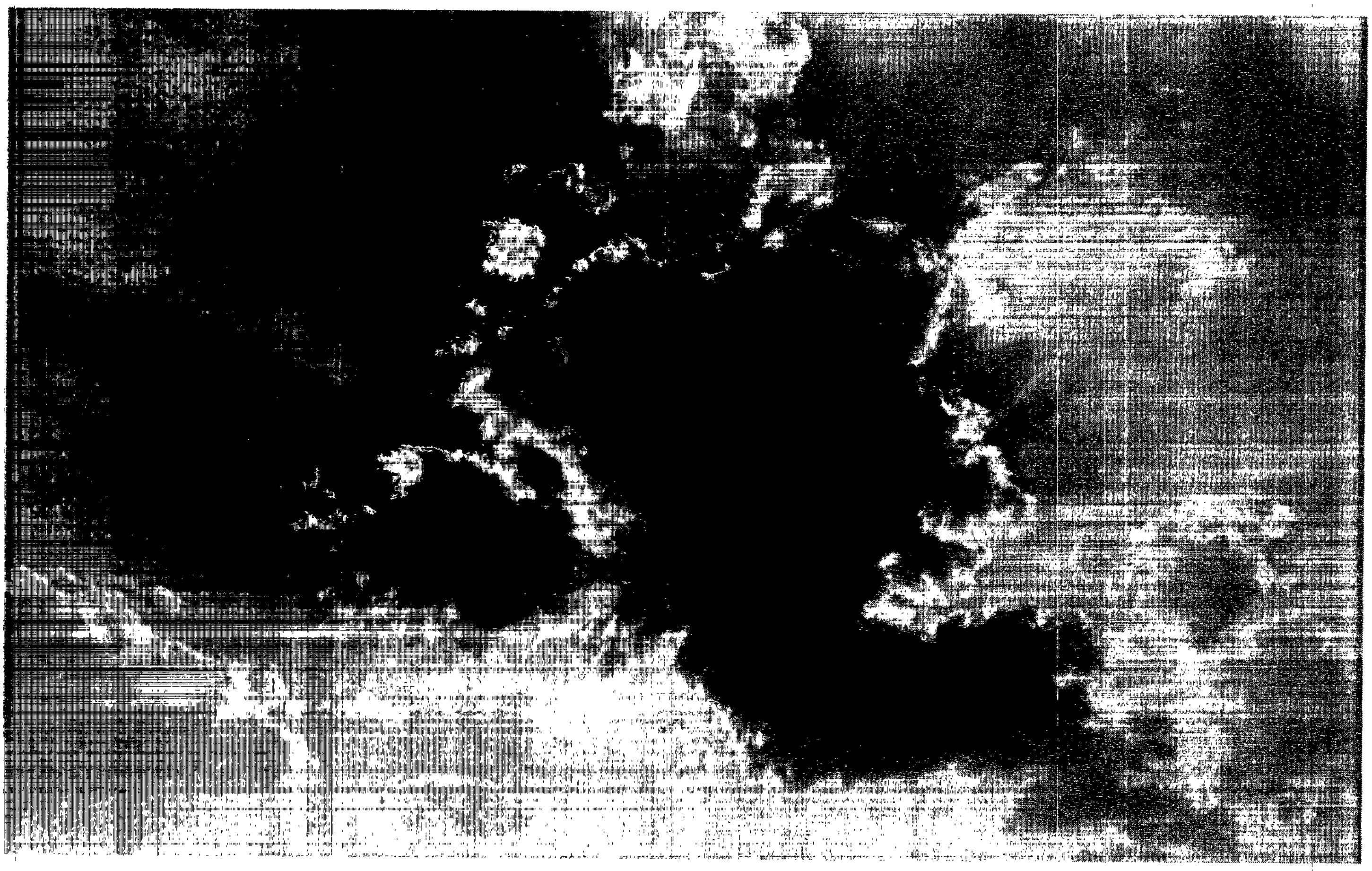


Since the Clean Air Act was passed in 1970, the United States has made impressive strides in improving and protecting air quality. In spite of pressures from economic and industrial growth, our air is now substantially cleaner. Pollution controls have removed the smoky haze that once perpetually enveloped American cities.

Our greatest success is the reduction of lead in the air. Since 1977, ambient levels of lead have decreased 87 percent. Annual nationwide levels of ozone, carbon monoxide, airborne particulates, sulfur dioxide, and nitrogen oxides have also been reduced, in some cases sharply. This success has been achieved through cooperation between EPA and state and local air quality programs over the past 15 years.

Nonetheless, the challenges ahead are formidable and present tough choices. The problem of ground-level ozone or "smog" has proven to be particularly difficult to control. In the next decade we will be working to resolve new and emerging problems such as radon and other indoor air pollutants. We will also continue to work with other countries to address the international problems of global warming and stratospheric ozone depletion.

This chapter begins with an overview of EPA's approach to air pollution control and the progress achieved so far. It then discusses eight major air pollution issues facing the nation and how EPA plans to address them.

AN OVERVIEW

Air pollution is one of the greatest risks to human health and the environment in our country. The long list of health problems brought on or aggravated by air pollution includes: lung diseases, such as chronic bronchitis and pulmonary emphysema; cancer, particularly lung cancer; neural disorders, including brain damage; bronchial asthma and the common cold, which are most persistent in places with highly polluted air; and eye irritation (Figure A-1). Environmental problems range from damage to crops and vegetation to increased acidity of lakes that makes them unlivable for fish and other aquatic life.

The first air pollution laws in the United States were passed by cities. In the 1880s, Chicago and Cincinnati initiated the earliest municipal regulation of smoke emissions, followed in the 1890s by Pittsburgh and New York. One of the earliest state air pollution laws was passed by Ohio in the 1890s to regulate smoke emissions from steam boilers. In 1952, Oregon became the first state to pass comprehensive statewide legislation and establish a state air pollution control agency.

But while Americans have long recognized dirty air as a serious problem, they paid little attention initially to the public health risks it presented. Not until the 1940s, did it become clear that air pollution was a serious problem. Killer fogs in Donora, Pennsylvania in 1948 and in London in 1952 focused national attention on the potential health hazards of air pollution. During the late 1940s, the state of California, Los Angeles County, and local industries began spending millions of dollars to study the causes and effects of smog.

By the 1960's, the necessity for a national approach to address air pollution more effectively was recognized. In 1963, Congress passed the Clean Air Act, authorizing the U.S. Public Health Service to study air pollution and providing grants and training to state and local agencies to control it. This legislation was strengthened considerably when the Clean Air Act of 1970 was enacted, making EPA the focal point of the Federal effort.

The new Act created a partnership between state and federal governments. It gave state and local governments primary responsibility for preventing and controlling air pollution. EPA has more of a support role: conducting research and development programs, setting national standards and regulations, providing technical and financial assistance to the states, and where necessary, supplementing state implementation programs.

As directed by the Clean Air Act of 1970, EPA set National Ambient Air Quality Standards for those pollutants commonly found throughout the country which posed the greatest overall threat to air quality. These pollutants, termed "criteria pollutants" under the act include: ozone, carbon monoxide, airborne particulates, sulfur dioxide, lead, and nitrogen oxides. For these pollutants, the Act sets primary standards to protect human health and secondary standards to protect "welfare," primarily crops, livestock, vegetation, buildings, and visibility. For some of these criteria pollutants, a single national ambient standard has been established that protects both health and welfare.

In addition to the criteria pollutants provisions, the Clean Air Act also requires EPA to set National Emission Standards for Hazardous Pollutants (NESHAP's). Hazardous pollutants are defined as those that can contribute to an increase in mortality or serious illness. EPA is currently analyzing a number of air pollutants to determine whether they are hazardous and require regulation. We have already issued emissions standards for asbestos, beryllium, mercury, vinyl chloride, arsenic, radionuclides, benzene, and coke oven emissions.

FIGURE A-1
Health Effects of the Regulated Air Pollutants

Criteria Pollutants	Health Concerns
Ozone	Respiratory tract problems such as difficult breathing and reduced lung function. Asthma, eye irritation, nasal congestion, reduced resistance to infection, and possibly premature aging of lung tissue.
Particulate Matter	Eye and throat irritation, bronchitis, lung damage, and impaired visibility.
Carbon Monoxide	Ability of blood to carry oxygen impaired. Cardiovascular, nervous, and pulmonary systems affected.
Sulfur Dioxide	Respiratory tract problems; permanent harm to lung tissue.
Lead	Retardation and brain damage, especially in children.
Nitrogen Dioxide	Respiratory illness and lung damage.
Hazardous Air Pollutants	
Asbestos	A variety of lung diseases, particularly lung cancer.
Beryllium	Primary lung disease, although also affects liver, spleen, kidneys, and lymph glands.
Mercury	Several areas of the brain as well as the kidneys and bowels affected.
Vinyl Chloride	Lung and liver cancer.
Aresenic	Causes cancer
Radionoclides	Causes cancer.
Benzene	Lukemia
Coke Oven Emissions	Respiratory cancer

PROGRESS TO DATE

SOURCES OF THE PROBLEM AND EPA'S APPROACH

Both criteria and hazardous air pollutants come from mobile and stationary sources. Mobile sources include passenger cars, trucks, buses, motorcycles, boats, and aircraft. Stationary sources range from iron and steel plants and oil refineries to dry cleaners and gas stations.

Under the Clean Air Act, each state must prepare a State Implementation Plan describing how it will control emissions from mobile and stationary sources to meet the National Ambient Air Quality Standards.

Mobile Sources

More than half of the nation's air pollution comes from mobile sources. Exhaust from such sources contains carbon monoxide, volatile organic compounds (VOCs), nitrogen oxides, particulates, and lead. Although VOCs are not regulated as a criteria pollutant, their emissions are controlled. Along with nitrogen oxides, they are the major contributors to the formation of ground-level ozone, also known as "smog."

EPA controls emissions from motor vehicles through the Federal Motor Vehicle Control Program. Under this program, the Agency sets national emission standards for fuel evaporation, carbon monoxide, nitrogen oxides, volatile organic compounds, and particulates. Car manufacturers must design new cars so that they meet those standards.

State and local governments, with EPA support and guidance, operate vehicle inspection and maintenance programs to test automobile emission levels. In addition, anti-tampering programs ensure that cars built for unleaded gas are not altered to receive leaded fuels and that emission control equipment is not removed.

State and local governments also try to reduce pollution from traffic by supporting public transportation and encouraging ride-sharing programs.

Stationary Sources

Stationary sources generate air pollutants mainly by burning fuel for energy and as by-products of industrial processes. Electric utilities, factories, and residential and commercial buildings that burn coal, oil, natural gas, wood, and other fuels, are the principle sources of such pollutants as sulfur dioxide, nitrogen oxides, carbon monoxide, particulates, VOCs, and lead.

Hazardous air pollutants also come from a variety of industrial and manufacturing processes. Fuel oils contaminated with toxic chemicals, hazardous waste disposal facilities, municipal incinerators, landfills, and electric utilities are other sources of toxic air pollutants.

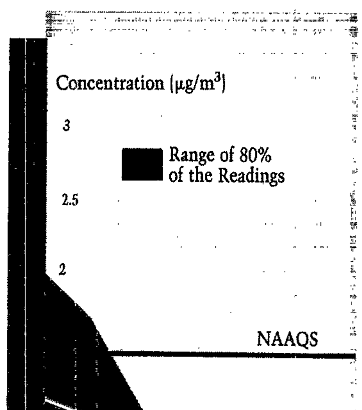
EPA closely monitors the compliance status of about 30,000 stationary air pollution sources that are regulated by the states. The Agency reviews whether states are meeting ambient standards for individual criteria pollutants. Where they are not meeting these standards, states are required to develop new plans to do so. Once these State Implementation Plans are developed, the states and EPA monitor emissions to ensure compliance with limits and take action against violators. Ambient pollution levels also are monitored.

EPA, together with state and local governments, has taken a number of effective steps to control mobile and stationary air pollution sources. Ambient levels of all criteria pollutants have decreased and far fewer communities have pollution levels exceeding air quality standards. Our greatest success, however, has been the reduction of airborne lead (Figure A-2).

The sharp reduction in lead emissions and ambient air levels is largely due to EPA's regulations phasing down the level of lead in gasoline. Between 1977 and 1986, ambient levels of lead in the air declined by 87 percent and emissions decreased by 94 percent. Levels of lead are expected to continue to decline as less leaded gasoline is produced. Some refiners no longer sell leaded gasoline in urban areas.

FIGURE A-2

Levels of Lead have Decreased Sharply



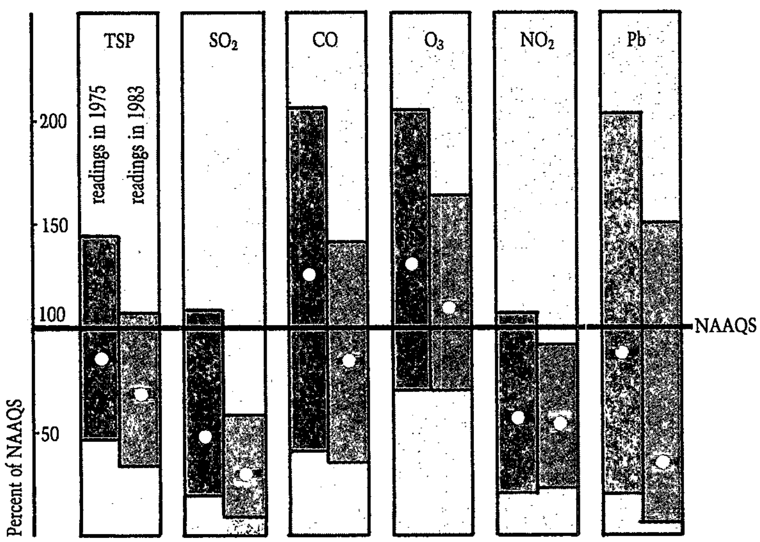
Source: *National Air Quality and Emissions Trends Report*, 1986, USEPA

The Amount of Pollutants in the Air

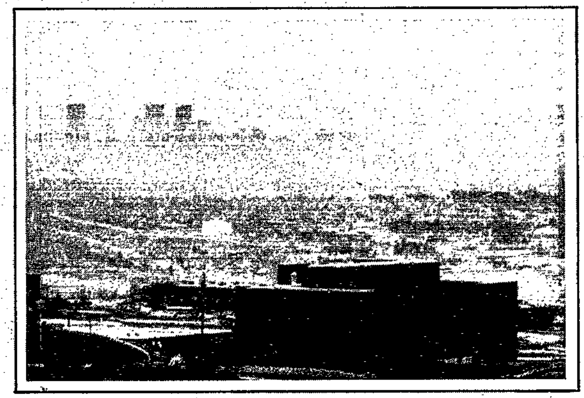
EPA and the states use a nationwide monitoring network to measure levels of criteria pollutants in the ambient air. Because the monitors are concentrated in cities, where there is the greatest potential for human exposure to these health threats, there is an urban bias to the data. In general, however, the network data reliably reflect national air quality trends. Data for the period from 1977 to 1986 show that annual average ambient levels of all criteria pollutants are down nationwide (Figure A-3). These achievements include:

- Particulate levels decreased 23 percent both because of the installation of pollution control equipment and a reduction in industrial activity.
- Sulfur dioxide levels decreased 37 percent because of efforts to cutback emissions, such as pollution controls at coal-fired power plants.
- Nitrogen dioxide levels decreased 14 percent, while remaining well below National Ambient Air Quality Standards (NAAQS) in almost all areas. Without pollution controls the large increase in the volume of traffic during this period would have resulted in a significant rise in nitrogen dioxide levels.
- Ozone levels decreased 13 percent between 1979 and 1985 due to the Federal Motor Vehicle Control Program and stationary source control efforts. Many urban areas, however, did not meet the standard in 1987.
- Carbon monoxide levels decreased 32 percent because of reductions brought about by the Federal Motor Vehicle Control Program.

FIGURE A-3
Some Air Quality Trends



TSP = Total Suspended Particulates SO_2 = Sulfur Dioxide CO_2 = Carbon Monoxide O_3 = Ozone NO_2 = Nitrogen Dioxide Pb = Lead NAAQS = National Ambient Air Quality Standards
Source: *National Air Quality and Emissions Trends Report*, 1986, USEPA



Cleaning Up the Air in Denver

Once a city with a reputation for pure, healthy air, Denver has in recent years become known for its summer-time "brown cloud" of nitrogen oxides and winter-time carbon monoxide problems. A growing volume of traffic, combined with Denver's unique geographic location and climate, is responsible for much of this air pollution. A temperature inversion develops every winter when a layer of cold air traps relatively warmer air below it, allowing a build up of carbon monoxide and particulates. Denver's mile-high elevation also adds to the problem. Poor fuel combustion caused by the thin air produces high emissions of carbon monoxide and small particulates.

Carbon monoxide is a colorless, odorless gas that has especially severe health effects for people with heart and lung problems. Levels of carbon monoxide in Denver have been measured at three times the national standard. Over 80 percent of Denver's carbon monoxide comes from automobiles.

Small particulates (less than 10 microns in size) and nitrogen oxides are responsible for Denver's infamous brown cloud. Most of the small particulates come from diesel trucks and buses, coal-fired power plants, and sand spread on the streets to improve traction in the snow.

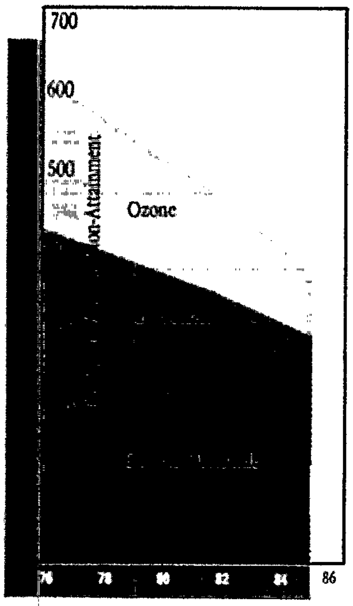
EPA has been cooperating with state and local governments in cleaning up the Denver air. The city's new Metropolitan Air Quality Council has enacted a carbon monoxide reduction plan that stiffened inspection and maintenance requirements and mandated the use of high oxygen fuels for all vehicles. The plan also improved the "Better Air Campaign," a voluntary program to cut down on driving and encourage municipalities to adopt wood burning bans on days when concentrations of particulates are high. Denver and four surrounding communities have already adopted wood burning restrictions. Other innovative ideas such as special pollution control devices for cars used at high altitudes are being discussed. In addition to efforts by government, the Denver business sector has contributed $1 million to study the causes and health effects of the brown cloud.

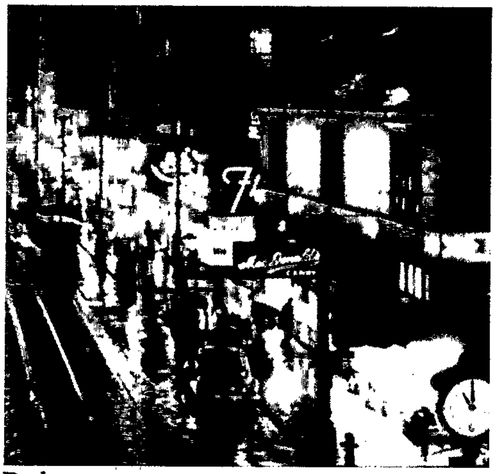
Areas Meeting Ambient Standards

Across the nation, we have made considerable progress in meeting air quality standards. As shown in Figure A-4, many more areas are now attaining standards for ozone, sulfur dioxide, and carbon monoxide than did in 1978. (Lead nonattainment was not reported in 1978, therefore, there is no basis for comparison.)

FIGURE A-4

Less Areas are Violating Air Quality Standards





Darkness at noon: Pittsburgh during the 1940s.

The Dramatic Reduction of Lead in the Air

The dramatic reduction of lead in the air we breathe is one of EPA's most important success stories. Lead has long been used in gasoline to increase octane levels to avoid engine knocking. Lead is a heavy metal that can cause serious physical and mental impairment. Children are particularly vulnerable to effects of high lead levels. Two efforts begun 15 years ago are responsible for a 95-percent reduction in the use of lead in gasoline.

Recognizing the health risks posed by lead, EPA in the early 1970s required the lead content of all gasoline to be reduced over time. The lead content of leaded gasoline was reduced in 1985 from an average of 1.0 gram/gallon to 0.5 gram/gallon, and still further in 1986 to 0.1 grams/gallon.

In addition to phasing down of lead in gasoline, EPA's overall automotive emission control program required the use of unleaded gasoline in many cars beginning in 1975. Currently, about 70 percent of the gas sold is unleaded.

These two efforts, combined with reductions in lead emissions from stationary sources such as battery plants and non-ferrous smelters, have substantially reduced lead levels. This success has been one of the greatest contributions EPA has made to the nation's health.

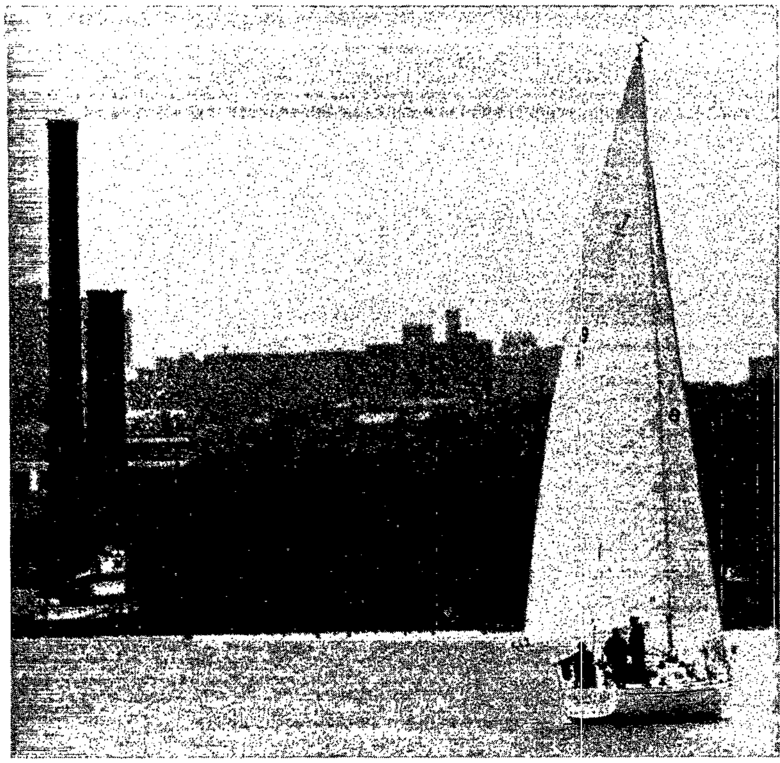
TODAY'S CHALLENGES

Although we have made considerable progress in controlling air pollution from both mobile and stationary sources, much still needs to be done. All of the six criteria pollutants except lead and nitrogen oxides are currently of major concern in a number of areas of the country. In many counties or portions of counties, health-related standards for one or more of the criteria pollutants are not being met. For example, ozone standards are still not being met in over 60 major urban areas, such as Southern California, Texas, the Northeast Corridor, and the Midwest.

We also need to do more work to determine the nature and extent of toxic air pollutants. Since 1984, EPA has developed and implemented a national air toxics program that assists states in monitoring and controlling high-risk local problems. EPA is continuing to develop national standards for air toxics and for sources of these pollutants.

To reduce the risk of exposure to radiation from indoor radon, EPA is working with state and local governments to detect and mitigate unhealthful radon levels. A major thrust of the next decade will be to address growing national and international problems from stratospheric ozone depletion, global warming, and indoor air pollution.

The remainder of this chapter focuses on eight of the most significant air quality challenges: ozone and carbon monoxide, airborne particulates, sulfur dioxide, airborne toxics, acid deposition, indoor air pollution, radon, and global issues.



EPA'S Radiation Efforts

Radioactive materials are widely used in our society, including electricity generation, medical research and treatment, weapons development, industrial applications, and consumer products. They are also by-products of certain mining operations. Large amounts of radioactive wastes have resulted from these activities, creating a potential for exposure of our population to levels of radiation that are well above natural background levels. As the amount of exposure increases, so do the health risks; exposure to increasing levels of radiation increases the risk of cancer and genetic damage.

Under the provisions of a broad range of legislation, EPA is addressing radiation problems in four primary areas: radiation from nuclear accidents, radon emissions, land disposal of radioactive waste, and radiation in ground water and drinking water. The Agency is responsible for setting certain radiation standards and for developing guidance to be implemented by other Federal agencies such as the Department of Energy and the Nuclear Regulatory Commission.

EPA has set standards for radioactive emissions under the Clean Air Act, the Atomic Energy Act, and the Uranium Mill Tailings Radiation Control Act. Under the Clean Air Act, radiation exposure limits have been established for emissions from Department of Energy facilities, Nuclear Regulatory Commission licensees, and elemental phosphorous plants, but under court order, EPA currently is reexamining these emissions standards. We also have prescribed work practices to reduce the emissions of radon from underground uranium mines and have published standards for controlling radon emissions from mill tailings at active and inactive uranium milling sites.

Under our authority to issue guidance, the Agency has proposed exposure limits for nonionizing radio frequency radiation emitted by broadcast and microwave transmitters. EPA has also issued general guidance for occupational exposure to ionizing radiation, including measures to protect the unborn. In addition, EPA has issued guidance to limit the exposure of underground uranium miners to radon decay products and to limit unnecessary exposure of medical patients to medical x-rays.

Nuclear Accident Response

Nuclear accidents vary in magnitude from major events such as Three Mile Island to accidental spills of small amounts of radioactive liquids at medical facilities. EPA plays a major role in any Federal response to nuclear accidents by coordinating and participating in environmental monitoring during and after emergencies. EPA maintains emergency mobile monitoring teams that can be rapidly deployed to an accident site. EPA operated a post-accident monitoring station at Three Mile Island for eight years, and was the focal point for the U.S. response to the 1987 Chernobyl accident in the Soviet Union.

As part of our Chernobyl response, we increased the sampling frequency of the Environmental Radiation Ambient Monitoring System, a nationwide monitoring system that routinely collects and analyzes air, water, and milk samples.

Ozone and Carbon Monoxide

THE PROBLEM

Helping Los Angeles, New York, Houston, Chicago, Boston, Philadelphia, Baltimore, and about 50 other cities across the country meet the health standard for low-level ozone is a critical national goal.

Ozone

Ozone is one of the most intractable and widespread environmental problems. Despite significant efforts including controls on refineries and cars, no major urban area in the country, with the exception of Minneapolis, is in attainment with the national health-based standards for ozone (Figure A-5). The major component of smog, ozone can cause serious respiratory problems such as breathing difficulty, asthma, and reduced resistance to infection.

Chemically, ozone is a form of oxygen with three oxygen atoms instead of the two found in regular oxygen. This makes it very reactive, so that it combines with

Express bus lanes and other improvements to mass transportation help reduce traffic.

practically every material with which it comes in contact. This reactivity causes health problems because it tends to break down biological tissues and cells. In the upper atmosphere, where ozone is needed to protect people from ultraviolet radiation, the ozone is being destroyed by man-made chemicals, such as chlorofluorocarbons (CFCs). But at ground level ozone can be a harmful pollutant.

Ozone is produced in the atmosphere when sunlight triggers chemical reactions between naturally occurring atmospheric gases and pollutants such as volatile organic compounds (VOCs) and nitrogen oxides. VOCs are released into the air through the combustion, handling, and processing of petroleum products. Nitrogen oxides are also produced by combustion sources.

Ozone levels are highest during the day, usually after heavy morning traffic has released large amounts of VOCs and nitrogen oxides. Motor vehicle traffic is growing so fast and is such an essential aspect of life in many places that even strenuous efforts may not sufficiently reduce emissions. In just the four years between 1980 and 1984, Americans increased their driving by almost two billion vehicle miles. Individuals as well as state and local governments must face tough choices if we are to make adequate reductions in ozone.

Carbon Monoxide

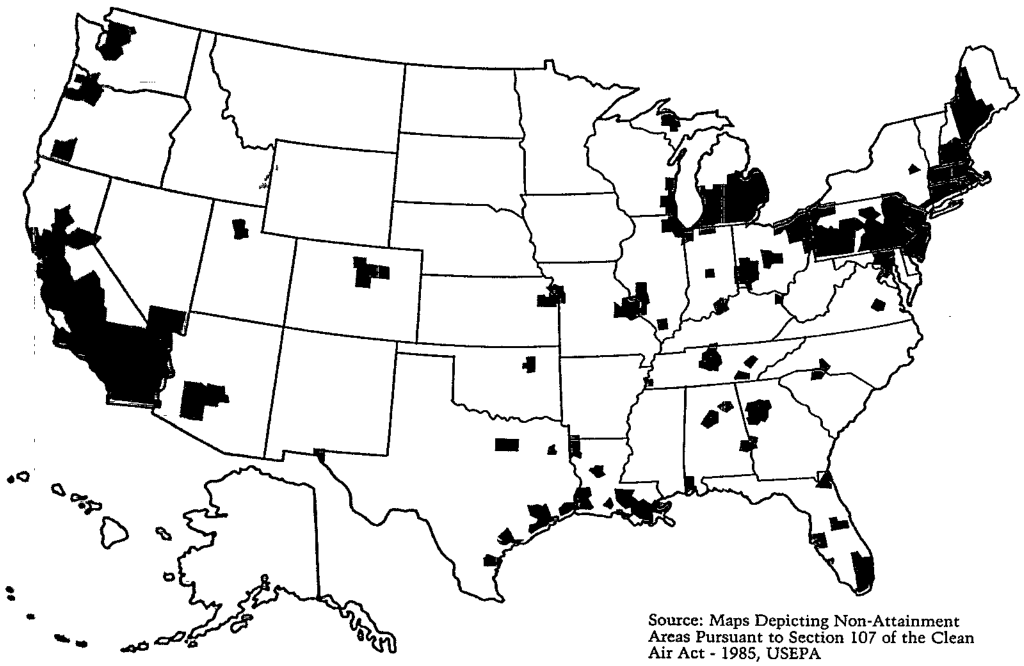
Carbon monoxide is an invisible, odorless product of incomplete fuel combustion. When inhaled, it replaces oxygen in the bloodstream and can impair vision, alertness, and other mental and physical capacities. It has particularly severe health effects for people with heart and lung problems.

The main source of carbon monoxide is motor vehicles, especially when their engines are burning fuel inefficiently as they do when starting up in the morning, idling, or moving slowly in congested traffic. Other sources are wood stoves, incinerators, and industrial processes.

Although carbon monoxide levels have declined in most parts of the country since 1970, the standards are still exceeded in 142 cities and counties throughout the United States (Figure A-6). Many areas have local "hot spots" of carbon monoxide pollution, usually near heavily congested roadways and intersections.

FIGURE A-5

Counties in Total or Partial Non-Attainment for Ozone - 1985



Source: Maps Depicting Non-Attainment Areas Pursuant to Section 107 of the Clean Air Act - 1985, USEPA

EFFORTS TO DATE

Considerable progress has been made in reducing both ozone and carbon monoxide levels over the past several years. National ambient ozone levels fell 13 percent between 1979 and 1986 (Figure A-6). The number of areas where the standard was violated more than once a year dropped from 607 in 1978 to 368 in 1985.

National ambient levels of carbon monoxide fell 32 percent between 1977 and 1986, largely because of automobile emissions controls. Further reductions in most places may depend on effective local "inspection and maintenance" programs to make sure the control equipment is functioning properly. Inspection and maintenance programs are now being operated in 60 urban areas in 32 states.

Despite these gains, ozone and carbon monoxide remain serious problems for millions of Americans. In 1986, 76.4 million Americans were living in metropolitan areas with unhealthy levels of ozone. Los Angeles is the worst, frequently having levels three times the standard. Reducing ozone to acceptable levels will take drastic changes in lifestyles in many areas.

Emissions of VOCs from large stationary sources such as chemical plants, refineries, and industrial processes have been substantially controlled through EPA, state, and local regulatory and enforcement efforts. However, many smaller sources such as paint manufacturers, dry cleaners, and gas stations have not been widely controlled. The Agency is assessing methods to control a number of these small stationary sources. New emission standards for industries producing synthetic organic chemicals, paints and other surface coatings, and pesticides are part of this effort.

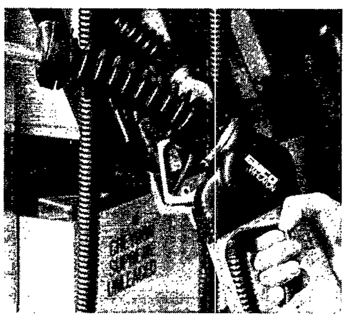
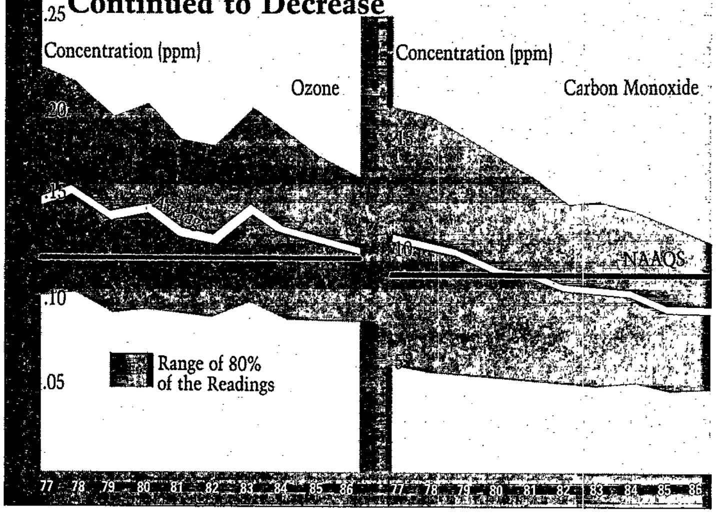
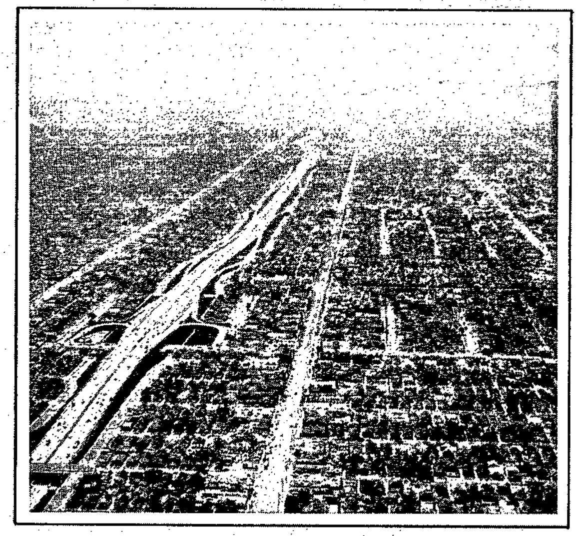


FIGURE A-6

Ozone and Carbon Monoxide Levels Have Continued to Decrease



Source: *National Air Quality and Emissions Trends Report*, 1986, USEPA



Ozone in Los Angeles

With a population of 11.3 million people, the Los Angeles metropolitan area continues to have the nation's most serious ozone problem. The same attributes that lured millions of people to the L.A. area contribute to its ozone problem: constant sunshine, light ocean breezes, and nearby mountains that concentrate and even trap the pollutants that produce ozone. L.A.'s large population, reliance on automobiles, emissions from a large petroleum industry, and numerous small sources of volatile organic compounds (VOCs) (such as dry cleaners and gas stations) make ozone extremely hard to control.

Ozone concentrations in L.A. have declined from 1965 to the present; peak concentrations in all areas of L.A. are well below the historic highs. California has recognized the significant contribution automobiles make to the ozone problem. The auto emission standards are the strictest in the country. Although there also are stringent controls on industrial and small sources, VOC emissions must be reduced by an additional 75 percent or more in order for L.A. to meet the health-related ozone standard.

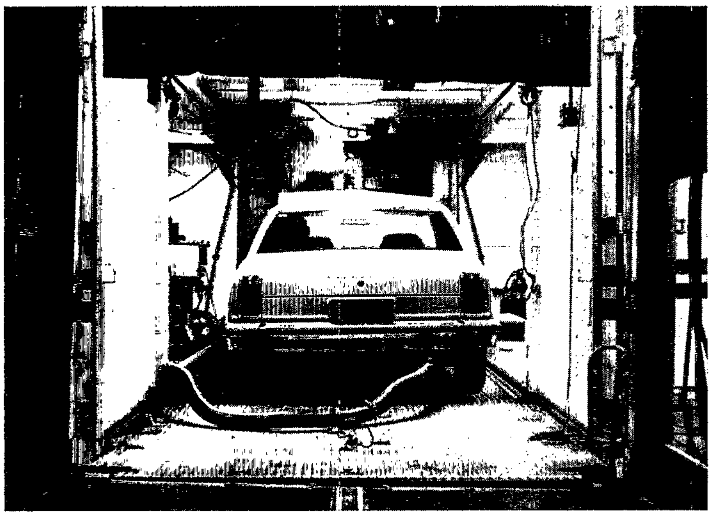
Continued population growth and a heavy reliance on automobiles pose formidable obstacles to meeting the ozone standard. The population in the L.A. area is expected to rise to 15.8 million people by the year 2007. Auto travel and the number of small sources of VOCs also are expected to increase. Anticipated increases in VOC emissions alone over the next 20 years are estimated to represent more than 95 percent of the total allowable emissions in the L.A. area.

For L.A. to meet the ozone standard, there must be a great deal of public support, as well as significant advances in technological developments that will reduce VOC emissions. In December 1987, the L.A. area took a further step and adopted an ambitious mandatory trip reduction regulation. Continued progress in reducing ozone concentrations will require successful implementation of this and other similar programs.

TODAY'S CHALLENGES

While considerable reductions in ozone and carbon monoxide have been achieved nationwide, there are major urban areas where especially intractable ozone and carbon monoxide problems will persist for a considerable period of time. The challenge for EPA and the states is to find responsive, effective, and politically supportive ways to meet ozone and carbon monoxide standards nationwide.

Cars made before 1970 are not subject to national emissions control programs. These cars and others with less stringent emissions control devices manufactured in the early 1970's are not being replaced as rapidly as had been expected. In addition, about 20 percent of the cars on the road have had their pollution control devices disabled. Many vehicle owners incorrectly believed that this tampering would improve the vehicle's performance or fuel economy. These factors make bringing ozone and carbon monoxide levels down, particularly in heavily populated urban areas, a difficult social, economic, and environmental problem. Local authorities must be encouraged to use incentive measures that could improve both the quality of life and the air by altering the transportation mix between cars and public transportation.



Auto exhaust being measured for carbon monoxide level in Fairbanks, Alaska.

Small Stationary Sources of Pollution

Small stationary sources of pollution were not initially regulated by EPA or states. But because reductions achieved by controlling automobile and large stationary source emissions have not sufficiently solved the ozone problem in several areas, further controls will be required on small stationary sources. The costs of controlling these sources, primarily small businesses with slim profit margins, present difficult economic and environmental trade offs.

Ozone Transport

Ozone and its precursors frequently drift across state and national boundaries, creating considerable interstate and international controversy. However, expense and large data requirements for modeling techniques to determine the source of ozone makes these controversies difficult to resolve.

Discarded catalytic converters and mufflers. Removal of catalytic converters greatly increases a car's ozone-causing emissions.

EPA'S AGENDA

Among the criteria air pollutants, ozone and carbon monoxide are still EPA's highest priority. The Agency is focusing its regulatory and enforcement efforts on controlling new and existing sources of VOCs, and is developing emission standards for a variety of new sources, based on the best control technology for VOCs. We have also proposed that cars be required to have equipment to control gasoline vapors while refueling. These "on-board" controls and other gasoline volatility regulations, along with normal vehicle turnover, should reduce nationwide volatile organic compounds emissions by as much as 25 percent over the next decade or so.

We will increase our assistance to state and local governments in promoting the use of alternative fuels. Methanol, ethanol, and compressed natural gas contribute substantially less to ozone and carbon monoxide than conventional gasoline. Methanol is especially attractive because it can be produced from coal, natural gas, and even plants.

EPA will continue to assist the states in understanding and addressing regional ozone problems by developing ozone models for areas such as the northeast corridor. This computer model will simulate atmospheric chemical reactions and dispersion patterns over a very large area.

In addition to our efforts, and those of federal, state, and local governments, individuals can reduce ozone and carbon monoxide pollution by using cars more efficiently, forming carpools and reducing the number of trips. In fact, millions of people will have to live, work, and travel in ways far different from the ways they do today to reduce ozone and carbon monoxide to healthy levels.

Airborne Particulates

THE PROBLEM

Particulates in air, such as dust, smoke, and aerosols may have both short and long-term health and environmental effects. These effects range from irritating the eyes and throat and reducing resistance to infection, to causing chronic respiratory diseases. Fine particulates, about the size of cigarette smoke particles, can cause temporary or permanent damage when they are inhaled deeply and lodged in the lungs (Figure A-7). Some particulates, such as those from diesel engines, are also suspected of causing cancer. Others, such as wind-blown dust, can carry toxic substances such as polychlorinated biphenyls (PCBs) and pesticides. Particulates can also corrode building materials, damage vegetation, and severely reduce visibility.

Major sources of particulates include steel mills, power plants, cotton gins, cement plants, smelters, and diesel engines. Other sources are grain storage elevators, industrial haul roads, construction work, and demolition. Wood-burning stoves and fireplaces also can be significant sources of particulates. Urban areas are likely to have wind-blown dust from roads, parking lots, and construction activity.

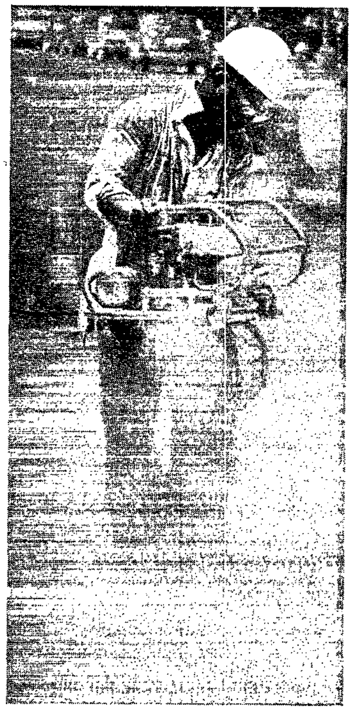
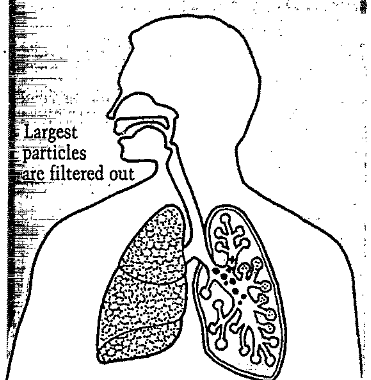


FIGURE A-7
Only Small Particles are Inhaled into Lung Tissue



EFFORTS TO DATE

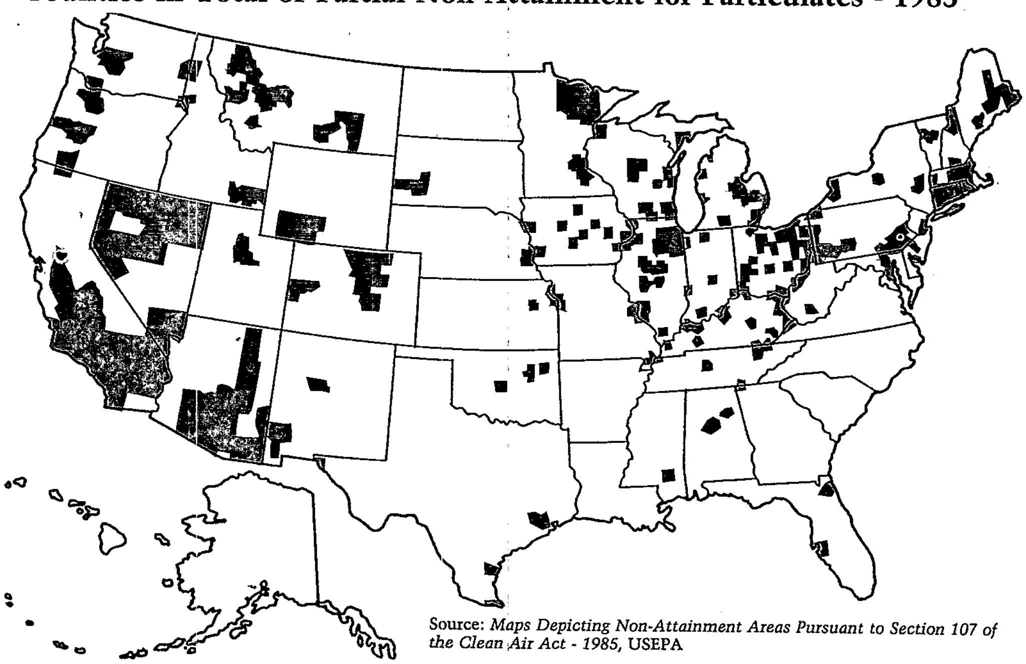
In 1971, EPA issued a National Ambient Air Quality Standard for total suspended particulates covering all kinds and sizes. In July 1987, EPA published new standards based on particulate matter smaller than ten microns in size (PM10) (a micron is approximately 1/25,000th of an inch). These smaller inhalable particulates present the most serious health threat because they tend to become lodged in the lungs and remain in the body for a long time.

Some particulates may be controlled by conventional means; others require more creative approaches. EPA and states have sought to meet the particulates standard by limiting emissions from industrial facilities and other sources. To meet emission limits, industries have installed pollution controls, such as electrically charged plates and huge filters. EPA has also set emissions standards for diesel automobiles. Improved paving, better street cleaning, limits on agricultural and forest-burning practices, and bans on backyard burning in urban areas are also reducing particulate concentrations.

Our data show a 23 percent decrease in ambient particulate levels from 1977 to 1986. In 1982, 345 areas had not achieved particulate standards. By 1985, the number of non-attainment areas had decreased to 290 (Figure A-8). For many of nonattainment areas, particularly in the western states, a major barrier to achieving the current standard is natural wind-blown dust.

EPA has established tailpipe standards for the emissions of particulates from diesel trucks and buses. These standards took effect for diesel vehicles in the 1988 model year and become progressively more stringent in the 1991 and 1994 model years.

FIGURE A-8
Counties in Total or Partial Non-Attainment for Particulates - 1985



Source: *Maps Depicting Non-Attainment Areas Pursuant to Section 107 of the Clean Air Act - 1985*, USEPA

TODAY'S CHALLENGES

Two of the greatest challenges we face include the successful implementation of the new inhalable particulate standard (the PM10 standard) and controlling new sources of particulates.

The PM10 standard will require substantial efforts by EPA, states, and local air pollution control agencies over the next several years. The particulate emission controls that have been used to date have been most effective in reducing emissions of large and intermediate-size particles. While the trend in the emission of small particles is not clearly known, there are doubts that they have been reduced as much as large and intermediate particulates (Figure A-9). Some small particles may be formed in the atmosphere as the result of various chemical and physical processes. High quality data for determining compliance with the PM10 National Ambient Air Quality Standards and identifying potential problem areas are essential to an effective state and local agency air pollution control program. Review procedures, monitoring networks, and emergency episode plans must be established.

Particulates from Field and Forestry Burning in Oregon

In Oregon, as in many other western states, controlled burning by the agricultural and forestry industries is a common practice. Such burning is the largest source of PM10 emissions in the state, exceeding industrial emissions by a factor of seven. Approximately 367,000 acres are burned each year in Oregon, generating about 97,000 tons of PM10. Forestry burning accounts for 84 percent of these emissions; the remainder is from agricultural field burning.

Brush and other unusable wood remaining after clear cutting, called "slash," are burned routinely to reduce fire hazards, permit reforestation, and prevent infestations of insects harmful to trees, such as the bark beetle. Most field burning occurs in the Willamette Valley where approximately half of American grass seed is grown. Fields are burned in the late summer after the seed harvest to control insects and to prepare for replanting. Wheat fields in the Umatilla Plateau region of eastern Oregon also are burned after harvest. The regrowth of grasses and leaves after rangelands are burned control weeds and provide fodder for cattle and sheep. Approximately 10,000 to 15,000 acres of rangelands in eastern Oregon are burned each year.

The potential health effects of smoke and reduction in visibility and odor have been controversial environmental issues in Oregon for many years. Smoke from forest burning, regulated by the U.S. Forest Service and the Oregon Department of Forestry, has been reduced by about 30 percent since the late 1970s. A recently adopted visibility strategy is designed to further reduce it by 22 percent by 1995. The Oregon Department of Environmental Quality has been successful in limiting the effects of field burning on populated areas through its Smoke Management Program.

As in many other parts of the country, environmental and economic values are in conflict. Concerns about public health and welfare must be balanced with the economic importance of burning as a land management practice. Logging and grass seed growing are two of Oregon's key industries. To make further progress in pollution control, Oregon must come to terms with competing economic and environmental values.

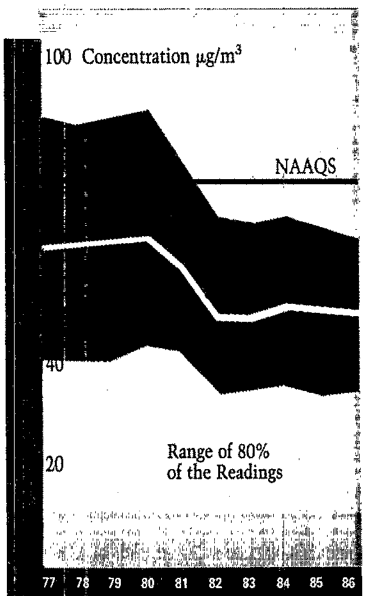
EPA'S AGENDA

Because of the lack of good quality PM10 data, EPA has classified all counties of the nation into three groups based on their probability of not meeting the new standard. For areas of high probability of non-attainment, we will require the states to revise their implementation plans. For areas with moderate probabilities of non-attainment, the states must carefully monitor the air quality. For areas with low probabilities, current control strategies will be presumed adequate. We are also helping states modify existing ambient monitoring sites for these small particulates. We will issue guidelines for states to determine whether an area is attaining the new standard and, if not, how to achieve attainment.

We are assessing the need for a fine particulate secondary standard for PM2.5. The standard is intended to protect visibility principally in the eastern United States and in urban areas.

FIGURE A-9

Particulate Levels Have Continued to Decrease



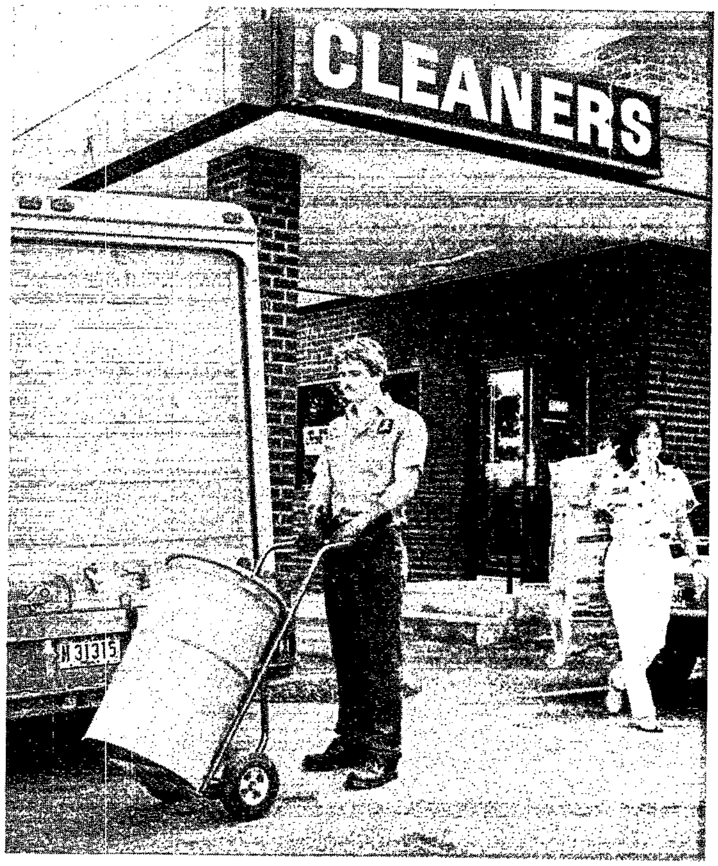
Source: *National Air Quality and Emissions Trends Report*, 1986, USEPA

Airborne Toxics

THE PROBLEM

Toxic pollutants are one of today's most serious emerging problems. Toxic substances are found in all environmental media. Despite their low concentrations, toxic chemicals emitted into the air by human activities may have serious short-term and long-term effects on human health and the environment.

Many sources emit toxic chemicals into the atmosphere: industrial and manufacturing processes, solvent use, sewage treatment plants, hazardous waste handling and disposal sites, municipal waste sites, incinerators, and motor vehicles. Smelters, metal refiners, manufacturing processes, and stationary fuel combustion sources emit such toxic metals as cadmium, lead, arsenic, chromium, mercury, and beryllium. Toxic organics, such as vinyl chloride and benzene, are released by a variety of sources, such as plastics and chemical manufacturing plants, and gas stations. Chlorinated dioxins are emitted by some chemical processes and the high-temperature burning of plastics in incinerators.



Once toxic contaminants are emitted from a smoke stack or tail pipe, people may be exposed to them in a variety of ways. The most common exposure is through inhalation. Indirect exposure may occur after airborne particles fall to earth and are taken up by crops, animals, or fish that we consume. These particles may also contaminate the water we drink. Through these routes, some toxics accumulate over time and become highly concentrated in human fatty tissue and breast milk.

Most information on the direct human health effects of airborne toxics comes from studies of industrial workers. Exposure to airborne toxics in the work place is generally much higher than in the ambient air. We know relatively little about the specific health and environmental effects of most airborne toxics at the low levels at which they are found in ambient air.

EFFORTS TO DATE

EPA has issued National Emission Standards for Hazardous Air Pollutants (NESHAP's) under the Clean Air Act for eight hazardous air pollutants: asbestos, beryllium, mercury, vinyl chloride, benzene, arsenic, radionuclides, and coke oven emissions. We are working on controls for eight other carcinogenic pollutants from 13 source categories. In addition to assessing risk and control options of these and many additional chemicals, the Agency is working with state and local governments to solve air toxics problems. Many state and local air agencies are developing their own programs for toxic pollutants. Some have addressed a large number of pollutants and, with our help, are improving monitoring techniques to measure these pollutants in the environment.

We also work with state or local agencies to investigate specific problems.Some of our cooperative programs with state and local governments include the following:

- The Control Technology Center provides state and local air pollution agencies with technical guidance and support for controlling air toxics. The Center's projects have included an evaluation of potential emission sources at a waferboard manufacturing plant for the state of Colorado, identification of the potential for accidental and routine releases of toluene di-isocyanate for the Allegheny County Health Department in Pennsylvania, and the evaluation of emission factors for formaldehyde from certain wood-processing operations for the state of Virginia.
- EPA's Regional offices have been working with state and local agencies to initiate the process of identifying, investigating, and controlling the general air toxics problem in urban areas. We are also helping state and local agencies develop appropriate regulatory or other control programs.
- In 1987, we began managing an ambient toxics program at sites in 18 cities. Over the next few years, this program will continue to help state and local governments assess the nature and extent of potentially toxic compounds in their ambient air.

Cleaning Up Vinyl Chloride in "Cancer Alley", Louisiana

Approximately one-fifth of the nation's petrochemicals are produced in an 85-mile industrial corridor stretching from Baton Rouge to New Orleans in southeastern Louisiana known as "Cancer Alley." Health statistics show that this area has an unusually high rate of several types of cancers. Many people believe this high incidence of cancer is attributable to air pollution. One of the most prominent chemicals produced and used in the corridor is vinyl chloride, which EPA regulates as a hazardous air pollutant.

Vinyl chloride is a colorless gas used in the manufacture of polyvinyl chloride, which is an ingredient in plastics. Vinyl chloride has been shown to cause liver cancer, and there is evidence linking it to lung cancer, nervous disorders, and other illnesses.

EPA has sued 22 of the approximately 50 plants nationwide whose emissions are regulated by vinyl chloride standards, including 11 plants in Louisiana. The Agency recently settled two cases out of court against a company for emissions from a polyvinyl chloride plant in Geismar, Louisiana.

This settlement may help unravel the possible cause-and-effect relationship between cancers and miscarriages and exposure to vinyl chloride. Among other things, the settlement calls for the company to pay a $1,000,000 penalty to the United States, and an additional $250,000 to the Louisiana State University Foundation for research into the health effects of hazardous air pollutants. The fund could be used for research on the relationship between vinyl chloride exposure and miscarriages in the Geismar-St. Gabriel area of Louisiana. With the research results, EPA and State and local authorities may be able to link vinyl chloride to reproductive effects.

EPA'S AGENDA

One of our highest priorities is to solve the growing national problem of air toxics. EPA will move aggressively under the provisions of the Clean Air Act to assist state and local governments as they develop their own programs.

Specifically, the Agency will continue to promulgate and enforce National Emissions Standards for Hazardous Air Pollutants (NESHAP's) for significant sources of air toxics. We are currently assessing the health effects of some 30 chemicals, including ammonia, chlorine, and formaldehyde. We are also evaluating other chemicals for regulation under NESHAP's; these include chromium, chloroform, carbon tetrachloride, and other suspected carcinogens.

Another high priority is continuing the effort to increase compliance with existing emission standards, especially those for VOCs. Bringing additional sources of these compounds into compliance should reduce both ozone levels and potential air toxics emissions.

The air toxics problem has turned out to be more complex than the framers of the Clean Air Act originally envisioned in 1970. In 1987, we developed a five year plan and strategy for routine releases. Some of the major components of the plan include:

- Establishing federal programs to identify and regulate air toxics from stationary and mobile sources.

TODAY'S CHALLENGES

- Helping states evaluate and decide on the regulation of high-risk point sources that pose significant local risk, but are not sufficiently national in scope for federal regulation.
- Enhancing state and local programs by providing planning, financial, and technical support.
- Enforcing NESHAP's and mobile source regulations.
- Expanding and improving long-term air toxics monitoring programs including those operated primarily by state and local agencies. This work will focus on consistent sampling and measurement techniques for toxic air pollutants to ensure compatibility and ready access to data handling systems that could be used by state and local programs as well.

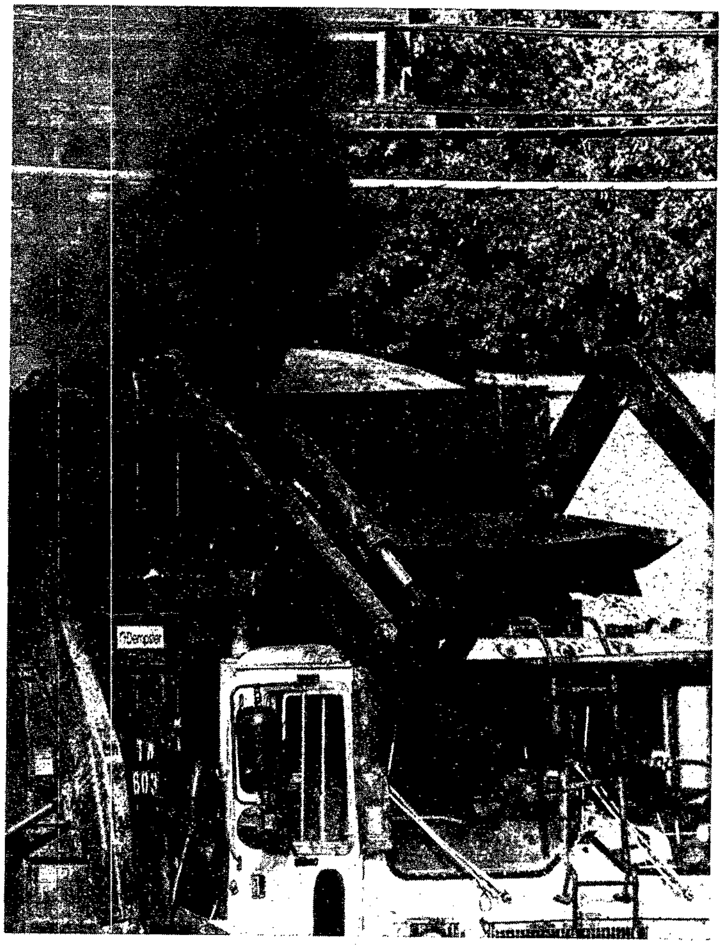
EPA's Air program routinely monitors and regulates emissions of air toxics. Provisions for emergency response to accidental releases are specified under Title III of the Superfund Amendments and Reathorization Act (see the Land Chapter). We are trying to integrate our approach to toxics. We now must coordinate our regulatory efforts and avoid inadvertently shifting problems from one medium to another or from one geographic location to another. An integrated approach is essential to managing cross-media toxic substances problems.

Risk Assessment

With improved scientific techniques, environmental contaminants can be identified at very low concentrations. Conducting a scientific assessment of the risk of these substances and deciding how to manage these risks, however, usually involves very complex and controversial scientific and policy issues. For example, scientists often disagree over the risk assessment for a substance because of the assumptions that must be made to develop the assessment. Additional issues related to airborne toxics include determination of what levels of exposure are acceptable from health and environmental perspectives and the social and economic costs and benefits of the controls necessary for reducing exposure levels.

Meaningful Involvement of the Public

EPA wants to be sure the public is informed about the issues and uncertainties in the risk management process and to involve citizens in evaluating possible options to the greatest extent possible. Because of the highly technical nature of the issues, it is often difficult for citizens to participate without special effort on EPA's part.



More Potential Sources

Economic growth in the chemical industry during the next ten years is expected to out-pace the average of all other industries. This will probably mean more new plants in states where the chemical industry is already concentrated -California, Texas, and New Jersey. Without adequate control of emissions, this growth may increase the range and quantity of toxic substances released to the environment.

Cooperation with State and Local Governments

A major focus of the national air toxics strategy is the multi-source, multi-pollutant urban toxics problem. High residual cancer risks from the cumulative effects of multiple pollutants from many sources may exist in many large, densely populated or industrialized urban areas. Problems and solutions vary from city to city. We are working with state and local agencies to address air toxics problems particularly where there are many sources and the complex mix of pollutants makes assessment of the health effects difficult.

AIR Sulfur Dioxide

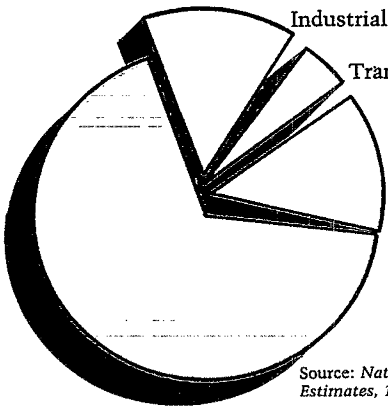
THE PROBLEM

Several areas of the country still exceed ambient standards for sulfur dioxide (Figure A-10). This presents serious health and environmental problems. Excessive levels of sulfur dioxide in the ambient air are associated with significant increases in acute and chronic respiratory diseases. Sulfur dioxide can be transported long distances in the atmosphere because it bonds to particles of dust, smoke, or aerosols. Combining with water vapor in the atmosphere to form sulfuric acid, sulfur dioxide emissions are one of the major contributors to acid rain.

Sulfur dioxide is released into the air primarily through the burning of coal and fuel oils. Up until the 1950s, the burning of coal by railroad locomotives was a major source of sulfur dioxide pollution. Emissions from industrial sources grew sharply between 1940 and 1970, as a result of increased production. But since 1970, industrial emissions have decreased because of controls on nonferrous smelters and sulfuric acid plants. Today, two-thirds of all national sulfur dioxide emissions come from electric power plants, with those that are coal-fired accounting for 95 percent of all power plant emissions (Figure A-11).

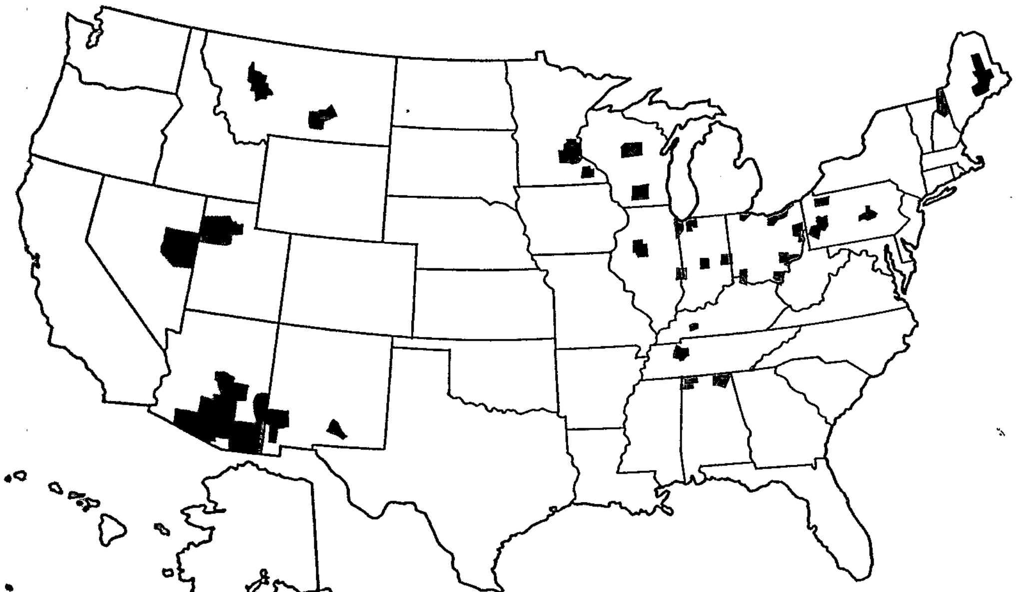
Other sources of sulfur dioxide include refineries, pulp and paper mills, smelters, steel and chemical plants, and energy facilities related to oil shale, synfuels, and oil and gas production. Home furnaces and coal-burning stoves are sources that more directly affect residential neighborhoods.

FIGURE A-11
Utilities Are the Primary Source of Sulfur Dioxide Emissions



Source: *National Air Pollutant Emissions Estimates, 1940 - 1986*, USEPA

FIGURE A-10
Counties in Total or Partial Non-Attainment for Sulfur Dioxide - 1985



Source: *Maps Depicting Non-Attainment Areas Pursuant to Section 107 of the Clean Air Act - 1985*, USEPA

EFFORTS TO DATE

Before EPA's establishment in 1970, some states had recognized the problems resulting from sulfur dioxide and had limited emissions from power plants and factories. One of EPA's first actions was to set National Ambient Air Quality Standards for sulfur dioxide.

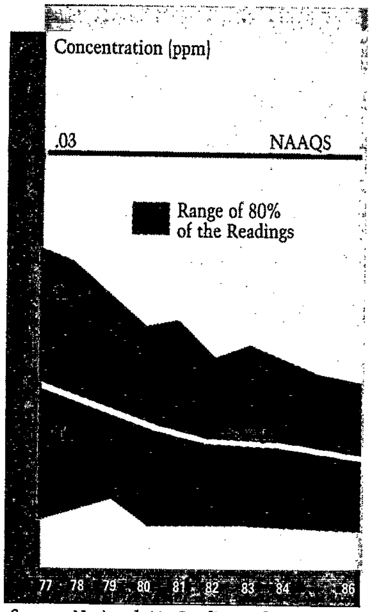
To meet the EPA standards, state environmental authorities developed control plans for the various facilities emitting sulfur dioxide. Many utilities installed equipment to wash excessive sulfur from their emissions. Some of these facilities converted sulfur emissions into commercial products, such as sulfuric acid.

One technique used to attain the ambient standards has proven to be short-sighted. Power plants and factories initially allowed some use of tall stacks as an alternative to further reducing emissions. These stacks dispersed the gas and effectively reduced the local impact of sulfur dioxide emissions. However, sulfur dioxide emitted from tall stacks can be carried hundreds of miles in the atmosphere. As a result, sulfur dioxide emissions in the upper Midwest today are contributing to acid rain in New England.

Efforts to control sulfur dioxide on the national level have been reasonably successful. Ambient levels decreased by 37 percent between 1977 and 1986, with a 2 percent reduction between 1985 and 1986 (Figure A-12). An even greater improvement was observed in the number of violations of the ambient standard, which dropped by 98 percent during the same period. Emissions, however, have decreased only 21 percent. Controls on existing plants in urban areas and construction of new power plants in rural areas accounts for the difference between emissions and ambient levels.

The decline in sulfur dioxide emissions is largely the result of the use of fuels with lower average sulfur content, the introduction of scrubbers to remove sulfur oxides from flue gases, and controls on industrial processes. The decrease in sulfur dioxide levels in residential and commercial areas are due to a combination of energy conservation measures and the use of cleaner fuels.

FIGURE A-12
Sulfur Dioxide Levels Have Continued to Decrease



Source: *National Air Quality and Emissions Trends Report*, 1986, USEPA

TODAY'S CHALLENGES

Today's major challenge is to reduce sulfur dioxide emissions from coal-fired power plants while continuing to lower emissions from other major sources. Recent new advances in scrubber technology are expected to play an important role in lowering emissions from power plants.

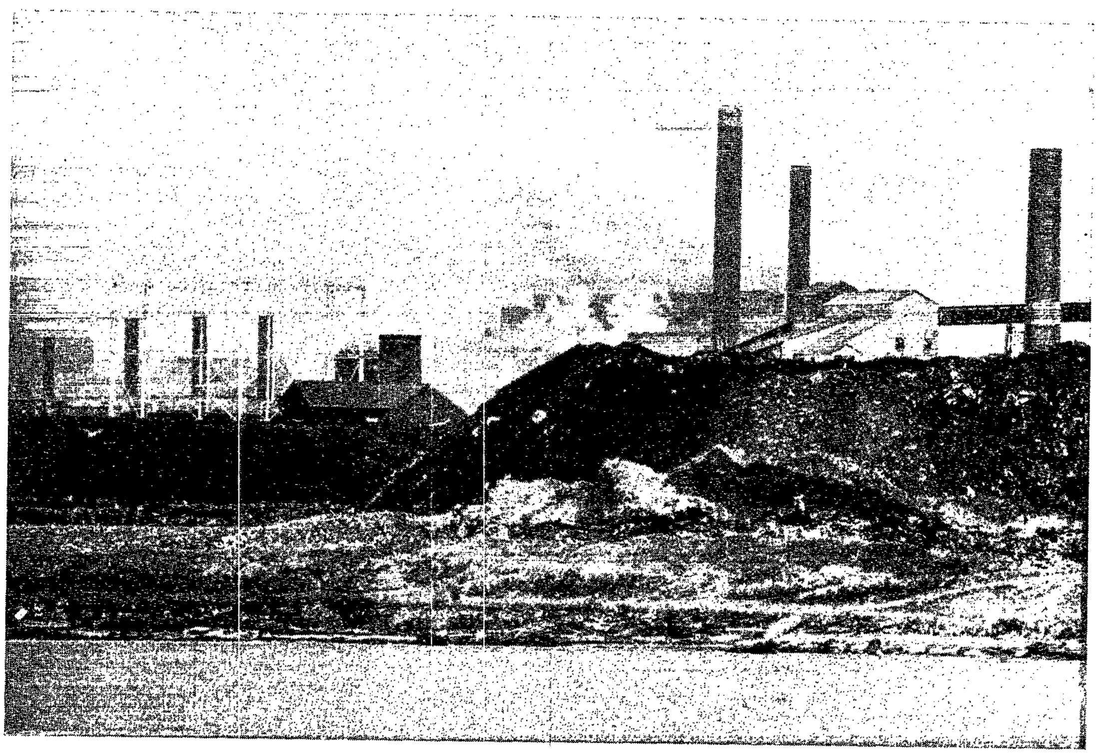
The sulfur content of coal varies greatly according to where it is mined. The technical, political, and economic ramifications of this variance have complicated the task of setting sulfur dioxide limits for facilities burning coal. The geographical distribution of high-and-low sulfur coal, the economic impact on the mining and utilities industries from restrictions on high-sulfur coal, the variability of the sulfur content within coal, and questions about the contribution of sulfur dioxide to acid rain have all caused considerable debate.

EPA'S AGENDA

EPA and the states will continue to develop compliance programs to maintain the air quality gains made so far and to enforce limits on sources in the areas violating the national standards. We will also work with the states to improve the quality and usefulness of monitoring data for managing future efforts to control sulfur dioxide.

Compliance and enforcement efforts will be focused particularly on implementing the sulfur dioxide Continuous Compliance Strategy scheduled to be issued in 1988. We will be developing guidelines on the broader and more efficient use of self-monitoring data, especially for new sources.

Revisions to the sulfur dioxide standards may require further tightening of current emission limits on existing sources, changing implementation plans in some states, and revising certain new source permits.



AIR Acid Deposition

THE PROBLEM

Acid deposition is a serious environmental concern in many parts of the country. The process of acid deposition begins with emissions of sulfur dioxide (primarily from coal-burning power plants) and nitrogen oxides (primarily from motor vehicles and coal-burning power plants). These pollutants interact with sunlight and water vapor in the upper atmosphere to form acidic compounds. During a storm, these compounds fall to earth as acid rain or snow; the compounds also may join dust or other dry airborne particles and fall as "dry deposition."

Over 80 percent of sulfur dioxide emissions in the United States originate in the 31 states east of or bordering the Mississippi River. Most emissions come from the states in or adjacent to the Ohio River Valley (figure A-13). Prevailing winds transport emissions hundreds of miles to the northeast, across state and national borders. Acid rain is now recognized as a serious long-term air pollution problem for many industrialized nations.

The extent of damage caused by acid rain depends on the total acidity deposited in a particular area and the sensitivity of the area receiving it. Areas with acid-neutralizing compounds in the soil, for example, can experience years of acid deposition without problems. Such soils are common in much of the United States. But the thin soils of the mountainous and glaciated northeast have very little acid-buffering capacity, making them vulnerable to damage from acid rain. Surface waters, soils, and bedrock that have a relatively low buffering capacity are unable to neutralize the acid effectively. Under such conditions, the deposition may increase the acidity of water, reducing much or all of its ability to sustain aquatic life. Forests and agriculture may be vulnerable because acid deposition can leach nutrients from the ground, kill nitrogen-fixing microorganisms that nourish plants, and release toxic metals.

EFFORTS TO DATE

Before the 1970 Clean Air Act, U.S. sulfur dioxide and nitrogen oxide emissions were increasing dramatically (Figure A-14). Between 1940 and 1970, annual sulfur dioxide emissions had increased by more than 55 percent and nitrogen oxide emissions had almost tripled.

The Clean Air Act helped to curb the growth of these emissions. By 1986, annual sulfur dioxide emissions had declined by 21 percent, and nitrogen oxide emissions had increased only 7 percent. These reductions in historical growth rates took place despite the fact that the U.S. economy and the combustion of fossil fuels grew substantially over the same period.

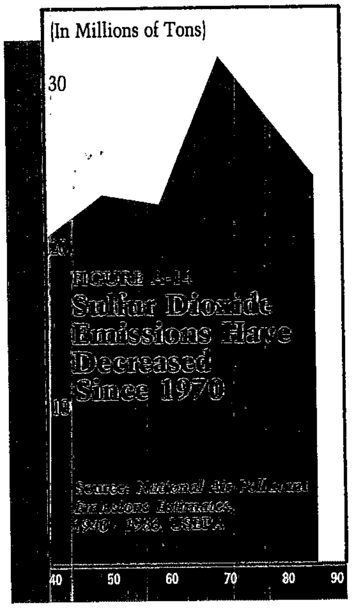
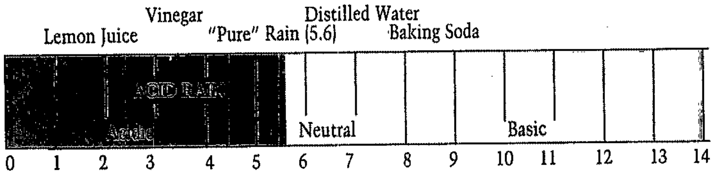


FIGURE A-14
Sulfur Dioxide Emissions Have Decreased Since 1970

Source: National Air Pollutant Emission Estimates, 1940 - 1986, USEPA

How "Acid" is Acid Rain?

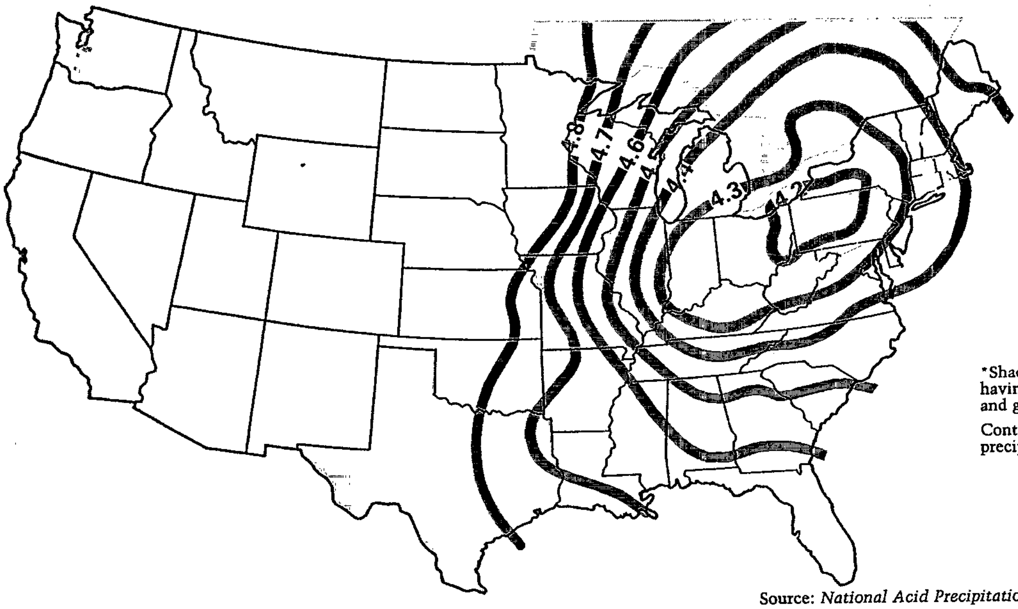


The pH scale ranges from 0 to 14. A value of 7.0 is neutral. Readings below 7.0 are acidic; readings above 7.0 are alkaline. The more pH decreases below 7.0, the more acidity increases.

Because the pH scale is logarithmic, there is a tenfold difference between one number and the one next to it. Therefore, a drop in pH from 6.0 to 5.0 represents a tenfold increase in acidity, while a drop from 6.0 to 4.0 represents a hunderedfold increase.

All rain is slightly acidic. Only rain with a pH below 5.6 is considered "acid rain."

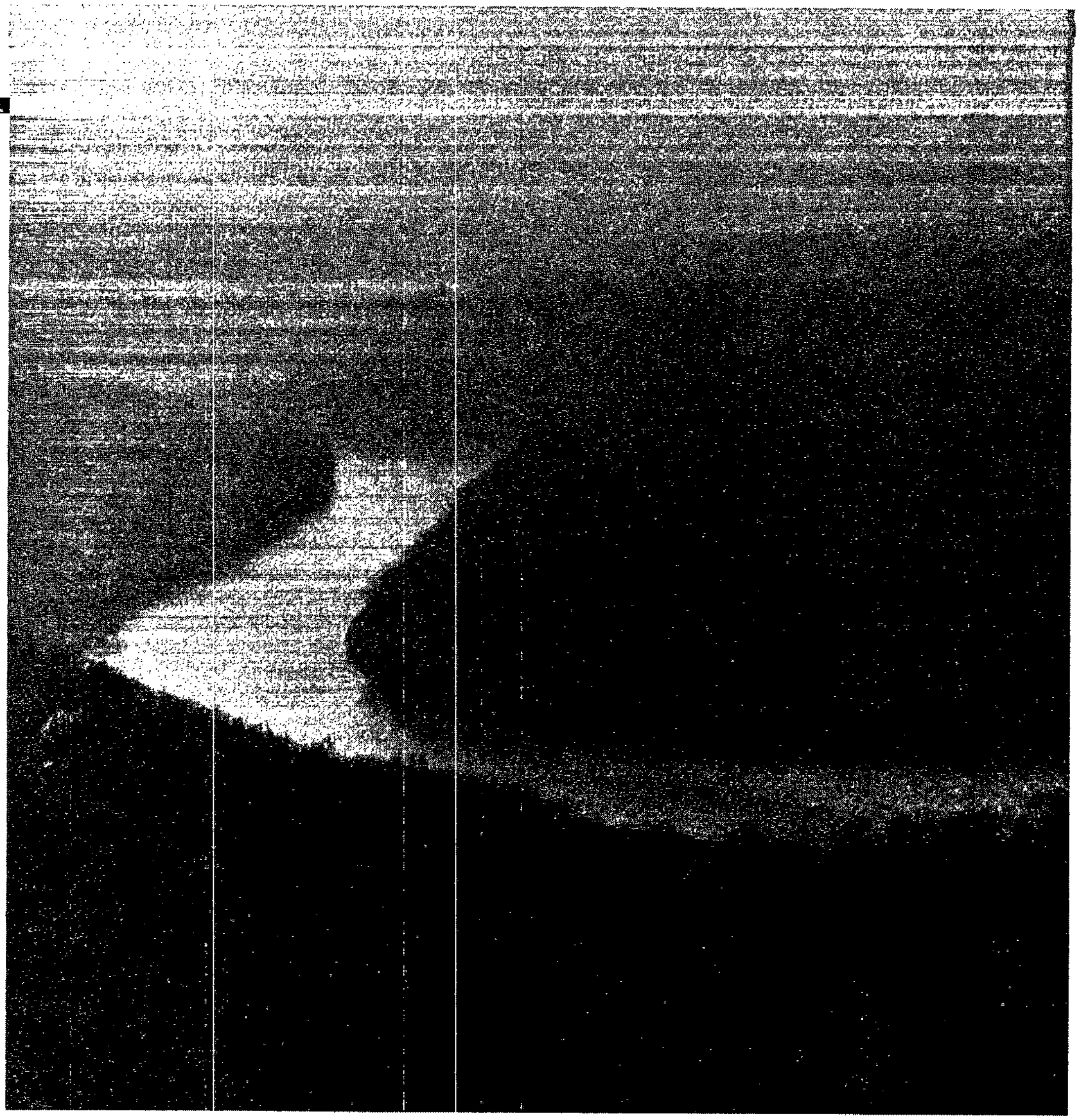
FIGURE A-13
Areas Where Precipitation in the East is below pH 5



*Shaded areas indicate individual states having emissions of 1,000 kilotonnes of SO_2 and greater.

Contours connect points of equal precipitation pH.

Source: *National Acid Precipitation Assessment Program Interim Report*, 1987, USEPA



NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM

In addition to enforcement and monitoring under the provisions of the Clean Air Act, the Agency is actively pursuing a major research effort with other federal agencies under the National Acid Precipitation Assessment Program (NAPAP). This on-going research project is designed to resolve the critical uncertainties surrounding the causes and effects of acid rain. About $300 million have been spent for federal research since NAPAP was initiated in 1980. In September 1987, NAPAP published an interim assessment on the causes and effects of acid deposition.

Aquatic Effects

One of the most important acid rain research projects being conducted by EPA is the National Surface Water Survey. This survey is designed to provide data on the present and future status of lakes and streams within regions of the United States believed to be susceptible to change as a result of acid deposition. Phase I of the Eastern and Western Lakes Surveys showed that there are essentially no lakes or reservoirs in the mountainous West, northeastern Minnesota, and the Southern Blue Ridge of the Southeast that are considered acidic. The four subregions with the highest percentages of acidic lakes are: the Adirondacks of New York, where 10 percent of the lakes were found to be acidic; the Upper Peninsula of Michigan, where 10 percent of the lakes were also found to be acidic; the Okefenokee Swamp in Florida, which is naturally acidic; and, the lakes in the Florida Panhandle where the cause of acidity is unknown.

The 1988 Stream Survey determined that approximately 2.7 percent of the total stream reaches sampled in the mid-Atlantic and Southeast are acidic. About 10 percent of head waters in the forested ridges of Pennsylvania, Virginia, and West Virginia were found to be acidic. Streams in Florida found to have a low pH are naturally acidic. The study indicated that Atmospheric deposition is the major cause of sulfates in streams. Atmospheric deposition was also found to be a major cause of sulfates in the lakes surveyed as part of the National Surface Water Survey.

Forest Effects

The NAPAP interim assessment reviewed research concerning the effects of acid deposition on forests. It focused on the effects of precursor pollutants (sulfur dioxide and nitrogen oxides) and Volatile Organic Compounds and their oxidants (including ozone and hydrogen peroxides) on eastern spruce-fir, southern pine, eastern hardwood, and western conifer. The assessment found that air pollution is a factor in the decline of both managed and natural forests. The San Bernardino National Forest in California and some types of white pine throughout the eastern United States are seriously affected by ozone.

Forests found to have unknown causes of damage included northeastern spruce-fir, northeastern sugar maple, southeastern yellow pine, and species in the New Jersey Pine Barrens. The high elevation forests such as the spruce fir in the eastern United States were found to be exposed to severe natural stresses as well as being frequently immersed in clouds containing pollutants at higher concentrations than those observed in rain. Research has shown no direct impacts to seedlings by acidic precipitation or gaseous sulfur dioxide and nitrogen oxides at ambient levels in the United States. Ozone is the leading suspected pollutant that may stress regional forests and reduce growth. Research is underway to resolve the relative importance of physical and natural stresses.

Crop Effects

The NAPAP assessment indicated that there are no measurable consistent effects on crop yield from the direct effects of simulated acidic rain at ambient levels of acidity. This finding was based on yield measurements of grains, forage, vegetable, and fruit crops exposed to a range of simulated rain acidity levels in controlled exposure studies. Continuing research efforts will examine whether stress agents such as drought or insect pests cause crops to be more sensitive to rainfall acidity.

Average ambient concentrations of sulfur dioxide and nitrogen oxides over most agricultural areas in the United States are not high enough or elevated frequently enough to affect crop production on a regional scale. However, crops may be affected locally in areas close to emission sources. Controlled studies also indicate that ambient levels of ozone in the United States are sufficient to reduce the yield of many crops.

Materials Effects

The NAPAP Interim Report indicated that many uncertainties need to be reduced before a reliable economic assessment could be made of the effects of acid deposition on materials, such as building materials, statues, monuments, and car paint. Major areas of uncertainty include inventories of materials at risk, variability of urban air quality, effects on structures, and cost estimates for repair and replacement.

Human Health Effects

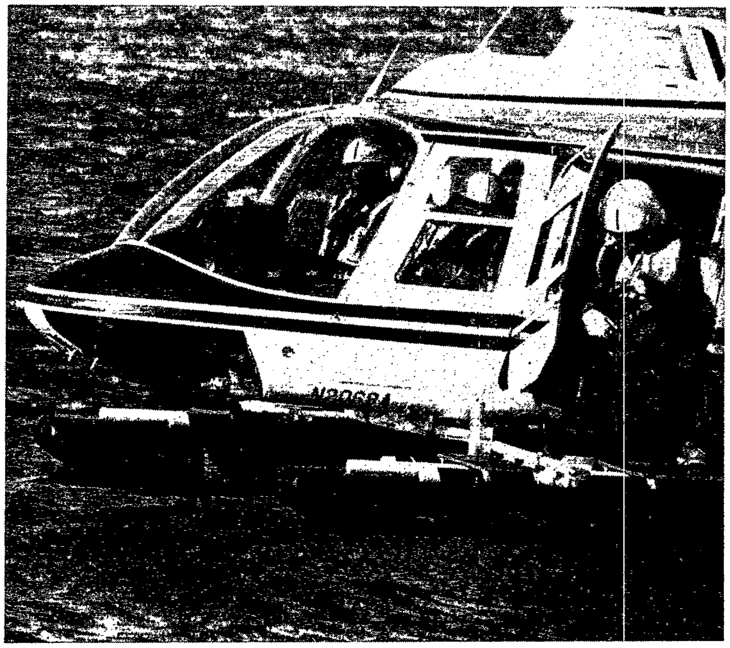
The NAPAP interim assessment reported that there are also many uncertainties associated with assessing the influence of ambient levels of atmospheric pollutants on human health. The primary factors involved are a lack of information on the levels of exposure to acidic aerosols for various population groups across North America; chronic health problems caused by short-term changes in respiratory symptoms and decrease in lung function; and the effects of repetitive or long-term exposures to air pollutants. Studies on toxicity of drinking water have linked rain acidity to unhealthy levels of toxic metals in drinking water and fish.

INTERNATIONAL AND STATE COOPERATION

On the international level, the United States has been working with Canada to solve transboundary air pollution problems. In 1986, the Canadian and U.S. Special Envoys on acid rain proposed a plan to begin a government/industry program to demonstrate innovative pollution control technology, and conduct ongoing bilateral consultations and cooperative research projects. We are working with other federal agencies to implement the recommendations of the Special Envoys' Report on Acid Rain, including a $5 billion government/industry clean coal technology program and a demonstration program of an expanded menu of commercial retrofit control technologies. We are also sponsoring joint meetings and field observations by European and American scientists to develop and test hypotheses to explain the mechanisms of forest damage.

EPA also is working with the states as part of the congressionally funded State Acid Rain Program (STAR) to identify and resolve potential implementation issues that may arise should an acid rain control program be established.

Our greatest challenge is to continue to reduce emissions of sulfur dioxide and nitrogen oxides. We must also continue research to reduce the level of scientific and economic uncertainties about acid deposition and work to resolve the regional and international conflicts related to this problem. In addition to EPA's research efforts, major federal research programs are being funded by the Department of Energy, the Tennessee Valley Authority, and the Argonne, Brookhaven, Lawrence Berkley, and Oak Ridge national laboratories.



EPA'S AGENDA

EPA, in coordination with other federal agencies, is continuing wide-ranging research on the causes and effects of acid deposition. Our major research efforts include effects on aquatic and forest ecosystems, building materials and human health. In the area of human health, in particular, EPA is conducting exposure studies on acid aerosols.

EPA is conducting ongoing aquatics research projects that will continue over the next two or three years. As part of the National Surface Water Survey, seasonal variability of lakes in the Northeast will be studied.

The Direct/Delayed Response Project will evaluate the rate and magnitude of future acidification with initial results expected in 1989. In 1990, the Episodic Response Project is expected to provide damage estimates for particular acid deposition events. When combined with projected emissions trends, the results of these studies will provide estimates of the current extent of surface water acidification together with expected rates of future acidification on a region-by-region basis for the eastern United States.

Also, EPA is working with the U.S. Forest Service to carry out the Forest Response Program. Under the program, research is conducted regionally on eastern spruce-fir, southern commercial forests, eastern hardwood, and western conifer. A report on the extent and severity of forest damage is expected by the end of 1988. Other studies concern the roles of sulfur and nitrogen compounds in forest damage. Estimates are expected by 1990. Data from these research projects will also be used to develop predictive models of forest health, growth, and general conditions. Quantitative estimates of current forest response to sulfur and nitrogen compounds will also be developed.

EPA will continue research to determine the effects of acid deposition on various types of building materials. Inventories of galvanized steel and painted surfaces, expected to be completed by 1990, will be used to determine the extent that building materials are at risk. Damage studies for galvanized steel are expected to be completed in 1988, and for carbonate stone in the next two to three years. Surveys are planned that will be used to determine the benefits of reducing the rate of acidic damage to building materials.

We will continue to work with the states through the State Acid Rain Program and with other federal agencies to implement the recommendations of the Canadian and U.S. Special Envoys. At the same time, EPA is enforcing provisions of the Clean Air Act to reduce the principal precursors of acid rain — sulfur dioxide and nitrogen oxides. We will also work with the Canada and United States Bilateral Committee to resolve the transboundary acid rain problem.

Over the next two years, major research results are anticipated for improving the basis of decisionmaking on acid rain issues. EPA also expects that Congress and other groups will continue to propose options to reduce acid deposition. As proposals are offered, we will provide analyses of costs, consequences, and the feasibility of implementation.

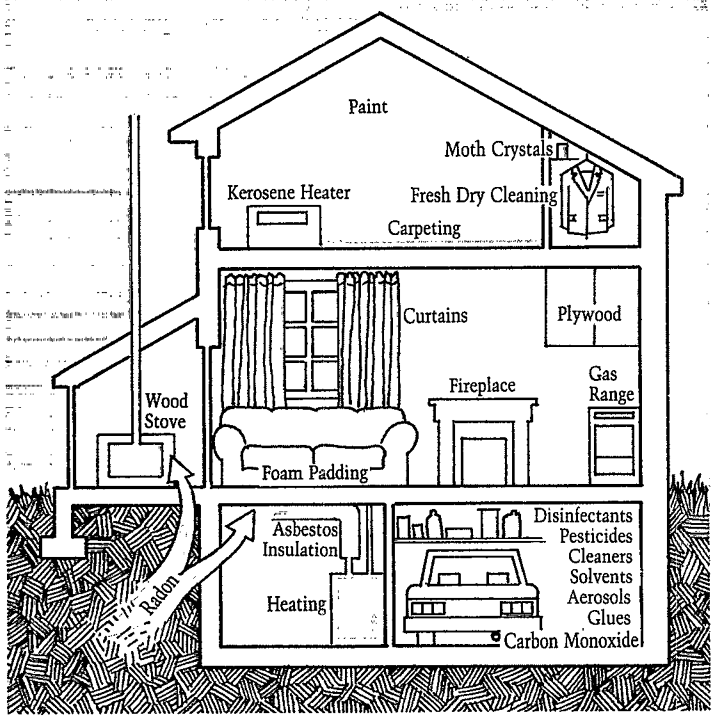
Indoor Air Pollution

THE PROBLEM

Indoor air pollution is rapidly becoming a major health issue in the United States. Indoor pollutant levels are frequently higher than outdoors, particularly where buildings are tightly constructed to save energy. Since most people spend 90 percent of their time indoors, many may be exposed to unhealthy concentrations of pollutants. People most susceptible to the risks of pollution — the aged, the ill, and the very young — spend nearly all of their time indoors. As many as 30 percent of new and remodelled buildings may have indoor air quality problems.

The degree of risk associated with exposure to indoor pollutants depends on how well buildings are ventilated and the type, mixture, and amount of pollutants in the building. Improperly designed and operated ventilation systems can cause "sick building syndrome", with complaints of eye, nose, and throat irritations, fatigue, lethargy, headaches, nausea, irritability, or forgetfulness. Long-term health effects range from impairment of the nervous system to cancer. Harmful indoor pollutants include airborne pathogens, such as viruses, bacteria, and fungi, as well as radioactive gases like radon; inorganic compounds like mercury and lead; and an array of organic compounds such as formaldehyde chloroform, and perchlorethylene. These pollutants may come from sources such as tobacco smoke, building materials, furnishings, space heaters, gas ranges, wood preservatives, consumer goods such as "air fresheners," and solvents in cleaning agents (Figure A-15). Indoor air pollutants of special concern are described below.

FIGURE A-15
Air Pollution in the Home



Radon

Radon is a naturally occurring gas resulting from the radioactive decay of radium, which is found in many types of rocks and soils. Radon enters buildings through cracks in the foundation. When inhaled, radon can adhere to particles and then lodge deep in the lungs, increasing the risk of cancer. Radon may be found in building materials such as concrete or stone. Radon can also be emitted from drinking water drawn from wells. EPA estimates that radon may be responsible for 5,000 to 20,000 lung cancer deaths per year. The National Academy of Sciences recently issued a report that supports this estimate. Radon is a particular risk for smokers, who have a health risk of cancer ten times greater than non-smokers. (The radon problem is discussed in the next section.)

Environmental Tobacco Smoke

Environmental tobacco smoke (smoke that non-smokers are exposed to from smokers) has been judged by the Surgeon General, the National Research Council, and the International Agency for Research on Cancer to pose a risk of lung cancer to non-smokers. Tobacco smoke contains a number of pollutants, including inorganic gases, heavy metals, particulates, VOCs, and products of incomplete burning, such as polynuclear aromatic hydrocarbons. Published risk estimates of lung cancer deaths among non-smokers exposed to environmental tobacco smoke range from 500 to 5,000 per year. Environmental tobacco smoke can also cause other diseases including other cancers and heart disease in healthy non-smokers.

Asbestos

Asbestos fibers have been shown to cause lung cancer and other respiratory diseases. Asbestos has been used in the past in a variety of building materials, including many types of insulation, fireproofing, wallboard, ceiling tiles, and floor tiles. The remodeling or demolition of buildings with asbestos-containing materials frees tiny asbestos fibers in clumps or clouds of dust. Even with normal aging, materials may deteriorate and release asbestos fibers. Once released, these asbestos fibers can be inhaled into the lungs and can accumulate.

Formaldehyde And Other Volatile Organic Compounds

EPA has found formaldehyde to be a probable human carcinogen. Formaldehyde is responsible for a variety of acute health problems, such as eye and nose irritation and respiratory ailments. People with lung diseases or impaired immune systems, children, and the elderly may be particularly affected by this pollutant. The use of formaldehyde in furniture, foam insulation, and pressed wood products, such as some plywood, particle board, and fiberboard, makes

formaldehyde a major indoor air pollutant.

Other VOCs commonly found indoors include benzene from tobacco smoke and perchlorethylene emitted by dry cleaned clothes. Paints and stored chemicals, including certain cleaning compounds, are also major sources of VOCs. VOCs can also be emitted from drinking water. Twenty percent of water supply systems have detectable amounts of VOCs, although only one percent of supply systems are thought to exceed 1986 Safe Drinking Water Act standards for VOCs.

Biological Pollutants

Heating, ventilation, air condition systems, and humidifiers can be breeding grounds for biological contaminants when they are not properly cleaned and maintained. They can also bring biological contaminants indoors and circulate them, resulting in such health problems as allergic reactions to pollen, fungi, and animal dander; bacterial and viral infections; and reactions to chemical toxins released by fungi.

Pesticides

Indoor and outdoor use of pesticides, including termiticides and wood preservatives are another cause of concern. Even when used as directed, pesticides may release VOCs. EPA researchers are investigating whether indoor use of insecticides and subsurface soil injection of termiticides can lead to hazardous exposure. (See the "Pesticides Section" of the Toxics Chapter.)

EFFORTS TO DATE

Over the past several years, EPA has addressed the indoor air pollution problem under a variety of environmental laws, including the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act, the Safe Drinking Water Act, the Resource Conversation and Recovery Act, the Asbestos in Schools Hazard Abatement Act of 1986 and the Uranium Mill Tailings Radiation Control Act. Congress gave EPA more specific direction to establish an indoor air quality program, however, in the 1986 Superfund Amendments and Reauthorization Act.

Research, Technical Assistance, and Public Information

Since 1982, EPA has conducted a research program on indoor air quality problems. This research has been directed toward increasing the understanding of personal exposure, emissions, health effects, and mitigation techniques. As part of the Superfund Amendments and Reauthorization Act, Congress passed the Radon Gas and Indoor Air Quality Act of 1986, which directed EPA to conduct research, implement a public information and technical assistance program, and coordinate Federal activities on indoor air quality.

Pioneering work has been done to develop monitoring equipment that measures an individual's "total exposure" to pollutants in the air both outdoors and indoors and in drinking water. EPA operates test chambers and a test house to determine the composition and rate of pollutant emissions from selected building materials and consumer produces. These facilities are also used to evaluate the effectiveness of mitigation and prevention techniques. The Agency is also conducting research on the health effects of some important indoor air pollutants and pollutant mixtures.

Several other programs within EPA have conducted information and public awareness activities related to indoor air quality for several years. For example, EPA has a radon program which is designed to identify the health risks of radon, demonstrate effective mitigation techniques, and give state and local governments information on how to implement these techniques in new and existing buildings. Several programs have issued booklets and other materials for the general public on such topics as radon, asbestos, termiticides, and wood preservatives. Hotlines on toxic substances and pesticides maintained by EPA offer another means for answering indoor air-related questions from the public.

Regulatory Actions

EPA has taken regulatory action on asbestos, volatile organic compounds (VOCs) in drinking water, and certain pesticides. We require schools to inspect for asbestos, to prepare management plans, and to take action when they find friable (easily crumbled) asbestos. In addition we have proposed a ten-year phase-out of the manufacturing and importing of asbestos products.

EPA issued Maximum Contaminant Levels for eight VOCs in water supplies serving more than 25 persons. Plans are to issue 75 more drinking water standards for a wide variety of chemicals having national significance. These actions should reduce the levels of these compounds in indoor air.

We have acted to control indoor exposures to a number of pesticides. For example, we have stopped use of the pesticide lindane as a domestic fumigant and have required child-proof packaging for certain other indoor applications. The Agency prohibited indoor applications of the wood preservatives penta-chlorophenol and creosote, cancelled use of pentachlorophenol in log homes, and required sealers on previously treated wood used indoors. Recent evidence showed that even with proper application, the termiticides known as chlordane, heptachlor, dieldrin, and aldrin persist in the air of homes long after treatment. In response, EPA arrived at an agreement with the major manufacturer of chlordane and heptachlor for a voluntary cancellation of further sales of this product pending demonstration of safe application methods. Finally, we have suspended the sale of the termiticides aldrin and dieldrin; they are no longer being produced.

TODAY'S CHALLENGES

EPA's 1987 comparative risk study places indoor air pollution among the top environmental problems facing the nation. More research is needed to identify and rank the health risks from exposure to individual pollutants or mixtures of pollutants. We also need effective, easily operated, commercially available devices to monitor personal exposure to indoor air pollution.

Methods for diagnosing and correcting the causes of building-related illnesses need to be improved. A variety of control measures need to be identified and analyzed, including product substitution or modification, and changes in building design and ventilation.

The Agency also needs to determine the most effective combination of public information, technical assistance, voluntary guidelines, and regulatory standards to manage known risks.

EPA'S AGENDA

The Agency is preparing a report to Congress that will make recommendations for long-term research needs. We have identified several sources and pollutants for further research including: environmental tobacco smoke; combustion appliances; building materials, furnishings, and consumer goods; biological contaminants; radon; pesticides; and nonionizing radiation from electric and magnetic fields. We also will be developing techniques to diagnose, mitigate, and prevent indoor air-related building problems. We will be producing several public information documents, including consumer booklets and technical manuals on building-related illnesses and environmental tobacco smoke.

In addition, EPA heads the Interagency Committee on Indoor Air Quality which coordinates Federal indoor air programs. With the Committee, EPA periodically issues the publication *Current Federal Indoor Air Quality Activities*. EPA will also lead or participate in other interagency efforts that address the problem of indoor air pollution. For example, EPA is leading an interagency review of certain chlorinated solvents to assess the potential risks to consumers and workers.

Radon

THE PROBLEM

Radon is a unique environmental problem because it occurs naturally. Radon results from the radioactive decay of radium-226, found in many types of rocks and soils. Most indoor radon comes from the rock and soil around a building and enters structures through cracks or openings in the foundation or basement. Secondary sources of indoor radon are well water and building materials.

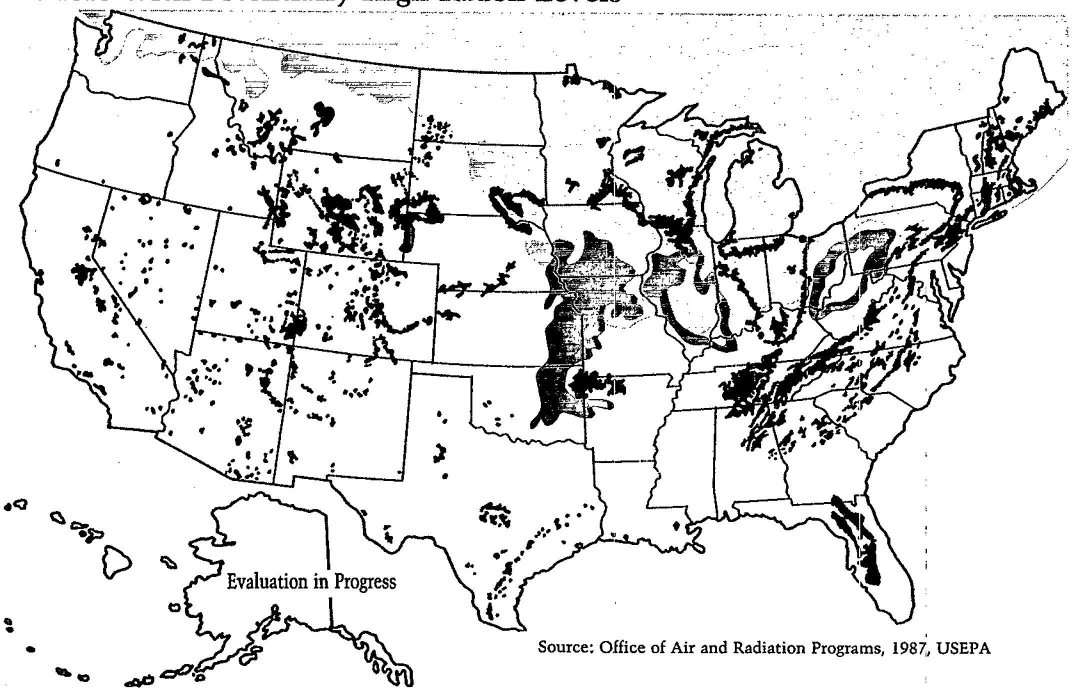
When inhaled, radon particles release ionizing radiation that can damage sensitive lung tissue and lead to lung cancer. EPA estimates that radon may be responsible for 5,000 to 20,000 lung cancer deaths each year. Radon may be the leading cause of lung cancer among nonsmokers. EPA believes that up to eight million homes may have radon levels exceeding four picocuries per liter of air, the level at which EPA recommends corrective action.

Levels of radon can vary greatly, even within the same community. The variation depends on a number of factors, including the concentration of radon in the soil, how individual buildings are constructed, and how well they are ventilated.

Exposure to elevated indoor concentrations of radon gas was first recognized as a potential problem in the 1960s when houses in Colorado were found to have been built with materials contaminated by uranium mill tailings. In the 1970s EPA discovered that some houses built on reclaimed phosphate lands in Florida also had elevated radon levels.

The discovery in 1984 that a nuclear power plant construction engineer had been contaminated by extremely high levels of naturally occurring indoor radon in his Pennsylvania home led to recognition of a broader problem at the state and national levels. His house was located on a geologic formation that runs through Pennsylvania, New Jersey, and New York known as the Reading Prong. Measurements have confirmed that high levels of indoor radon also exist in a number of other geologic regions in many states.

FIGURE A-16
Areas With Potentially High Radon Levels



Source: Office of Air and Radiation Programs, 1987, USEPA

Shaded regions are areas which may have the greatest chance of producing high radon levels and the largest number of high radon levels.

This map should not be used as the sole source for any radon predictions. This map cannot be used to predict locations of high radon in specific localities or to identify individual homes with high radon levels.

Local variations, including soil permeability and housing characteristics, will strongly affect indoor radon levels and any regional radon prediction.

This map is only preliminary and will be modified as research progresses.

Areas outside of shaded regions are not free of risk from elevated indoor radon levels.

- Extent of continental glaciation.
- Geologic areas with known or expected indoor radon levels: granitic rocks, black shales, phosphatic rocks, near surface distribution of NURE potential uranium sources.
- Areas with scattered occurences of uranium bearing coals and shale

EFFORTS TO DATE

EPA has acted as a catalyst to bring together expertise in radon assessment and remedial techniques in federal, state, and local governments as well as the private sector. We have developed a non-regulatory approach which relies on this close partnership to help citizens reduce their health risk from indoor radon. In 1979 we recommended initial radon guidelines for existing homes and new home construction on reclaimed phosphate lands in Florida. The discovery of high levels of naturally occurring radon along the Reading Prong led to the development of our Radon Action Program in 1985, and helped focus national attention on indoor air pollution in general.

As a result, EPA issued national guidelines in 1986 which explain the health risks of radon and recommend actions for homeowners to reduce exposure. The radon program today has five major elements: problem assessment; mitigation and prevention; capability development; public information; and interagency cooperation.

Problem Assessment

The Agency is assisting states in conducting surveys to identify areas with high indoor radon levels. We also have worked with Indian tribes in three states. More than 11,000 homes were tested in the first ten states surveyed. Preliminary results show that 21 percent of the houses tested have radon levels above EPA's four picocuries per liter action guideline. Figure A-16 is a preliminary map of areas in the United States with potentially high radon levels, based on geology. State surveys have confirmed that geology is usually a good predictor of high-risk areas.

Mitigation and Prevention

EPA has a multi-year program to research, demonstrate, and evaluate techniques to reduce radon levels in new and existing homes. These techniques include sealing cracks, improving ventilation both within the home and in the surrounding soil, and removing radon and its decay products from the air.

Capability Development

The Agency established standard methods for measuring radon levels using several techniques, such as carbon canisters, to collect radon samples. We now evaluate semiannually the performance of states and private companies in analyzing measurements done in homes.

We also have helped states and the private sector develop technical capabilities to assess and reduce radon levels in homes. We have provided classroom and field training for state and local officials and private contractors, and have distributed videotapes of course material. The Agency produced a technical guide on radon reduction techniques for detached houses and, in cooperation with the National Association of Home Builders, a summary of techniques for new home construction.

Public Information

EPA provides information on how radon measurements are made, how to evaluate health risks associated with different levels of radon, and how to reduce radon levels, both in indoor air and in drinking water. We have produced several brochures intended to help homeowners better understand the nature of radon.

Interagency Cooperation

We have been working closely in our research efforts with other federal agencies, including the Department of Energy; the Centers for Disease Control; the U.S. Geological Survey; the Department of Housing and Urban Development; the Tennessee Valley Authority; the National Institutes of Health; and the National Bureau of Standards.

Radon Risk Evaluation Chart

pCi/1	WL	Estimated lung cancer deaths due to radon exposure (out of 1000)	Comparable exposure levels	Comparable risk
200	1	440—770	1000 times average outdoor level	More than 60 times non-smoker risk
				4 pack-a-day smoker
100	0.5	270—630	100 times average indoor level	2,000 chest x-rays per year
40	0.2	120—380		2 pack-a-day smoker
20	0.1	60—210	100 times average outdoor level	1 pack-a-day smoker
10	0.05	30—120	10 times average indoor level	5 times non-smoker risk
4	0.02	13—50		200 chest x-rays per year
2	0.01	7—30	10 times average outdoor level	Non-smoker risk of dying from lung cancer
1	0.005	3—13	Average indoor level	20 chest x-rays per year
0.2	0.001	1—3	Average outdoor level	

Note: Measurement results are reported in one of two ways.
1) pCi/l(Picocuries per liter) - measurement of *radon gas*
2) WL(Working levels) - measurement of *radon decay products*

Source: Office of Air and Radiation Programs, USEPA

TODAY'S CHALLENGES

In spite of the risks associated with exposure to indoor radon, relatively few people have had their houses tested. To remedy this, the Agency must continue working with the states to develop effective ways to communicate risks to the public and to share results of ongoing research. This will need to include developing additional ways to measure and correct indoor radon problems in houses as well as in schools and commercial buildings.

EPA'S AGENDA

In the future, EPA will focus on assisting those states which are now finding elevated radon levels. The Agency will continue to expand its mitigation efforts and will include a wider variety of building types. We will also work with building code organizations to ensure that radon-resistant building techniques are incorporated into new construction practices.

EPA will continue providing technical assistance to state and tribal governments to enable them to develop radon programs and to expand private sector capabilities to control radon. Among the federal agencies, EPA will coordinate research into health effects from radon and provide assistance with measurement activities in federal buildings.

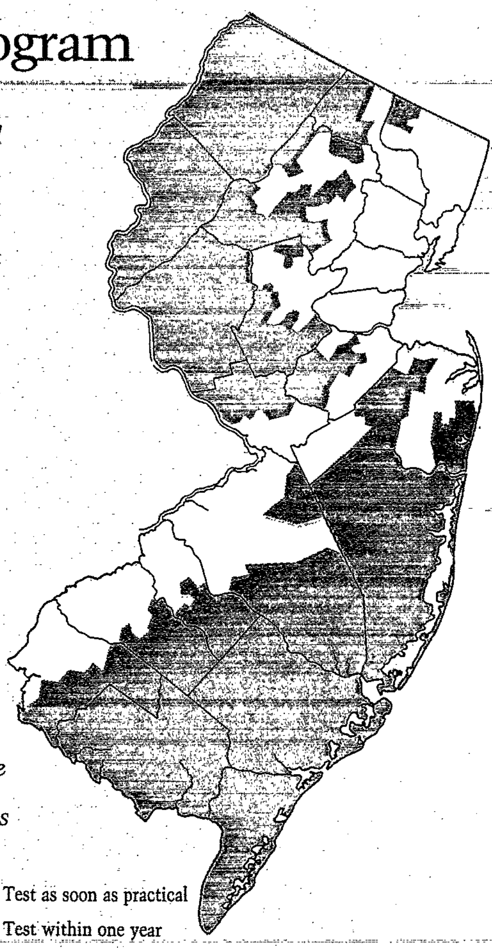
Radon gas enters buildings through openings around pipes and cracks in foundations.

New Jersey's Radon Awareness Program

The New Jersey Department of Environmental Protection's Radon Outreach Program is often viewed as a model by other states. A major portion of the New Jersey program is the statewide survey of radon levels, which found that almost two-thirds of the state is at risk. Thirty three percent of the 6,000 homes tested so far have radon concentrations greater than the 4 picocuries/liter level used to identify buildings requiring further testing or action. The results of this study were released in the form of a map showing three priority areas for testing: areas where radon testing should be done as soon as possible, areas where testing should be done within one year, and areas where testing is suggested only if the homeowners are concerned. A list of individual towns in each area was also published to help communities and homeowners determine if they were at risk.

An other important element of the program is public information. New Jersey's toll-free Radon information line has handled over 50,000 calls since 1985, and is currently receiving several thousand calls per month. EPA has cooperated with the state and local officials in establishing a highly successful community based information campaign. New Jersey has been training local health officers in the affected towns about ways to solve the radon problem. Towns have started to sponsor "Radon Awareness Weeks" which include slide show presentations and information about radon in local papers.

The New Jersey Department of Environmental Protection has instituted a monitoring program to confirm radon measurements. Confirmatory tests have been done for over 4,000 homes. About 25 percent of the tests were done by local public health officials. New Jersey has also been supporting research to help solve the radon problem by participating in mitigation demonstration projects with EPA, including a state-of-the-art project with Lawrence Berkeley Labs, Oak Ridge Universities, and Princeton University on the ways radon enters buildings and how to counteract it.



Global Atmospheric Change

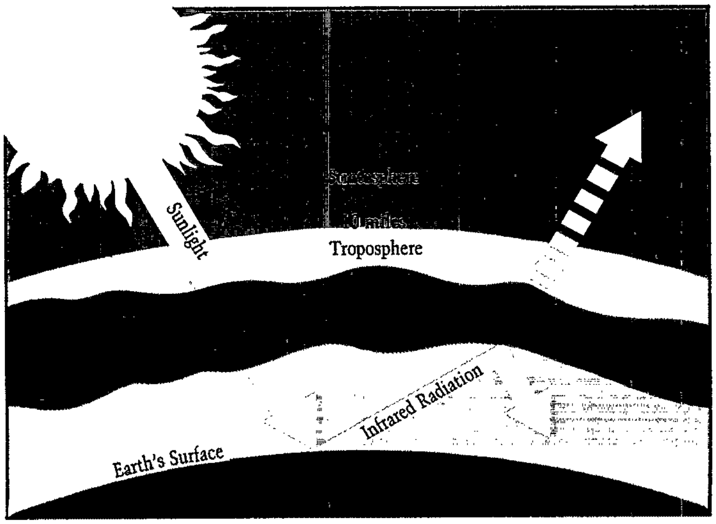
THE PROBLEM

Certain types of air pollutants are producing long-term and perhaps irreversible changes to the global atmosphere. These changes seriously threaten human health and the environment. Industrial growth since the mid-nineteenth century has released large amounts of carbon dioxide. In the troposphere (the lower ten miles of atmosphere) high levels of carbon dioxide are producing an overall warming of the global temperatures. This "greenhouse" effect may cause irreversible changes to the climate. In the stratosphere (extending from the troposphere to about 30 miles above the earth's surface) chlorofluorocarbons (CFCs) and halons are breaking down the ozone layer which protects the earth from ultraviolet radiation. This increased radiation threatens to cause increases in skin cancer and other adverse effects. CFCs and halons can remain in the atmosphere from 75 to 100 years. Even if emissions were eliminated today, the concentrations of these gases would take many decades to return to pre-industrial levels. The global warming trend may take even longer to correct.

The Greenhouse Effect

The greenhouse effect is a natural phenomenon largely caused by carbon dioxide, which has an effect comparable to that of the glass in a greenhouse. Visible light passes through the atmosphere to the earth's surface. The earth radiates the heat as infrared rays; some heat escapes, but carbon dioxide and other

FIGURE A-17
The Greenhouse Effect Traps Solar Heat

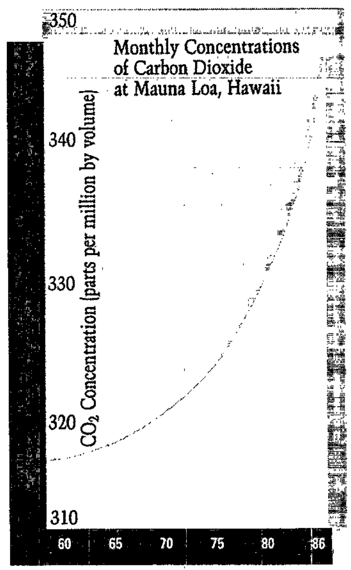


gases in the troposphere trap the rest, warming the earth (Figure A-17). Without the greenhouse effect the earth would be a frozen planet like Mars; the average temperature of the earth would be 00 Fahrenheit, rather than the current 590 Fahrenheit.

By increasing the amount of carbon dioxide in the atmosphere through the burning of fossil fuels such as coal, oil, and natural gas, we have created a warming trend that may raise global temperatures between 20 F and 80 F by the year 2050 (Figure A-18). The clearing of rain forests also contributes carbon dioxide and other greenhouse gases to the atmosphere when wood is burned. Moreover, the clearing of large areas of rain forests means that less carbon dioxide is removed from the air by plants. Deforestation in Brazil, Africa, Indonesia, and the Philippines may be contributing to rising global temperatures.

Global warming may change weather patterns and regional climates. Many important agricultural areas of the United States, for example, could become arid and less productive. Natural ecosystems would also be affected. One major

FIGURE A-18
Global Concentrations of Carbon Dioxide Have Risen 10 Percent Since 1958

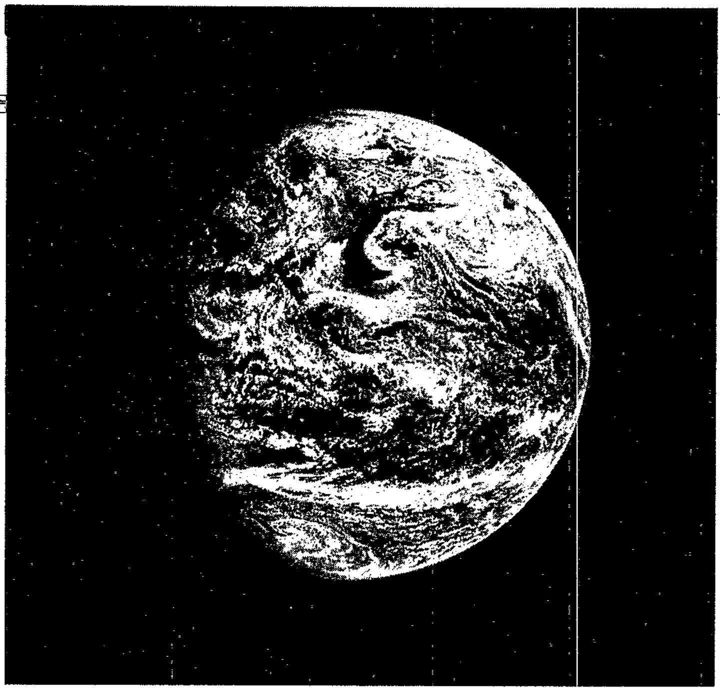


Source: National Oceanic and Atmospheric Administration, 1985

consequence of global warming is already being felt: rising sea levels, amplified by storms, are increasing the erosion of many coastal areas. Sea levels are being raised not only by the melting of alpine glaciers and polar ice sheets, but also by the expansion of the oceans as they are heated. Sea level is expected to rise one foot in the next 30 to 40 years, and 2 to 7 feet by the year 2100. Sea level rise of this magnitude would inundate 50 to 80 percent of U.S. coastal wetlands, erode all recreational beaches, and increase the salinity of estuaries and aquifers. In addition, coastal development would be damaged.

Ozone Depletion in the Stratosphere

Increasing concentrations of the synthetic chemicals known as CFCs and halons are breaking down the ozone layer, allowing more of the sun's ultraviolet rays to penetrate to the earth's surface. Ultraviolet rays can break apart important biological molecules, including DNA. Increased ultraviolet radiation can lead to greater incidence of skin cancer, cataracts, and immune deficiencies, as well as decreased crop yields and reduced populations of certain fish larvae, phytoplankton, and zooplankton that are vital to the food chain. Increased ultraviolet radiation would also contribute to smog and reduce the useful life of outdoor paints and plastics. Stratospheric ozone also protects oxygen at lower altitudes from being broken up by ultraviolet light and keeps most of these harmful



rays from penetrating to the earth's surface.

Chlorofluorocarbons are compounds that consist of chlorine, fluorine, and carbon. First introduced in the late 1920s, these gases have been used as coolants for refrigerators and air conditioners, propellants for aerosol sprays, agents for producing plastic foam, and cleansers for electrical parts. CFCs do not degrade easily in the troposphere. As a result, they rise into the stratosphere where they are broken down by ultraviolet light. The chlorine atoms react with ozone to convert it into two molecules of oxygen (Figure A-19). More important, chlorine acts as a catalyst and is unchanged in the process. Consequently, each chlorine atom can destroy as many as 10,000 ozone molecules before it is returned to the troposphere.

Halons are an industrially-produced group of chemicals that contain bromine, which acts in a manner similar to chlorine by catalytically destroying ozone. Halons are used primarily in fire extinguishing foam.

Laboratory tests have shown that nitrogen oxides also remove ozone from the stratosphere. Levels of nitrous oxide (N_2O) are rising from increased combustion of fossil fuels and use of nitrogen-rich fertilizers.

Ozone Hole Over Antarctica

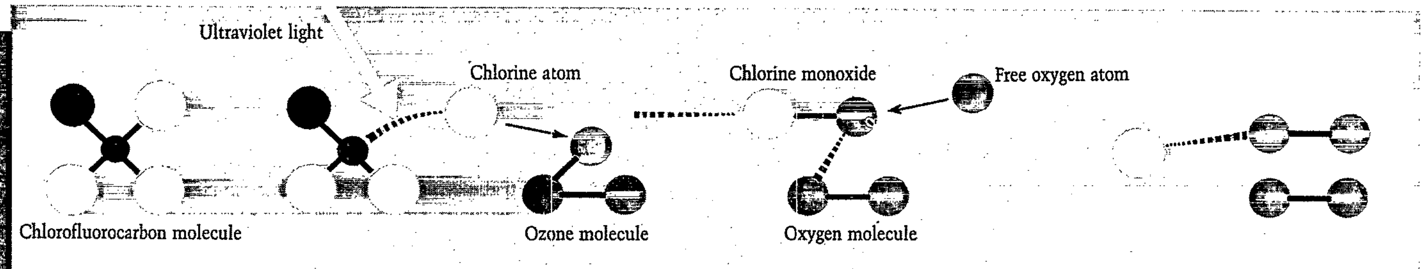
In 1985, atmospheric scientists of the British Antarctic Survey published the unexpected finding that there is an ozone "hole" in the atmosphere over Antarctica. They found that springtime levels of ozone in the stratosphere over Halley Bay, Antarctica had decreased by more than 40 percent between 1977 and 1984. Measurements taken from space by the Nimbus-7 satellite showed that the loss was occurring above an area greater than the size of the entire Antarctic continent. The British study provided the first evidence that the stratospheric layer of ozone surrounding the earth might be in greater jeopardy than previously thought.

In 1987, scientists from four countries met in Punta Arenas, Chile to conduct the most detailed study to date, the Airborne Antarctic Ozone Experiment. Data from high altitude airplanes, ground monitors, and satellites were used to gather detailed information about its size and chemistry. Investigators concluded not only that the ozone hole in 1987 was the largest ever, but that it is caused by chlorofluorocarbons (CFCs).

It is now clear that CFCs are responsible for reducing the amount of ozone in the atmosphere. Moreover, the CFCs that have already been released into the stratosphere will continue to break down ozone for decades to come.

FIGURE A-19

How Ozone Is Destroyed



In the upper atmosphere ultraviolet light breaks off a chlorine atom from a chlorofluorocarbon molecule.

The chlorine attacks an ozone molecule breaking it apart. An ordinary oxygen molecule and a molecule of chlorine monoxide are formed.

A free oxygen atom breaks up the chlorine monoxide. The chlorine is free to repeat the process.

EFFORTS TO DATE


Polar ice-caps are at risk of further melting from global warming.

In the early 1970s, CFCs were primarily used in aerosol propellants. After 1974, U.S. consumption of aerosols had dropped sharply as public concern intensified about stratospheric ozone depletion from CFCs. Moreover, industry anticipated future regulation and shifted to other lower cost chemicals. In 1978, EPA and other Federal agencies banned the nonessential use of CFCs as propellants. However, other uses of CFCs continued to grow, and only Canada and a few European nations followed the United States' lead in banning CFC use in aerosols.

In recognition of the global nature of the problem, 31 nations representing the majority of the CFC-producing countries signed the Montreal Protocol in 1987. The Protocol, which must be ratified by at least 11 countries before it becomes official at the start of 1989, requires developed nations to freeze consumption of CFCs at 1986 levels by mid-1990 and to halve usage by 1999. The Protocol provides for periodic assessments and rapid revision should scientific analysis indicate the need for such steps. Additional features of the Protocol include provisions on trade and enforcement to ensure that nations that fail to take responsibility for protecting the ozone layer do not gain any economic advantage. Many of the countries that signed the Protocol now are moving toward its ratification.

In addition to implementing the Montreal Protocol, EPA is working with industry, the military, and other government organizations to reduce unnecessary emissions of CFCs and halons by altering work practices and testing procedures, or by removing institutional obstacles to reductions. We are working with the National Air and Space Administration, the National Oceanic and Atmospheric Administration, the Department of Energy, the National Science Foundation, and other federal agencies to better understand the effects of global warming and stratospheric ozone depletion.

In 1986 and again in 1987, research teams were sent to investigate the causes and implications of the hole in the ozone over Antarctica. In 1986 we published a multi-volume summary with the United Nations on the effects of global atmospheric change. In addition, in 1987 we published a major risk assessment of the implications of continued emission of gases that can alter the atmosphere and climate.

In December of 1987, the Agency published proposed regulations for implementing the Montreal Protocol. The provisions of the Protocol would be implemented by limiting the production of regulated chemicals and allowing the marketplace to determine their future price and specific uses.

TODAY'S CHALLENGES

While the Montreal Protocol represents a major step toward safeguarding the earth's ozone layer, considerable work remains to be done. Our major challenge is to develop a better understanding of the effects of stratospheric ozone depletion and global warming on human health, agriculture, and natural ecosystems. Substantial scientific uncertainty still exists. More must be learned about the Antarctic ozone hole and its implications, both for that region and the rest of the earth. More must also be learned about recent evidence of global ozone losses of 2 to 5 percent during the past 15 years. Any new scientific information must be incorporated into the upcoming 1989/90 assessments called for by the Montreal Protocol.

Efforts to develop alternatives to CFCs and halons must be expedited. The Montreal Protocol provides a clear signal for industry to shift away from these chemicals. New technologies and new chemicals that will not deplete the ozone layer and increased conservation and recovery are essential to reducing the economic effects of the Protocol both in the United States and abroad. In the short time since the Protocol was signed, major advancements in alternative technologies have been announced for CFC use in food packaging and solvents. Yet these are only a beginning and more must be done.

EPA'S AGENDA

We plan to continue international efforts to protect the ozone layer and to assess the risks of future climate change. We will send advisory teams to several key nations to help them explore options for reducing use of CFCs, such as producing different products, substituting other chemicals, and controlling emissions.

We are expanding our efforts to address the greenhouse effect by continuing to study the potential consequences of global warming, such as sea level rise and loss of agricultural productivity. In 1988 the Agency will submit reports to Congress on the effects of global warming and ways to limit the emissions of greenhouse gases.

Stratospheric ozone depletion is increasing the risk of skin cancer from exposure to sun light.

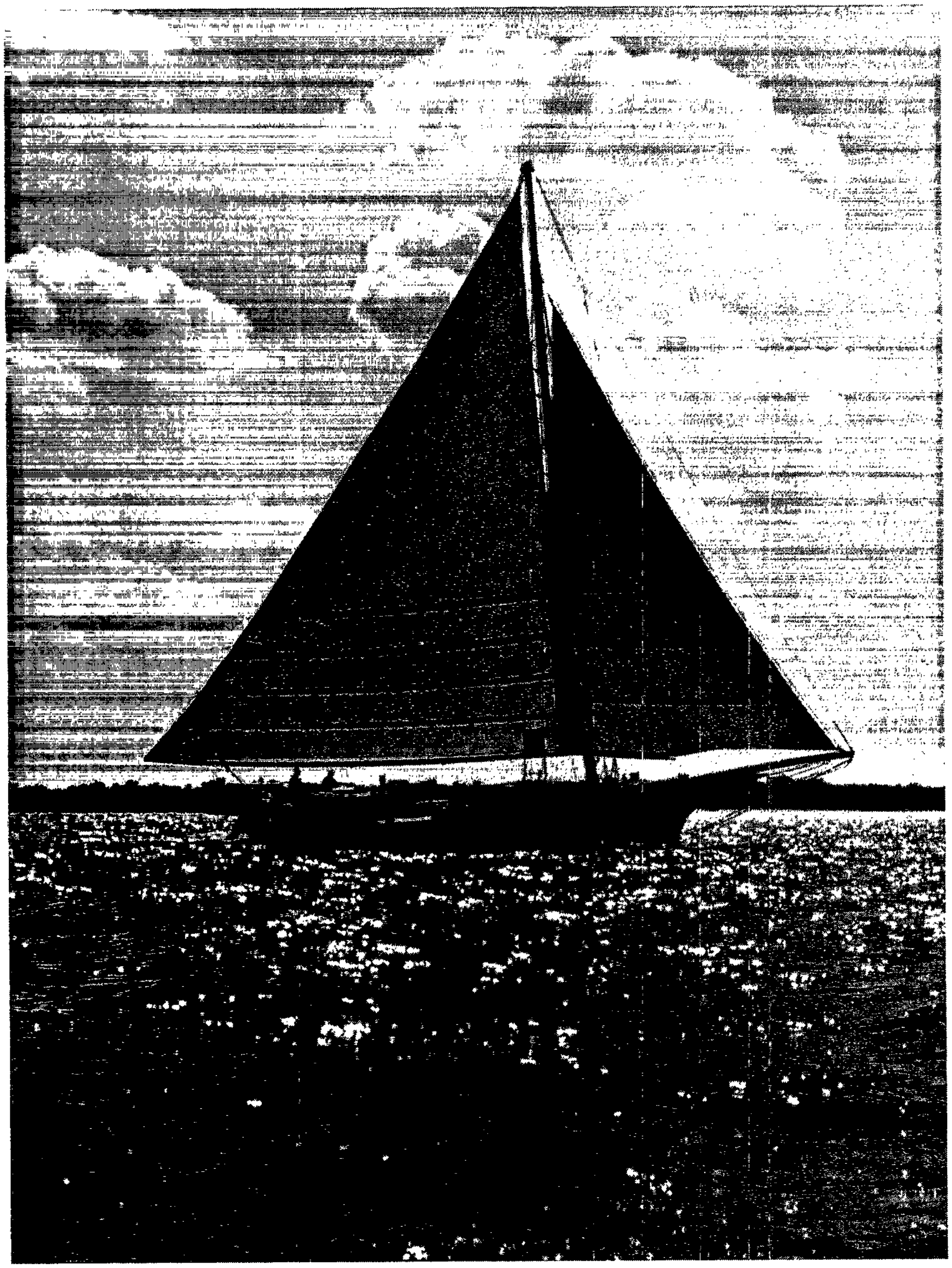
WATER

WATER

In the past 18 years since EPA was established, our nation has made significant progress in restoring water quality. At the same time, we have learned that many water resources have become increasingly threatened.

- Ground water is being contaminated by leaking underground storage tanks, fertilizers and pesticides, uncontrolled hazardous waste sites, septic tanks, drainage wells, and other sources, threatening 50 percent of the nation's drinking water supplies for half of this nation's population.
- Many coastal towns along the Atlantic and Gulf of Mexico have to close beaches one or more times during the summer months because of shoreline pollution.
- In Puget Sound, fecal coliform bacteria contaminate oysters, and the harbor seals have higher concentrations of polychlorinated biphenyls (PCBs) than almost any other seal population in the world.
- Wetlands, the most productive wildlife habitat on an acre-per-acre basis, are being destroyed at a rate between 350,000 to 500,000 acres per year.

This chapter provides an overview of the nation's water pollution problems and describes the progress achieved so far and major challenges remaining.



AN OVERVIEW

EPA, in partnership with state and local governments, is responsible for improving and protecting water quality. These efforts are organized around three themes. The first is maintaining the quality of *drinking water*. This is addressed by monitoring and treating drinking water prior to consumption and by minimizing the contamination of the surface water and protecting against contamination of ground water needed for human consumption. The second theme is preventing the degradation and destruction of *critical aquatic habitats*, including wetlands, nearshore coastal waters, oceans, and lakes. The third is reducing the pollution of *free-flowing* surface waters and protecting their uses.

Drinking water is provided to 200 million Americans (83 percent of the population) by 58,000 community water supply systems and to nonresidential locations such as campgrounds, schools, and factories by 160,000 small-scale suppliers. The balance of Americans are served by private wells. The drinking water supplied to over half of all Americans is drawn from ground water, which comprises about 90 percent of the nation's available fresh water. In rural areas, ground water is the source of 95 percent of drinking water consumed. Protection of ground water from contamination must be a major component of our nation's effort to provide good quality drinking water.

Untreated water drawn from ground water and surface waters, (such as lakes and rivers), can contain contaminants that pose acute and chronic threats to human health. EPA has developed a program for monitoring and treating surface water before it is consumed. Because significant problems still remain, EPA is continuing its work in establishing standards for contaminants found in drinking water and continuing to ensure compliance with all drinking water standards.

Wetlands, coastal waters, marine waters, and lakes serve as breeding areas for commercial and sport fisheries and other wildlife, and as recreational areas for millions of residents and tourists. For a variety of reasons, some of these critical aquatic habitats have been significantly degraded or destroyed during our nation's history, and many more are threatened. EPA is placing particular emphasis on the protection of these resources.

In the early 1970's the nation recognized the impact of conventional pollutants on surface waters and developed programs for their control. EPA and the states have established a major program of establishing standards for our surface waters and subsequent permitting and enforcement to safeguard these standards. Now we are also aware of the impact of toxic pollutants in surface water. In 1986, 27 states reported detectable levels of toxic contaminants in fish tissue and 23 reported concentrations in localized areas exceeding levels considered safe by the Food and Drug Administration. Continuing to protect rivers, lakes, and streams is the third focus of EPA's effort to protect our nation's water resources.

LAWS PROTECTING WATER RESOURCES

Congress has given EPA, the states, and Indian tribal governments broad authority to deal with water pollution. The principal law is the Clean Water Act of 1972 (CWA). The CWA's goal is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." Under this mandate, EPA has developed regulations and programs to reduce pollutants entering all surface waters, including lakes, rivers, estuaries, oceans, and wetlands. In 1987 Congress passed the Water Quality Act of 1987 that reauthorized and strengthened the Clean Water Act. The amendments ensure continued support for municipal sewage treatment plants, initiate a new state-federal program to control nonpoint source pollution, and accelerate the imposition of tighter controls on toxic pollutants.

The Safe Drinking Water Act (SDWA) of 1974 created major legislative authority for protecting drinking water resources. This act, which was amended in 1986, requires the establishment of additional drinking water standards as well as protection of underground sources of drinking water from underground disposal of fluids. The 1986 amendments to the SDWA also established two new major ground-water protection programs: the wellhead protection program to protect areas around public drinking water wells and the sole-source aquifer demonstration program to protect unique underground water supplies.

To protect the marine environment from the harmful effects of ocean dumping, Congress enacted the Marine Protection, Research and Sanctuaries Act in 1972. This act established a permit program to ensure that dumping of wastes in the ocean does not cause degradation of the marine environment.

Additional environmental laws such as the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund), and the Toxic Substances Control Act (TSCA) require measures that ultimately improve and protect our inland, marine and ground-water resources.

SOURCES OF THE PROBLEM AND EPA'S APPROACH

The job of cleaning and protecting the nation's drinking water, coastal zone waters, and surface waters is made complex by the variety of sources of pollution that affect them. In general, water quality problems are caused by one of four major categories of pollution sources: municipal, industrial, nonpoint, and dredge and fill activities (see Figure W-1). A stream or ground-water aquifer may be affected by only one of these sources. More often, they are polluted by a combination of these sources.

Municipal Sources

Municipal wastewater consists primarily of water from toilets and "gray water" from sinks, showers, and other uses. This wastewater which runs through city sewers may be contaminated by organic materials, nutrients, sediment, bacteria, and viruses. Toxic substances used in the home, including crankcase oil, paint, household cleaners, and pesticides, also make their way into sewers. In many towns, industrial facilities are hooked into the municipal system and frequently discharge toxic metals and organic chemicals into the systems. Storm water from downspouts, streets, and parking lots, sometimes enters the municipal system through street sewers and may carry with it residues, toxic chemicals, and sediments.

Municipal pollution can be controlled by properly constructed and maintained household systems and, where necessary, by the construction and operation of sewage treatment plants. Toxics discharged by industry are controlled by "pretreating" industrial wastes before they are discharged into municipal sewers. Initially, the CWA mandated a program of federal grants to share the cost of sewage treatment plant construction with states and local governments. The 1987 amendments provided for phasing out this program and replacing it with state revolving funds with initial seed money provided to the states by EPA.

The CWA also created a program to issue permits to every facility that discharges waste into water, including all sewage plants. The permits, under the National Pollutant Discharge Elimination System or NPDES, establish the amount of each pollutant that the plant may discharge based on national, technology-based effluent limits or, where necessary, the quality of the water as determined by state water quality standards.

Industrial Sources

The use of water in industrial processes, such as the manufacturing of steel or chemicals, produces billions of gallons of wastewater daily. Some industrial pollutants are similar to those in municipal sewage but often more concentrated. Others are more exotic and include a great variety of heavy metals and synthetic organic substances. In large enough dosages, these pollutants may present serious hazards to human health and aquatic organisms.

Industrial water pollution control also relies mainly on the enforcement of NPDES permits. Many industrial permits are now being revised to improve control of toxic substances in their discharges.

Nonpoint Sources

Nonpoint sources of water pollution are multiple, diffuse sources of pollution as opposed to a single "point" source such as a discharge pipe from a factory. For example, rainwater washing over farmlands and carrying top soil and chemical residues into nearby streams is a major nonpoint source of water pollution. Primary nonpoint sources of pollution include water runoff from farming, urban areas, mining, forestry, and construction activities.

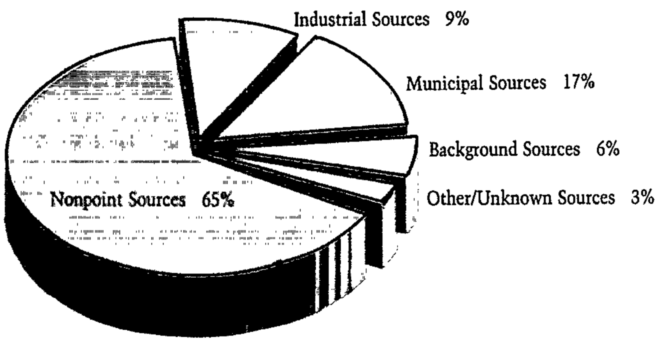
The major pollutant from nonpoint sources by volume is sediment. Runoff also may carry oil and gasoline, agricultural chemicals, nutrients, heavy metals, and other toxic substances, as well as bacteria, viruses, and oxygen-demanding compounds. Nonpoint sources now comprise the largest source of water pollution, contributing 65 percent of the contamination in impaired rivers, 76 percent in impaired lakes, and 45 percent in impaired estuaries.

Dredge and Fill Activities

When waterways are dredged to make them wider or deeper, the dredging churns up bottom sediments and other pollutants, such as PCBs and heavy metals, that are bound to the sediments. These resuspended pollutants thus get a new chance to pollute the environment. Moreover, when dredged materials are dumped onshore, they can seriously harm sensitive wetland areas such as swamps, bogs, and coastal marshes. Fill material, too, harms wetlands when used to provide development sites.

The federal program to regulate through permits the discharge of dredged or fill material in United States waters is jointly administered by EPA and the U.S. Army Corps of Engineers. As part of its responsibility, EPA encourages careful consideration of alternative sites and methods to mitigate the effects of dredged or fill material on wetlands or open waters.

FIGURE W-1
Major Causes of Stream Pollution
(for 370,000 stream miles not meeting designated uses)



Source: 305(b) 1986 National Report

Legislative Tools

Congress has provided EPA and the states with three primary statutes to control and reduce water pollution: the Clean Water Act, the Safe Drinking Water Act, and the Marine Protection, Research, and Sanctuaries Act. Each statute provides a variety of tools that can be used to meet the challenges and complexities of reducing water pollution in our nation.

CLEAN WATER ACT

Standards

The states adopt water quality standards for every stream within their borders. These standards include a designated use such as fishing or swimming and prescribe criteria to protect that use. The criteria are pollutant specific and represent the permissible levels of substances in the waters that would enable the use to be achieved. Water quality standards are the basis for nearly all water quality management decisions. Depending upon the standard adopted for a particular stream, controls may be needed to reduce the pollutant levels. Water quality standards are reviewed every three years and revised as needed.

Effluent Guidelines

EPA develops uniform, nationally consistent effluent limitations (pollutant-specific discharge limitations) for industrial categories and sewage treatment plants. These limitations are based on a consideration of the best available technology that is economically achievable. EPA and the states use these guidelines to establish National Pollutant Discharge Elimination System (NPDES) permit limitations. The effluent guidelines are minimum or baseline limitations; additional controls may be required to achieve water quality standards for the stream segment that receives a plant's discharge.

Permits and Enforcement

All industrial and municipal facilities that discharge wastewater directly into our nations rivers and streams must have an NPDES permit and are responsible for monitoring and reporting discharge levels. The states and/or EPA inspect dischargers to determine if they are in compliance with the permit limitations and conditions. Appropriate enforcement actions, including criminal actions, are taken as needed.

Wetlands Protection

EPA and the U.S. Army Corps of Engineers implement jointly a permit program regulating the discharge of dredged or fill material into waters of the United States, including wetlands. As part of this program, EPA's principal responsibility is to develop the substantive environmental criteria by which permit applications are evaluated. EPA also reviews the permit applications and, if necessary, can veto permits that would result in significant environmental damage.

National Estuary Program

States nominate and EPA selects estuaries of national significance that are threatened by pollution, development, or overuse. EPA and the involved state(s) form a management committee consisting of numerous workgroups to assess the problems, identify management solutions, and develop and oversee implementation of plans for addressing the problems.

Grants

The CWA authorizes EPA to provide financial assistance to states to support programs such as the construction of municipal sewage treatment plants; water quality monitoring, permitting, and enforcement; and implementation of nonpoint source controls. These funds also may support development and implementation of state ground-water protection strategies. In addition, EPA provides grants to states for the creation of State Water Pollution Control Revolving Funds. States may use these funds for loans and other types of financial assistance to local governments for the construction of municipal wastewater treatment plants, implementation of nonpoint source programs, and the development and implementation of estuary protection programs.

SAFE DRINKING WATER ACT

Standards

EPA establishes standards for drinking water quality. These standards represent the Maximum Contaminant Levels (MCL) allowable, and consist of numerical criteria for specified contaminants.

Treatment and Monitoring

Local water supply systems are required to monitor their drinking water periodically for contaminants with MCLs and for a broad range of other contaminants as specified by EPA. Additionally, to protect underground sources of drinking water, EPA requires periodic monitoring of wells used for underground injection of hazardous waste, including monitoring of the ground water above the wells.

Enforcement

States have the primary responsibility for the enforcement of drinking water standards, monitoring, and reporting requirements. States also determine requirements for environmentally sound underground injection of wastes.

Grants

The Safe Drinking Water Act authorizes EPA to award grants to states for developing and implementing programs to protect drinking water at the tap and ground-water resources. These several grant programs may be for supporting state public water supply, wellhead protection, and underground injection programs, including compliance and enforcement.

MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT (TITLE I)

Permits, Enforcement, and Site Designation

EPA designates recommended sites and times for ocean dumping. Actual dumping at these designated sites requires a permit. EPA and the Corps of Engineers share this permitting authority, with the Corps responsible for the permitting of dredged material (subject to an EPA review role), and EPA responsible for permitting all other types of materials. The Coast Guard monitors the activities and EPA is responsible for assessing penalties for violations. EPA also is responsible for designating sites and times for the ocean dumping activities.

FIGURE W-2

Major Sources of Ground Water Contamination Reported by States

Source	No. of States Reporting Source*	No. of States Reporting as Primary Source**
Septic Tanks	46	9
Underground Storage Tanks	43	13
Agricultural Activities	41	6
On-site Landfills	34	5
Surface Impoundments	33	2
Municipal Landfills	32	1
Abandoned Waste Sites	29	3
Oil and Gas Brine Pits	22	2
Saltwater Intrusion	19	4
Other Landfills	18	0
Road Salting	16	1
Land Application of Sludge	12	0
Regulated Waste Sites	12	1
Mining Activities	11	1
Underground Injection Wells	9	0
Construction Activities	2	0

*Based on a total of 52 States and territories which reported ground-water contamination sources in their 1986 305 (b) submittals.

*Some States did not indicate a primary source.

Source: 305b 1986 National Report

PROGRESS TO DATE

Overall, the national strategy to restore and maintain water quality is working. A strong cooperative relationship has been developed among the federal, state, and local jurisdictions responsible for maintaining the integrity of our waters. Expenditures by EPA, the states, and local governments to construct and update sewage treatment facilities have substantially increased the population served. Public awareness and concern over safe drinking water has increased due to more frequent reporting of the occurrence of contamination in finished water. Interest in protecting ecologically critical areas such as wetlands and estuaries has increased in the public and private sectors. By focusing primarily on point sources, the United States has kept significant amounts of pollutants out of its surface waters.

Details of the progress made in protecting drinking water, critical aquatic habitats, and surface waters from pollution generated by municipalities, industry, nonpoint sources, and dredging activities is summarized below.

Protecting Drinking Water Sources

EPA's program to protect the nation's drinking water focuses on two areas: protecting ground water and assuring that water being consumed meets health-based standards.

There are many potential sources of ground-water contamination resulting from commercial and household activities, and hundreds of chemicals have been found in ground water (see Figure W-2). Recognizing the high costs of treating and cleaning up contaminated ground water, EPA and the states have worked together on developing and implementing a variety of ground-water protection management, research, and control activities. In 1984, EPA adopted a Ground-Water Protection Strategy that was designed as a comprehensive approach to protecting our nation's ground-water. States have developed and are starting to implement strategies to deal with ground-water problems, including Wellhead Protection programs to protect public wells providing drinking water.

Indeed, the nation has become increasingly aware of the need to protect recharge areas of wells. Many states are moving forward to create statewide or more localized wellhead protection programs. EPA is providing numerous technical assistance documents and training to help states with their wellhead protection efforts.

When the Safe Drinking Water Act became law, the federal government had little reliable information about water suppliers, the quality of the drinking water being provided, the treatment techniques used, or even about water system owners. This information was available for only about 19,200 community water systems in 1969. Today this information is available on more than 58,000 systems. To protect drinking water, EPA established standards defining the maximum extent to which contaminants are allowed. In the past decade, the Agency has issued Maximum Contaminant Levels (MCLs) for 26 important pollutants in drinking water. In 1986, 87 percent of 58,000 public water systems were meeting these federal standards. Standards for 83 additional MCLs will be established by 1989.

An active enforcement program, in partnership with the states, also has been successful in identifying the most flagrant violations of treatment standards and working with communities to return water systems to compliance.

Protecting Critical Aquatic Habitats

EPA only recently started to focus attention on critical aquatic habitats as a major environmental problem. The current program combines the expertise and experience of EPA, other federal agencies, and state and local governments. The initial focus is on problem recognition, developing new program strategies, and beginning research and development of protection and cleanup technologies. Some significant accomplishments already exist:

- EPA has successfully pioneered coastal waterbody management programs in the Great Lakes and Chesapeake Bay, and in other estuaries under its National Estuary Program. We are now expanding our efforts to reach other waters through implementing a newly developed strategic plan for improving the management of near coastal waters. This Near Coastal Waters Initiative is the next step in improving the waters of our bays, estuaries, coastal wetlands and the coastal ocean.
- Great strides have been made in changing public views on wetland areas. Over 50 percent of the wetlands in the lower 48 states have been converted to other uses within the last 200 years. By the mid-1950s, the rate of wetland loss was 458,000 acres annually; and annual losses are estimated to continue at 350,000 to 500,000 acres. These areas which once were treated as unhealthy wastelands fit only to be drained and filled are now recognized for the wide variety of important natural functions they provide. This is an important first step in developing a comprehensive approach to the protection and management of wetlands. Within recent years, EPA has been taking an increasingly active role in the Clean Water Act dredge and fill permitting program. Evidence of EPA's increased role is the Agency's use, in appropriate circumstances, of its veto authority of Corps of Engineers approved permits. EPA also has initiated projects to identify and protect sensitive wetlands

FIGURE W-3

Degree of Designated Use Support in the Nation's Waters*

	Rivers (miles)	Lakes (acres)	Estuaries (sq. miles)
Total in U.S.**	1,800,000	39,400,000	32,000
Assessed (% of Total)	370,544 (21%)	12,531,846 (32%)	17,606 (55%)
Fully Supporting (% of Assessed)	274,537 (74%)	9,202,752 (73%)	13,154 (75%)
Partially Supporting Uses (% of Assessed)	70,916 (19%)	2,181,331 (17%)	3,224 (18%)
Not Supporting Uses (% of Assessed)	22,974 (6%)	859,080 (7%)	1,177 (7%)
Unknown (% of Assessed)	2,127 (1%)	288,684 (2%)	51 (0.30%)

*Based on 1986 Sec. 305(b) data as follows: for rivers 42 States and territories reported; for lakes, 37 States reported; for estuaries, 20 States reported.

**Total waters based on State-reported information in America's Clean Water: The States' Nonpoint Source Assessment, ASIWPCA, 1985. Total U.S., estuarine square miles excludes Alaska.

throughout the country. In addition, EPA is working with other federal agencies to eliminate policies that encourage wetlands destruction.

- EPA has made progress in the last four years limiting the amount of primary treated effluent discharged to the ocean on all coasts. These improvements have been achieved by significantly reducing the amount of wastes dumped in the ocean, and by transferring the disposal of New York and New Jersey sewage sludge from nearshore sites to more environmentally sound, deep-water sites.

Protecting Surface Waters

One of the best measures of progress in cleaning up surface water is the extent to which the water quality goals of the Clean Water Act have been achieved. State and federal data indicate that our water pollution efforts have made significant headway to restore or protect surface water quality. Many rivers that once were heavily degraded by municipal and industrial discharges now are safe for swimming and fishing again.

- Over 99 percent of the Nation's streams are designated for water uses equal to or better than the "fishable/swimmable" goal mandated by Congress in 1972. The states reported that of the 370,544 miles of rivers assessed in 1986, designated uses were fully supported on 74 percent, partially supported in 19 percent (i.e. some designated uses are met), and not supported in 6 percent (see Figure W-3).

- The Nation's ability to treat its wastewater has improved substantially since 1972. Under the Clean Water Act, secondary treatment to remove 85 percent of key constituents such as oxygen demanding material and suspended solids is the minimum treatment required of sewage treatment plants nationwide. Many treatment facilities now achieve even greater removals of these constituents and nutrients such as phosphates or nitrates. The total population served by secondary treatment or better has increased from 85 million in 1972 to 127 million in 1986. At the same time, the total population discharging untreated wastewater to rivers or lakes dropped from 5 million to less than 2 million. EPA's construction grants program has assisted this process by providing federal funds for projects at over 5,000 treatment plants.

Courtesy Michigan Travel Bureau

Partnership in Action in the Great Lakes

Canada and the United States share the largest area of fresh water on earth (with the exception of the polar ice caps): the Great Lakes. This vast resource, containing 20 percent of the world's fresh water, provides drinking water, recreational opportunities, and routes for commerce and travel. Industrial, municipal, and agricultural activities in the Great Lakes Basin have resulted in pollutant accumulation over time, because the Great Lakes are to a large extent a closed system. Less than one percent of the lakes' waters flow out through the St. Lawrence River per year.

The U.S. and Canada cooperate through the International Joint Commission to resolve problems in the Great Lakes. In November of 1987, the U.S. and Canada renegotiated the Great Lakes Water Quality Agreement that was first signed in 1972. They identified further steps to protect the Great Lakes ecosystem from toxic substances.

Prior to 1972, severely degraded conditions were evident within the Great Lakes, particularly in Lake Erie. Cooperative efforts by the United States and Canada in response to the problems have resulted in a major recovery in the Lakes' condition, primarily through expenditure of $7.6 billion since 1972 for construction and upgrading of municipal sewage treatment facilities. In addition to controlling phosphorus discharges from sewage treatment plants, Canada and several U.S. states limited amounts of phosphates allowed in laundry products. These efforts, coupled with strict controls on industrial wastewater, largely have freed the lakes from their oppressive nutrient burden. Progress in the area of toxic chemical pollutants, however, has been much more difficult.

Remedial action plans are being prepared for geographical areas of concern where problems are most severe. The Great Lakes Water Quality Agreement specifically calls for identification of contaminated sediment areas, watershed management for nonpoint source pollution, monitoring airborne toxics, mapping of contaminated ground-water, and efforts for coordinated bilateral research. "Lakewide Management Plans" will be prepared for critical pollutants affecting the open waters of the Lakes. Lakewide plans exist already for control of phosphorus. Plans for toxic pollutant control will follow a similar pattern.

TODAY'S CHALLENGES

The Clean Water Act and Safe Drinking Water Act place great reliance on state and local initiatives in addressing water problems. With the enactment of the 1986 Safe Drinking Water Act amendments and the 1987 Water Quality Act, significant additional responsibilities were assigned to EPA and the states. Faced with many competing programs and limited resources, the public sector will need to set priorities. With this in mind, EPA is encouraging states to address their water quality problems by developing State Clean Water Strategies. These strategies are to set forth state priorities over a multi-year period. They will help target the most valuable and/or most threatened water resources for protection.

Success in the water programs is increasingly tied to state and local leadership and decision-making and to public support. EPA will work with state and local agencies, industry, environmentalists, and the public as we develop our environmental agenda in the following three areas:

- Protection of drinking water: Although more Americans are receiving safer drinking water than ever before, there are still serious problems with contamination of drinking water supplies and of ground water that is or could be used for human consumption. Contaminated ground water has caused well closings in every state. The extent and significance of contamination by toxics has not been fully assessed for most of the nation's rivers and lakes, which are often used for drinking water supply. All of these issues are areas for continued work and improvement.
- Protection of critical aquatic habitats: Contamination or destruction of previously underprotected areas such as oceans, wetlands, and near coastal waters must be addressed.
- Protection of surface-water resources: EPA and the states will need to establish a new phase of the federal-state partnership in ensuring continuing progress in addressing conventional sources of pollution and in

National Pollutant Discharge Elimination System

What is a NPDES Permit?

Under the Clean Water Act, the discharge of pollutants into the waters of the United States is prohibited unless a permit is issued by EPA or a state under the National Pollutant Discharge Elimination System (NPDES). These permits must be renewed at least once every five years. There are approximately 48,400 industrial and 15,300 municipal facilities that currently have NPDES permits.

What Do NPDES Permits Contain?

An NPDES permit contains effluent limitations and monitoring and reporting requirements. Effluent limitations are restrictions on the amount of specific pollutants that a facility can discharge into a stream, river, or harbor. Monitoring and reporting requirements are specific instructions on how sampling of the effluent should be done to check whether the effluent limitations are being met. Instructions may include required sampling frequency (i.e., daily, weekly, or monthly) and the type of monitoring required. The permittee may be required to monitor the effluent on a daily, weekly, or monthly basis. The monitoring results are then regularly reported to the EPA and state authorities. When a discharger fails to comply with the effluent limitations or monitoring and reporting requirements, EPA or the state may take enforcement action.

Field biologists monitor water quality of streams through collection of fish for laboratory testing.

How Are These Effluent Limitations Developed?

Congress recognized that it would be an overwhelming task for EPA to establish effluent limitations for each individual industrial and municipal discharger. Therefore, Congress authorized the Agency to develop uniform effluent limitations for each category of point sources such as steel mills, paper mills, and pesticide manufacturers. The Agency develops these effluent limitations on the basis of many factors, most notably efficient treatment technologies. Once EPA proposes an effluent limit and public comments are received, EPA or the states issue all point sources within that industry category NPDES permits using the technology-based limits. Sewage treatment plants also are provided with effluent limitations based on technology performance.

What Are Water Quality-Based Limits?

Limitations that are more stringent than those based on technology are sometimes necessary to ensure that state developed water quality standards are met. For example, several different facilities may be discharging into one stream, creating pollutant levels harmful to fish. In this case, the facilities on that stream must meet more stringent treatment requirements, known as water quality-based limitations. These limits are developed by determining the amounts of pollutants that the stream can safely absorb and calculating permit limits such that these amounts are not exceeded.

creating and managing state revolving loan funds for municipal wastewater treatment. Additionally, we will need to address the increasingly apparent problems caused by toxic pollutants discharged into our waters and by the nonpoint sources of pollutants coming from farm lands and city streets.

Overall, we have made significant gains in protecting the quality of the nations waters since 1970. The most fundamental challenge now is to maintain these gains, strengthen the state and local organizations we have relied on to carry out these programs, and move forward together to address new problems.

Dealing with Environmental Variability: The Ecoregion Approach

Most people recognize that the landscape of the United States is not just a grab bag of environmental characteristics, but rather is the result of specific combinations of weather patterns, vegetation, and land forms. Environmental managers must account for these local variations when developing pollution control programs. This is especially true in managing water quality. For example, the effect of a toxic chemical discharge on living organisms will vary, depending upon the temperature, flow, and other natural conditions of the water body.

Many of the traditional approaches to controlling water pollution are based on water quality criteria. These criteria are scientifically derived in-stream concentrations of chemicals that will protect a desired use for the water. Although the criteria can be adjusted for some local variability in pH and water hardness, they are not sensitive to other site-specific conditions. These local variations can significantly affect the toxicity of a chemical on stream life.

A principal complaint against these national criteria is that they are too general for some local conditions, resulting in either underprotection or overprotection of the water body. In such cases, states are encouraged to develop site-specific criteria and to designate more specialized categories of water use. Although this is a desirable approach, the process of conducting these intensive studies at numerous sites within a state is very costly.

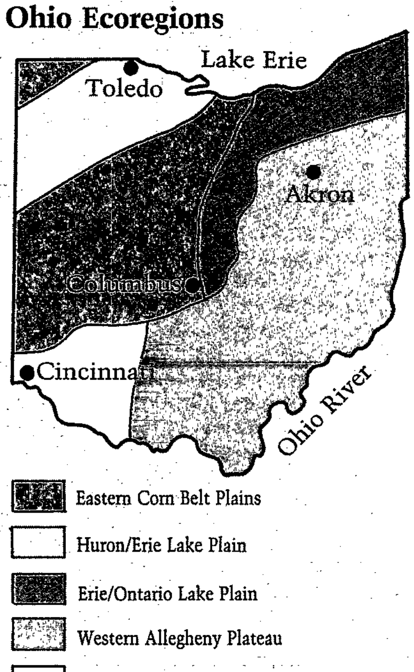
Several states are working with biologists and geographers at the EPA research laboratory in Corvallis, Oregon to develop a less costly method for conducting these studies. Instead of developing unique water quality criteria for thousands of small segments of rivers or streams, scientists have studied regional characteristics, such as the surface of the land, soils, natural vegetation, and land use, and have identified 76 homogeneous ecological regions or "ecoregions" for the United States.

The approach is based on the hypothesis that streams reflect the characteristics of the watersheds, or lands they drain. The scientists have shown that streams within a particular ecoregion are more similar to one another in terms of their physical habitat, hydrology, water chemistry, and types of fish and aquatic insects than they are to streams in other ecoregions. It might be appropriate, therefore, for EPA to derive one set of water quality criteria for all similar ecoregions.

Ecoregion analyses have been used for both research and regulatory purposes. For example, an ecoregion approach has been used to identify surface waters that are sensitive to acidic deposition. This helps researchers decide where and when to monitor water quality, and assists them in developing programs to modify or eliminate the effects of acid rain. In Arkansas and Ohio, the primary use of this concept has been to reexamine state water quality criteria and standards. The motivation for undertaking the ecoregion program in Arkansas was that many of the state's cleanest streams and lakes had not met national water quality standards because of naturally occurring physical and chemical conditions. Rather than enforce inappropriate standards, state officials undertook an ambitious program to assess water quality and ecological conditions in least disturbed streams in each of the six ecoregions that were identified in Arkansas. These least disturbed streams will be used as "reference streams" for comparative studies of polluted areas and as a basis for setting achievable water quality goals. Ohio has conducted similar analyses for its five ecoregions.

The ecoregion approach is designed to provide a sound basis for reclassifying streams where existing criteria and standards are either too stringent or too lenient. The applications of this technique in Arkansas and Ohio have demonstrated its usefulness in developing and evaluating programs to protect the use of valuable aquatic resources.

Ohio Ecoregions



Ground-Water Protection

THE PROBLEM

EPA's drinking water program is focused in two areas: minimizing the contamination of ground water and surface waters needed for human consumption, and monitoring and treating drinking water prior to consumption. This section summarizes EPA's efforts in these areas. The Agency's program to protect surface water is discussed separately in this chapter.

Half of all Americans (120 million people) and 95 percent of rural Americans, use ground water for drinking water (see Figure W-4). Ground-water is also used for about half of the nation's irrigation needs in agriculture and about one-quarter of the nation's industrial needs. To meet this demand, ground water withdrawals more than doubled between 1950 and 1980 and have leveled off since then. Until the 1970's it was widely thought that ground water was adequately protected from contamination. Since then, every state in the nation has found contaminated ground-water.

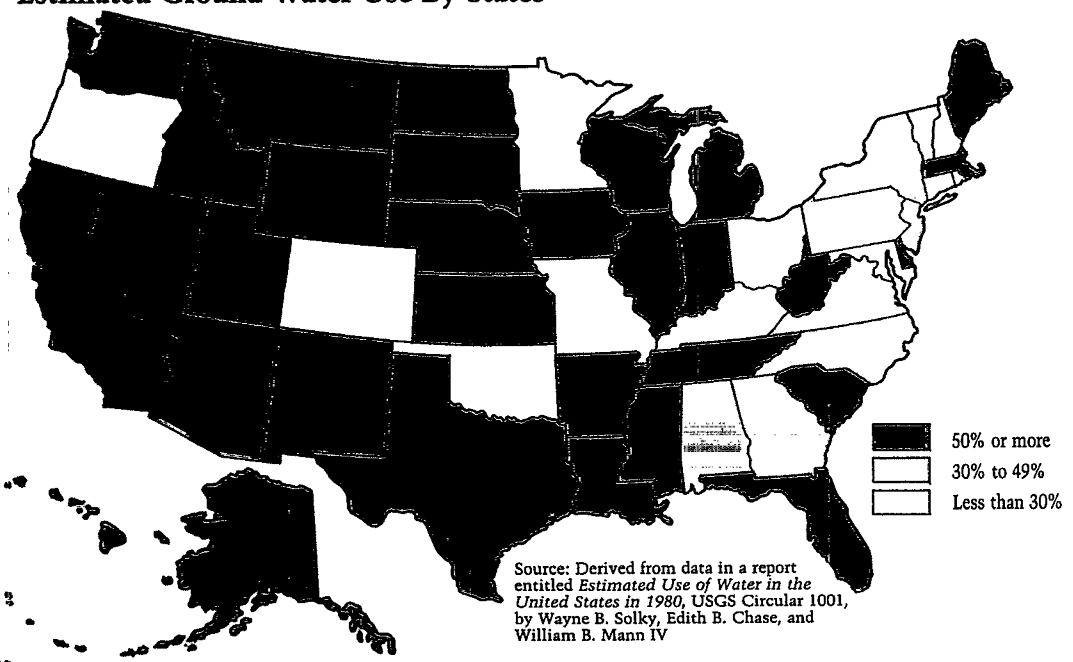
EPA reported in 1984 that at least 8,000 water wells throughout the nation were unusable or had degraded water. As a result of advanced technological capabilities, we are constantly expanding our understanding of the extent of ground-water contamination. However, because of the complexity of the ground-water resource and the expense of monitoring, we may never have a complete picture of the nature and extent of the problem. We do know, however, that the current and potential sources of ground-water contamination are vast (see Figure W-5). Examples of the broad categories of actual or potential sources of contamination include:

- about 29,000 hazardous waste sites stated as potential candidates for the Superfund National Priorities List;
- millions of septic systems (one-fourth of homes in the U.S. use such systems or similar ones);
- over 180,000 surface impoundments (i.e. pits, ponds and lagoons);
- an estimated 500 hazardous waste land disposal facilities, and 16,000 municipal and other landfills;
- Approximately 5-6 million underground storage tanks, (hundreds of thousands of which are estimated to be leaking);
- thousands of underground injection wells; and
- millions of tons of pesticides and fertilizers spread on the ground, primarily in the rural areas.

Many of these sources could contain hundreds of different chemicals that could reach ground water and potentially contaminate drinking water wells. The Agency's major concern is with man-made toxic chemicals such as the synthetic organic chemicals that are pervasive in plastics, solvents, pesticides, paints, dyes, varnishes, and ink. Some of the 40,000 community public water systems and 13 million private wells that supply 50 percent of Americans with drinking water are known to be contaminated with these substances. For example:

- Between 1975 and 1985, about 1,500 to 3,000 public water supplies out of 40,000 using ground water exceeded EPA's drinking water standards for inorganic substances (fluoride and nitrates were the most common problem).
- The Council of Environmental Quality in 1981 reported major problems from toxic organics in some wells in almost all states east of the Mississippi River (trichloroethylene, a known carcinogen, was the most frequent contaminant found).
- EPA's 1980 Ground-Water Supply Survey showed that 20% of all public water supply wells and 29% of those in urban areas (serving over 10,000 people) had detectable levels of at least one volatile organic chemical.
- EPA has also found that about 60 pesticides have been detected in 30 states at various levels of contamination. In most cases, however, pesticide levels were below health advisory levels.

FIGURE W-4
Estimated Ground-Water Use By States



Source: Derived from data in a report entitled *Estimated Use of Water in the United States in 1980*, USGS Circular 1001, by Wayne B. Solky, Edith B. Chase, and William B. Mann IV

EFFORTS TO DATE

- At least 13 organic chemicals which are confirmed animal or human carcinogens have been detected in drinking water wells.

The principal concern over ground-water contamination is related to its adverse impact on human health. Concerns about the environmental and ecological effects of ground-water contamination, however, are also growing. Potential impacts of ground-water contamination on the environment include adverse effects on surface waters and damage to fish, vegetation, and wildlife. For example, 15 percent of endangered species rely upon ground water for maintaining their habitat.

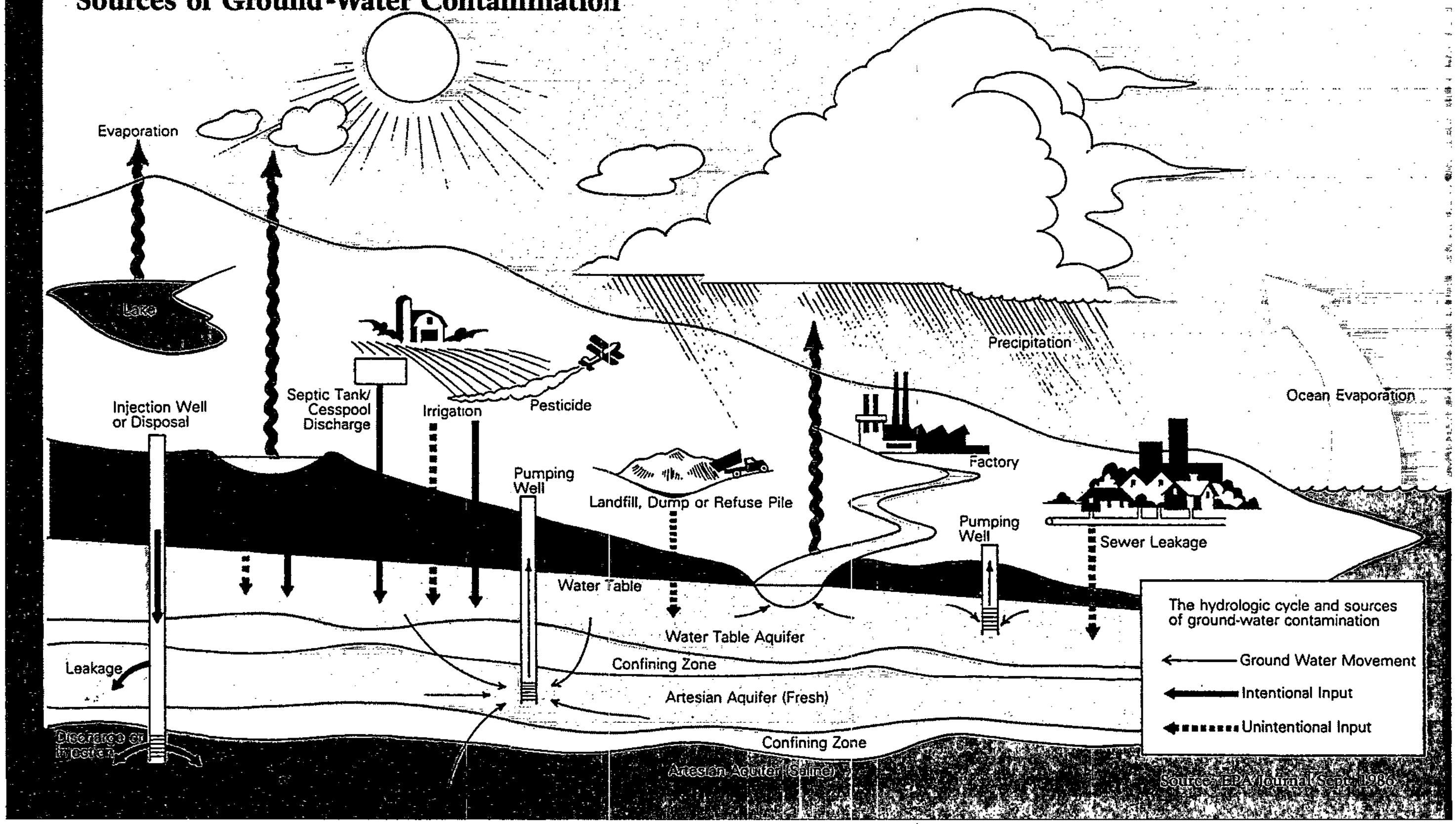
Many programs and a large percentage of EPA's budget support activities to protect, maintain, and restore ground-water quality. In this effort, EPA controls, inspects and cleans up hazardous waste disposal facilities, enforces permit conditions at underground injection wells, regulates the annual use of millions of tons of pesticides, and helps states develop their own ground-water protection programs. The regulated community encompasses not only a few large industries and businesses, but also small businesses, individual homeowners, and farmers.

In August 1984, EPA issued a Ground-Water Protection Strategy to provide an integrated framework for the many EPA statutes affecting the protection of ground water. Over the past four years, we have effectively applied the strategy to move EPA and other federal and state institutions toward preserving ground water quality and protecting the public health.

The Agency's primary goal is to help states to develop and implement ground-water protection strategies. Since 1984, EPA has provided over $25 million to states to help them develop and carry out these strategies. As a result, all fifty states are developing, or have instituted, overall state strategies as compared to eleven in 1985. These states have assessed their ground water problems and made major changes to the way they carry out ground water protection efforts. New state statutes and regulations have been written, specialists in hydrology hired, statewide and local level ground water task groups established, and major studies conducted.

Since the issuance of the Ground-water Protection Strategy, the Congress passed the Safe Drinking Water Act Amendments (SDWA) of 1986, to require states to develop a program to protect areas surrounding drinking water wells (the wellhead) from contaminants that may have adverse health effects. Wellhead protection areas are defined as the surface and subsurface areas surrounding a water well or wellfield supplying a public water system that may be contaminated through

FIGURE W-5
Sources of Ground-Water Contamination



normal or exceptional human activity.

Further, to implement EPA's Strategy and the 1986 SDWA Amendments, we have developed and distributed documents to help state and local officials design and implement programs to prevent or reduce ground-water contamination. EPA has published a series of guides addressing specific sources of contamination and addressing implementation of wellhead protection programs. We also are implementing a ground-water data management strategy to provide better information for ground-water decision making.

A second goal of the strategy is to develop a better understanding of the ground-water contamination problems that are of national concern, including pesticides, underground storage tanks, and other diffuse sources of contamination, and to take appropriate action. To achieve this goal, we are conducting a national survey of agricultural chemicals, pesticides, and fertilizers in drinking water and developing an "Agricultural Chemicals in Ground Water Strategy" in coordination with the U.S. Department of Agriculture. These activities will serve to develop an environmental baseline.

A third goal of the Ground-Water Protection Strategy is to create a consistent and rational policy for protection and cleanup of ground water. In 1988, EPA will publish guidelines for classifying ground water. The purpose of this guidance is to assist in establishing more consistent prevention and cleanup goals across the various EPA programs. As appropriate, we will

incorporate the classification system into those regulations and program guidance that affect ground water. The ground-water classification system is important technical guidance for EPA programs as they develop regulatory policy.

Because ground water is an integral and often predominant part of many EPA programs, another goal of the EPA Ground-Water Protection Strategy is to strengthen EPA's internal ground-water organization. For over three years, the Office of Ground-Water Protection has been coordinating the implementation of ground-water policies across the Agency. Each EPA Region now has a functioning Ground-Water Protection Office that primarily assists states implement the ground-water policies. We also have established a Ground-Water Oversight Committee at headquarters at the top levels of management, and Regional Ground-Water Coordinating Committees.

Research is another essential component of EPA's ground-water protection program. Research over the past three years has led to new methods to monitor contamination, track contaminant movements, control and clean up contamination, and to understand the health and environmental effects of contaminants.

Although we have known about ground-water contamination problems in many areas of the country for several decades, it wasn't until the late 1970's that the EPA began to develop a comprehensive framework for managing ground-water resources. This framework includes utilizing EPA's statutory authorities for ground-water protection most effectively for ground-water protection, building institutional capabilities at the federal and state levels, and collecting data to describe the magnitude and significance of the problem. Much has happened since the initial discussions of the strategic plan to protect this valuable resource: in 1984, EPA issued a Ground-Water Protection Strategy; the Office of Ground-Water Protection was established as a focal point for ground water in the Agency; in 1986 the Safe Drinking Water Act Amendments required states to develop programs to protect wellhead areas from contamination; and in 1987, the Agency developed a strategic plan to address contamination of ground water from agricultural chemicals. Major amendments were also made to RCRA and CERCLA during this period greatly strengthening their statutes ability to protect ground water.

The increasing focus on ground-water issues by the Congress, the public, and within the Agency, has resulted in some major challenges that must be address over the next 10 years if we are to achieve the goals of our ground-water strategy.

Building Capacity in State Governments and Indian Tribes

EPA's goal is to build capacity in state and Indian tribal governments to protect their own ground water.

States and Indian tribes have the principal responsibility in ground-water protection and should maintain their traditional role in managing water and land use. The recent emphasis on ground-water protection has resulted in a large improvement in our understanding of the extent and significance of ground water in EPA programs and have required the states to expand their role in many new and unfamiliar areas.

Agricultural Chemicals in Ground Water

Pollution of ground water by pesticides and nitrates due to the application of agricultural chemicals is a major environmental concern in many parts of the country, particularly the Midwest. In Iowa, where agricultural chemicals are used in 60 percent of the state, some public and private drinking water wells have exceeded public health standards for nitrate. Pesticides also have been found in ground water. About 30 towns in Nebraska have excessive amounts of nitrate in their drinking water. Bottled water must be provided to infants and monthly well testing is required.

The interagency, interdisciplinary Iowa Big Spring Basin Demonstration Project is a seven-year effort to test the ground-water consequences and economic viability of various agricultural management techniques. It will include demonstrations of traditional and innovative agricultural practices to document effects on chemical movement, water quality, and crop production. It also will include educational programs to help farmers use fertilizers and pesticides more efficiently.

The Big Spring area in Iowa is a unique "laboratory" for expanding our understanding of how farm chemicals get into ground water and how to prevent contamination. Big Springs is dominated by farming. Nearly all of its ground water emerges at Big Spring, so chemicals that leach into the ground water eventually appear there. Transport of contaminants to the springs is extremely rapid due to limestone conditions. Early research shows nitrate concentrations have tripled in the last 25 years, paralleling a three-fold increase in use of nitrogen fertilizers. Toxic pesticides also have been found in greater amounts than anticipated.

The $6.8 million Big Spring Project is considered one of the nation's most significant studies of the effects of agricultural practices on ground water. It seeks not only more definitive answers on the relationship between ground water and agricultural practices, but also could provide the economically stressed farmers with cost-saving information.

Our principal challenge then is to support and assist them in that role. We have already responded by providing financial assistance for state and tribal strategy development and implementation as well as disseminating technical and policy guidance that will make this job easier. We will continue to provide technical assistance, training and guidance where necessary to ensure the development and effective implementation of state and tribal programs.

Achieving Consistency Among EPA Programs

Nearly all human activity has the potential to adversely affect ground-water resources. Consequently, there are multiple laws, regulations, policies, and programs for which EPA is responsible. The strength of our protection efforts will be vastly improved if we can get the many participants to support a well coordinated and comprehensive approach to ground-water protection. Critical elements of this approach are the differential protection policy and its implementation through the ground-water classification system.

Increasing Research Efforts

Our recent investigations regarding the nature, extent and significance of ground-water contamination has generated a series of questions. We will continue our ground-water research program to increase knowledge of monitoring, fate and transport of pollutants, aquifer restoration, source control, and health effects of exposure to contaminated ground water. Further, we will increase our efforts to disseminate our research findings to state and local governments and the private sector through a technical assistance and training program.

EPA'S AGENDA

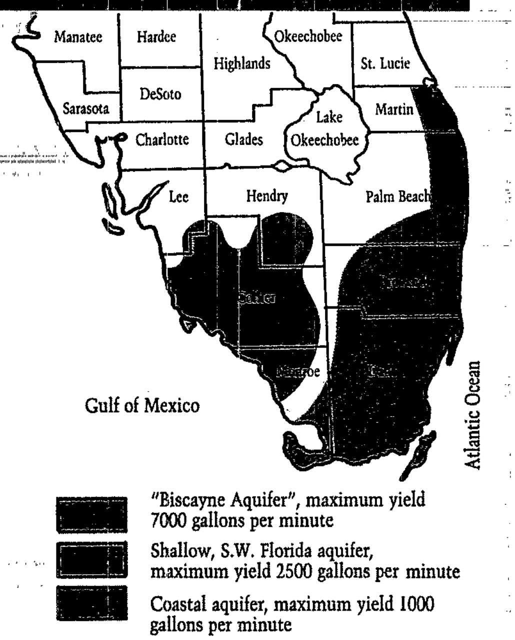
To meet the challenges of protecting ground-water resources, EPA will increase efforts to implement the ground-water protection strategy. The following actions are listed in order of priority:

- First and foremost, we will continue to strengthen the capability of states and indian tribes to effectively manage and protect ground-water resources. This will be done by continuing our support of ground-water strategies and wellhead protection programs. We will develop methods and techniques for state and local governments to delineate high priority areas and control sources of contamination that are not federally regulated.
- The Agency will also continue efforts to control sources of contamination of national concern. The Agricultural Chemicals in Ground Water Strategy provides a comprehensive and well reasoned plan of action to manage this growing problem. We will encourage its rapid implementation. Our survey of Agricultural Chemicals in Drinking Water will provide the data necessary to assist in making choices called for in this strategy.
- Publication of classification guidelines will provide all programs that address ground water with a consistent benchmark that can be used to guide their activities. We will therefore assist and encourage all EPA programs to be consistent with these guidelines. In support of the goals of the guidelines, we are planning an outreach effort to enable

federal, state and local ground-water managers, private business, and citizens to understand how EPA plans to establish priorities in its efforts to protect and cleanup ground water.

- EPA will continue its already substantial research efforts. We will continue ground-water research programs on monitoring, fate and transport, aquifer restoration, source control, and health effects of contaminants. Particular emphasis will be placed on the following: "aquifer restoration" technology; on-site treatment of wastes in groundwater utilizing biological microorganisms; and real time, on-site monitoring techniques.
- We will continue to improve the quality and accessibility of ground-water data collected by or on behalf of EPA (for example, by contractors, and by states with responsibility for EPA programs) so that regularly collected data can be used to develop a better understanding of the quality of our ground water.
- Finally, the Agency will further efforts to achieve interagency coordination and seek a more coordinated approach to problem resolution, through discussions with all federal departments responsible for ground-water protection.

Ground-Water Management in Dade County, Florida



Ground water is an abundant and vital resource in Florida. It supplies most of the state's drinking water and industrial needs, as well as about half of the state's agricultural needs. However, Florida also has many sources of ground-water contamination that threaten this essential resource. These sources include industrial wastewater lagoons, agricultural pesticides and fertilizers, leaking underground storage tanks, landfills, mining activities, and salt-water intrusion. In South Florida, the Biscayne Aquifer is the sole source of drinking water for three million people, many of whom live in populous Dade county, which includes Miami. This aquifer system is very vulnerable to contamination because of its thin soil cover and high permeability (i.e., water, as well as pollutants, easily can enter and flow through the aquifer).

In response to the many threats to its ground-water supplies, Florida has developed one of the most thorough and active ground-water protection programs in the country. It is administered through six district offices of the Florida Department of Environmental Regulation and five Water Management Districts. The state's programs incorporate a classification system, a wastewater discharge permitting system, ground-water monitoring program, public awareness and involvement programs, and research programs.

In addition to these state programs, Dade County has developed a program incorporating more restrictive and specific regulations to protect its water supplies. For example, the county is a pioneer in the development of wellhead area protection, which controls activities in areas surrounding the county's wells. The program is based largely on zoning regulations, inspections and enforcement. The County prohibits waste disposal sites, underground storage tanks and other potentially contaminating activities in designated wellhead protection areas.

Dade county also has compiled a list of 900 chemicals used to define hazardous waste, and has developed a permitting program that regulates about 8,000 generators of hazardous waste. In addition, the county program incorporates recharge area management, population growth management, and conventional pollution control techniques. Dade County and two neighboring counties also participate in the Biscayne Aquifer Project, a regional program established to protect the entire aquifer system in a coordinated effort. Through this conscientious effort, Dade County hopes to maintain and improve ground-water quality for the millions of people who depend upon it.

Drinking Water at the Tap

THE PROBLEM

The most severe and acute public health effects from contaminated drinking water such as cholera and typhoid have been eliminated in America. However, some less acute and immediate hazards remain in the Nation's tap water. These hazards are associated with a number of specific contaminants in drinking water.

Contaminants of special concern to EPA are lead, radionuclides, microbiological contaminants, and disinfection by-products. The remaining hazards also are related to the low level of compliance of small community systems with national drinking water standards. Finally, the Agency is concerned about potential contamination from underground injection of solid and hazardous waste.

Contaminants of Special Concern

- **Lead:** The primary source of lead in drinking water is corrosion of plumbing materials, such as lead service lines and lead solders, in water distribution systems and in houses and larger buildings. Virtually all public water systems serve households with lead solders of varying ages, and most faucets are made of materials that can contribute some lead to drinking water.

The health effects related to the ingestion of too much lead are very serious and can lead to impaired blood formation, brain damage, increased blood pressure, premature birth, low birth weight and nervous system disorders. Young children are especially at risk from high levels of lead in drinking water.

- **Radionuclides:** Radionuclides are radioactive isotopes that emit radiation as they decay. The most significant radionuclides in drinking water are radium, uranium, and radon, all of which occur in nature. These radionuclides are seldom found together in high concentrations, and relatively high levels of each radionuclide tend to be found in certain areas of the country; with radium occurring most frequently in the Midwest and Appalachian regions, natural uranium in the Rocky Mountains, and radon in the Northeast. Recent surveys, however, show that radon also may be naturally occurring in other parts of the country.

Ingestion of uranium and radium in drinking water may cause cancer of the bone and kidney. While radium and uranium enter the body by ingestion, radon, which is a gas, is usually inhaled after being released into the air during showers, baths, and other activities such as washing clothes and dishes. Although radon can be ingested as well as inhaled, it is estimated that inhalation is far more toxic than the ingestion route. The main health risk of concern due to inhalation of radon is lung cancer.

Radionuclides in drinking water occur primarily in those systems that use ground water. Naturally occurring radionuclides seldom are found in surface waters (such as rivers, lakes, and streams).

- **Microbiological Contaminants:** Water contains many microbes—bacteria, viruses, and protozoa. Although some organisms are harmless, others can cause disease. The Centers for Disease Control reported 112 waterborne disease outbreaks from 1981 through 1983. Parasites, such as Giardia lamblia, were the cause in 43 cases, while bacteria and viral pathogens were the causes in 22 cases. Microbial contamination continues to be a national concern because contaminated drinking water systems can rapidly spread disease.

- **Disinfection By-Products:** Disinfection by-products are produced during water treatment by the chemical reactions of disinfectants with naturally occurring or synthetic organic materials present in untreated water. Many disinfection by-products may pose health risks. These risks tend to be related to long-term exposure to low levels of contaminants. Disinfectants are essential to safe drinking water, therefore, EPA is looking at ways to minimize the risks from byproducts.

Improving Compliance of Small Water Supply Systems

Water supply systems serving between 25 and 3,300 persons account for the vast majority of our nation's public water suppliers. These small suppliers also represent the majority of water systems in the nation that are not in compliance with national drinking water standards. About one-third of the systems exceed Maximum Contaminant Levels (MCLs) for contaminants in drinking water or do not meet reporting requirements. Noncompliance with MCLs may increase as EPA meets its Congressionally-mandated responsibility to issue MCLs for 83 additional constituents during the next few years. Many small communities cannot afford to purchase equipment necessary for treating their drinking water adequately or to hire experienced operators to maintain drinking water treatment systems. Improving compliance by small systems will be particularly difficult.

Underground Injection Wells

Underground injection wells are used to dispose of solid and hazardous wastes and other fluids. If improperly injected, these wastes can contaminate underground sources of drinking water. This could create health risks for anyone drawing water from contaminated sources or result in otherwise unnecessary treatment before drinking.

EPA is particularly concerned about two types of wells, Class I wells and Class V wells. Class I wells are used for disposal of hazardous waste. Over half of all liquid hazardous waste that is generated in this country is disposed of in Class I wells. Class V wells are used for injecting solid waste into or above underground sources of drinking water. These Class V wells are not subject to detailed national standards and some may be damaging underground sources of drinking water.

EFFORTS TO DATE

We have established regulations to implement the SDWA for coliform bacteria, turbidity, and a number of inorganic, organic, and radioactive chemicals. To date, MCLs have been set for 26 contaminants as well as for volatile organic compounds. These regulations also call for periodic monitoring of public water supplies for the specified contaminants, and notification of water users when any of the standards are exceeded. Violations of drinking water criteria and monitoring and reporting requirements are analyzed periodically by state agencies and EPA.

The process of setting standards includes the collection of data on the toxicology and occurrence of contaminants, the costs and economic effects of treatment, and new methods of treatment. These data are needed before the Agency can objectively assess the extent of environmental problems associated with individual contaminants and set reasonable standards as required under the Safe Drinking Water Act. EPA recently finished a National Inorganic and Radionuclides Survey of drinking water to determine the occurrence of organic and radionuclide contamination in drinking water across the country.

The 1986 amendments to the SDWA require EPA to establish MCLs for 83 contaminants by 1989, and at least 25 more by 1991. The amendments also limit the use of lead solder, flux, and pipes used in new installations and repairs of public water systems. States are responsible for enforcing this prohibition.

The amendments require EPA to issue rules within 18 months for monitoring the disposal of hazardous waste below a drinking water source using Class I injection wells. Additionally, we are required to issue a report to Congress summarizing results of state surveys of Class V solid waste disposal wells. This report was submitted in September 1987.

As part of our commitment to state and local community outreach, the Agency published health advisories to help officials determine the health hazard of unregulated contaminants in drinking water. This guidance includes available scientific data and information on analytical methods and treatment techniques. State and local officials use these health advisories to select measures to protect public health for contaminants for which no MCL has yet been established.

EPA, states, and territories have the authority to enforce drinking water standards. At the beginning of 1988, 54 of 57 states and territories operated drinking water programs and were responsible for ensuring that public water systems met federal standards for MCLs. Thirty-nine states operate underground injection control programs.

TODAY'S CHALLENGES

One of the greatest challenges facing the nation's safe drinking water program is communicating to the public the long-term health risk associated with drinking water with low levels of contaminants. Historically, public concern with drinking water quality focused on health effects such as Giardiasis, hepatitis, cholera, typhoid, and Legionnaires Disease which result from drinking water containing disease-causing microbial organisms. These diseases appear almost immediately after consumption of the contaminated water. However, exposure to many other contaminants, such as organic chemicals, disinfection by-products, or radionuclides, may result in health effects that are less immediate but are of equal or greater concern. The challenge is to effectively communicate to the public the significance of these long-term health risks, and the importance of reducing these risks by further treatment of its drinking water.

Risks of diseases caused by microbial contamination which can be controlled by disinfection and filtration of water remain a concern of the Agency. From 1961 through 1983, there were over 575 reported cases of waterborne disease outbreaks involving more than 153,000 individual cases of illness resulting in 23 deaths. From 1981 through 1985, 351 cases of outbreaks were reported from public systems which inadequately treated their water. And yet, there are still over 1300 community water systems and more than 1500 noncommunity water systems which use surface water as a source of drinking water and do not provide filtration.

EPA'S AGENDA

Another challenge is to overcome the financial problems faced by public water supply systems, especially the small systems. Many systems lack funds for treatment technologies or regular monitoring and analysis of drinking water. Because of their size, small systems have limited access to capital and there is often consumer opposition to rate increases to finance additional treatment systems. One possible reason for this opposition is the lack of information about the potential health risks from inadequate treatment.

The financial problems are likely to become worse as EPA meets its mandate under the Safe Drinking Water Act. New regulations will not only require public water systems to treat and monitor for additional contaminants but also require systems which use surface water to provide filtration and stringent coliform monitoring.

Mobilization

A five-year project is underway to involve agencies and organizations concerned about drinking water quality in mobilizing support and understanding of national drinking water problems and solutions. This effort will concentrate on the four contaminants of concern (radionuclides, lead, microbiological contaminants, and disinfection by-products) and small system compliance.

EPA hopes to increase knowledge and awareness of the drinking water program. It is also important to increase the number of trained personnel in the public and private sectors. Finally, we need to increase the willingness of the public to pay for improved water systems.

We will work with as many agencies and organizations as possible to provide technical assistance, education, and training. For example, EPA has basic informational materials, such as brochures, videos, and public service announcements, to use in meetings and conferences and to distribute to consumers.

Enforcement

Having more contaminants to regulate means that technical assistance, education, and training must be supplemented by enforcement to form a balanced compliance program. The 1986 amendments to the Safe Drinking Water Act gave EPA greater authority to take action against violators. However, enforcing all of the new MCLs will be difficult and expensive. We will need an efficient and effective strategy if we are to meet our responsibilities under the statute. Enforcement will focus on systems whose contaminant levels exceed MCLs and where appropriate measures are not being taken to reduce the contaminant levels. Of special concern will be those high risk situations where a system has shown a long-term failure to monitor for contaminants and where there have been frequent violations relating to microbiological risks.

Underground Injection

We will be publishing final rules in 1988 for the disposal of hazardous waste into injection wells. These regulations will prevent the migration of injected hazardous wastes out of the deep underground zone where they are injected. As part of the implementation of these rules, EPA will be reviewing permit applications submitted by owners of hazardous waste injection wells. When approved, each permit will specify what the owner must do to comply with the new rules. In addition, we will be reviewing Class V wells and deciding what kinds of controls are needed to prevent these wells from contaminating underground sources of drinking water.

Pesticides in Drinking Water

As part of the National Pesticide Survey, we will be sampling 1500 drinking water wells around the country for 70 pesticides to determine if contamination from pesticides is a national problem. The results of this effort will help us to decide if MCLs should be set for any additional pesticides. The final report is due in early 1990.

Critical aquatic habitats that need special management attention include the nation's wetlands, near coastal waters, oceans, and lakes. In recent years EPA has been focusing on addressing the special problems of these areas.

Wetlands

THE PROBLEM

The United States is losing one of its most valuable, and perhaps irreplaceable, resources - the nation's wetlands. Once regarded as wastelands, wetlands are now recognized as an important resource to people and the environment.

Wetlands are among the most productive of all ecosystems. Wetland plants convert sunlight into plant material or biomass which serves as food for many types of aquatic and terrestrial animals. The major food value of wetland plants occurs as they break down into small particles to form the base of an aquatic food chain.

Wetlands are habitats for many forms of fish and wildlife. Approximately two-thirds of this nation's major commercial fisheries use estuaries and coastal marshes as nurseries or spawning grounds. Migratory waterfowl and other birds also depend on wetlands, some spending their entire lives in wetlands and others using them primarily as nesting, feeding or resting grounds.

The role of wetlands in improving and maintaining water quality in adjacent water bodies is increasingly being recognized in the scientific literature. Wetlands remove nutrients such as nitrogen and phosphorus, and thus help prevent over-enrichment of waters (eutrophication). Also, they filter harmful chemicals, such as pesticides and heavy metals, and trap suspended sediments, which otherwise would produce turbidity (cloudiness) in water. This function is particularly important as a natural buffer for nonpoint pollution sources.

Wetlands also have socioeconomic values. They play an important role in flood control by absorbing peak flows and releasing water slowly. Along the coast, they buffer land against storm surges resulting from hurricanes and tropical storms. Wetlands vegetation can reduce shoreline erosion by absorbing and dissipating wave energy and encouraging the deposition of suspended sediments. Also, wetlands contribute $20 billion to $40 billion annually to the nation's economy, for example, through recreational and commercial fishing, hunting of waterfowl, and the production of cash crops such as wild rice and cranberries. Unfortunately, our natural heritage of swamps, marshes, bogs, and other types of wetlands is rapidly disappearing. Once there were over 200 million acres of wetlands in the lower 48 states; by the mid-1970's, only 99 million acres remained. Between 1955 and 1975, more than 11 million acres of wetlands were lost entirely - an area three times the size of the state of New Jersey. The average rate of wetland loss during this period was 458,000 acres per year - 440,000 acres of inland wetlands and 18,000 acres of coastal wetlands. Agricultural development involving drainage of wetlands was responsible for 87 percent of the losses during those two decades. Urban and other development caused 8 percent and 5 percent of losses, respectively. In addition to the physical destruction of habitat, wetlands are also threatened by chemical contamination and other types of pollution.

EFFORTS TO DATE

As recognition of the importance of our nation's wetlands has increased, so have government efforts to protect them. In 1987, EPA established the Office of Wetlands Protection to expand our efforts and emphasize our wetlands protection goals. EPA has been involved in wetlands protection since the enactment in 1972 of Section 404 of the Clean Water Act. This section regulates the discharge of dredged or fill material into waters of the United States. However, EPA's wetland protection responsibilities extend beyond Section 404 to other sections of the Clean Water Act. Since most wetlands are waters of the United States within the meaning of the Act, they are automatically accorded all of the law's protection.

Programmatically, wetland protection is linked directly and indirectly to other Office of Water programs, such as marine and estuarine protection, nonpoint source management, and ground-water protection. An integrated strategy for wetlands results in increased recognition of the importance of wetlands in improving water quality, and provides enhanced protection by addressing wetlands as an ecologically meaningful unit.

Section 404 of the Clean Water Act

Currently no comprehensive federal law for protecting wetlands exists. The major federal regulatory program for wetlands is section 404 of the Clean Water Act, which is jointly administered by EPA and the U.S. Corps of Engineers. The Corps bears the day-to-day administrative responsibilities for the program, reviewing permit applications, issuing permits, and taking actions against violators of the law.

EPA and the Corps jointly developed the section 404 (b)(1) guidelines, which are the environmental standards that the Corps must apply when evaluating a permit application for the discharge of dredged or fill material. Section 404(c) authorizes EPA to prohibit or restrict the use of a wetlands site for such discharge if we determine that the proposed discharge will have an adverse effect on municipal water supplies, shellfish beds and fishing areas, wildlife, or recreational areas.

EPA's other section 404 responsibilities include: determining and defining the areas that constitute wetlands subject to regulation under section 404; reviewing permit applications and providing recommendations to the Corps regarding permit issuance, restriction, or denial; defining activities that may be exempt from the permit requirements, such as certain farming, ranching,and forestry practices; approving and overseeing state assumption of the 404 program; and enforcing against unpermitted discharges.

In recent years, we have taken an increasingly active role in the 404 program. One area of stepped-up activity has been Section 404(c). Between 1983 and early 1988, we have initiated 13 actions to veto or restrict a proposed permit issuance by the Corps. This represents an important increase in activity, since we had only used Section 404(c) once between 1972 and 1983.

Also, we have begun a more anticipatory approach that addresses wetland loss problems in advance of individual project proposals. Under this advanced identification process, we work with the Corps, and possibly state and local agencies, to select and study geographic areas. We then determine which are likely to be environmentally suitable and unsuitable for disposal of dredged or fill materials. Numerous advanced identification projects are ongoing throughout the country. The process can avoid costly litigation by helping developers identify areas that are not environmentally sensitive and slow down the loss of valuable wetlands.

Other Federal Laws

Federal programs other than the Clean Water Act also protect the Nation's wetlands. The U.S. Fish and Wildlife Service acquires migratory waterfowl habitat, that are primarily wetlands, for inclusion in the National Wildlife Refuge System. These acquisitions are funded in part by revenues obtained from the sale of duck stamps (which are required of all waterfowl hunters aged 16 and over). In 1986, Congress passed the Emergency Wetlands Resources Act that expands and enhances the sources of funds for wetlands acquisition. The new law also directs the Secretary of the Interior to develop, in consultation with EPA and other federal and state agencies, a National Wetlands Priority Conservation Plan that identifies the type of wetlands and wetland interests to be given priority for federal and state acquisition.

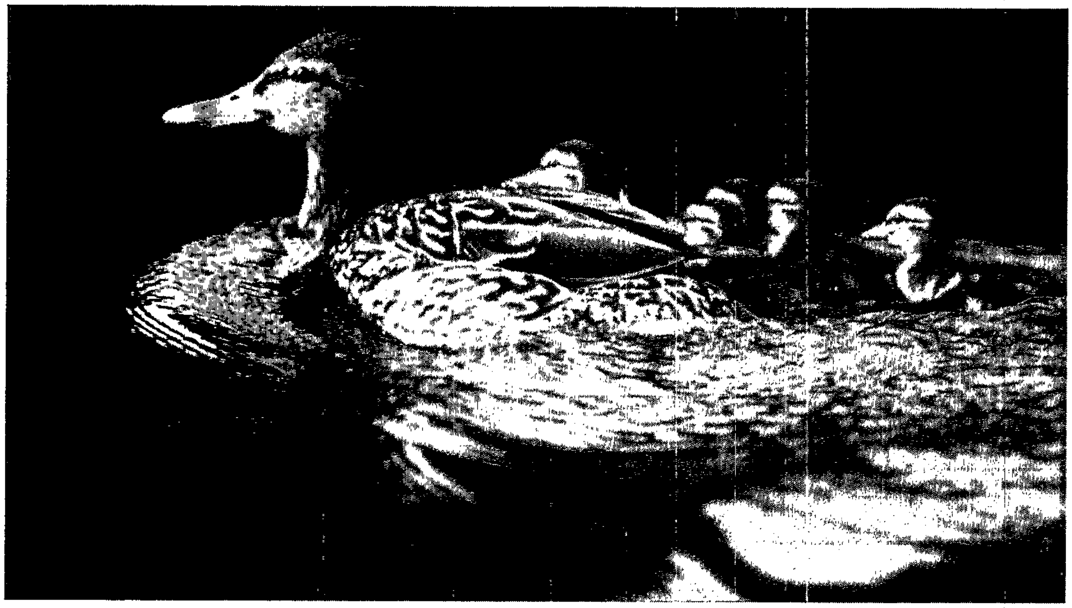
While various federal programs do protect wetlands, other policies actually encourage wetland destruction by reducing the costs of conversion to other uses. In recent years, Congress has passed laws designed to eliminate these inconsistent federal wetland policies. The Coastal Barriers Resource Act of 1982 prohibits most new federal expenditures and financial assistance for development of designated barrier islands, helping to protect their important wetland resources. Of greater significance for other wetlands is the "Swampbuster" provision of the Food Security Act of 1985, implemented by the Department of Agriculture. Swampbuster seeks to discourage the further conversion of wetlands for agricultural purposes by making any person who produces crops on wetlands converted after December 23, 1985, ineligible for most federal farm benefits.

State and Local Laws

Like the federal government, state and local governments have passed laws to protect wetlands through acquisition, regulation, and other approaches. Laws passed by most coastal states have significantly reduced the loss of coastal wetlands. In contrast, inland wetlands are inadequately protected; fewer than 25 states have laws specifically regulating their uses. Within the last several years, however, an increasing number of states have passed inland wetlands legislation including New Jersey, Maine, and Florida.

TODAY'S CHALLENGES

Despite recent efforts, our nation's wetlands continue to be threatened. Loss of habitat remains the primary threat for all of our nation's wetlands. These threats vary, depending on the wetland type and region of the country.Descriptions of some of the principal areas of concern are:



Coastal Louisiana: Louisiana contains approximately one-third of the coastal marshes in the lower 48 states. These marshes are being lost at an annual rate of 25,000 acres due to a combination of natural and human-induced causes, such as Mississippi River channelization and levee construction, canal dredging for navigation and energy operations, and subsidence from extraction of oil and gas, minerals, and ground water.

Southeast: Bottomland hardwood wetlands occupy the floodplains of many of the forested wetlands occurring in the lower Mississippi Valley. Less than 25 percent of the original acreage remains today. Many of these wetlands have been cleared and drained for crop production. Federal flood control and small watershed projects also have adversely affected the bottomland hardwoods.

Seventy percent of the nation's pocosins — a type of shrub swamp — are found in North Carolina, where they help stabilize water quality and balance salinity in such estuaries as Albermarle and Pamlico Sounds. Of the 2.5 million acres originally found in North Carolina, barely one million remain in their natural condition. Timber production, agriculture, and peat extraction have been the most rapidly developing uses of these wetlands.

Midwest/Great Plains: The Prairie Pothole Region consists of about 300,000 square miles extending from south-central Canada to the north-central United states. Prairie pothole wetlands are water-holding depressions usually of glacial origin. These are perhaps the most valuable inland marshes for waterfowl production in North America. Although the Prairie Pothole Region comprises only 10 percent of the continent's total waterfowl breeding area, it produces 50 percent of the duck population in an average year. Millions of acres of potholes have been drained and converted to agricultural uses or destroyed by irrigation and flood control projects.

Northeast: Unlike many other regions of the country, the primary threat to the inland marshes and swamps of the Northeast in recent years has not been agricultural activities. These wetlands are being destroyed by highway construction, hydroelectric and water supply projects, and recreational houses and facilities.

Alaska: Alaska has more than 200 million acres of wetlands, encompassing about 58 percent of the state's land area. Although wetland losses have not been great, the discovery of significant oil and gas deposits at Prudhoe Bay and the subsequent pipeline construction and energy development have altered wetlands.

Coastal California: Of special concern are the coastal wetlands of San Francisco Bay, California's largest estuary. Most of the bay's original wetland acreage was lost to urban and industrial development, while many remaining coastal wetlands were diked to create salt-evaporation ponds. Despite the existence of state and local wetland protection laws, these wetlands are still under heavy pressure for urban and industrial development.

Urban Areas: Wetlands in urban areas frequently represent the last large tracts of open space and often are a final haven for wildlife. Not surprisingly, as suitable upland development sites become exhausted, urban wetlands are under increasing pressure for residential housing, industry, and commercial facilities.

Increasing evidence exists that our nation's wetlands, in addition to being destroyed by physical threats, also are being degraded by chemical contamination. Although the extent of the threat is not known, the problem of wetland contamination received national attention in 1985, with reports of waterfowl deaths and deformities caused by selenium contamination at Kesterson National Wildlife Refuge in California. Selenium is a trace element that occurs naturally in soil and is needed in small amounts to sustain life. However, for years it was being leached out of the soil and carried in agricultural drainwater used to flood the refuge's wetlands, where it accumulated in dangerously high levels.

EPA'S AGENDA

In 1986, after a major strategic study of wetlands, EPA Administrator Lee Thomas underscored the Agency's commitment to protecting this resource by creating an Office of Wetlands Protection (OWP). Wetland protection activities will be expanded beyond the traditional Clean Water Act section 404 authorities with the following areas of emphasis.

Expedite Section 404 Policy Development

The section 404 regulatory responsibilities will continue to serve as the cornerstone for EPA's wetland protection activities, with particular emphasis on expediting policy development in such areas as enforcement, mitigation, and delineation of wetland boundaries.

Enhance State and Local Participation

EPA has long recognized the importance of the state and local roles in wetland protection. In the context of the section 404 program, we are continuing to look for ways to make program assumption more attractive and easier for the states. We are expanding technical assistance to state wetland programs and developing scientific initiatives to strengthen the role of local governments in wetlands protection.

Superfund Sites in Wetlands

Preliminary estimates indicate that less than 10 percent of contamination from Superfund sites has been found in wetlands. In 1988, EPA will be refining these estimates by conducting a more detailed evaluation of Superfund sites. EPA is identifying how the Superfund program can take better account of the special needs of Superfund sites in wetlands.

Increase Anticipatory Approaches to Wetlands Protection

While seeking to make the traditional regulatory programs more efficient and effective, we are also identifying and promoting complementary or related nonregulatory programs. The goals of this effort include: ensuring protection of high priority wetlands; complementing wetland protection where section 404 does not apply or is ineffective; and supplementing permit-by-permit review with other approaches that facilitate consideration of indirect or cumulative impacts. In addition to the advanced identification process, we are also working with the comprehensive planning processes of other agencies that could provide more wetland protection, such as special area management planning under the Coastal Zone Management Act.

Increase Coordination with and Consistency of Federal and State Policies

We are improving integration of wetlands into EPA's planning and management efforts. The Agency also is working with other federal agencies to support complementary programs

Rainwater Basin Advanced Identification Project

The Rainwater Basin spans 4,200 square miles in central Nebraska south of the Platte River. Early in this century, it contained nearly 4,000 distinct wetlands, totalling about 94,000 acres. Today, largely as a result of the installation of irrigation or drainage systems, more than 90 percent of the original wetland basins have been destroyed. About 375 wetlands remain. Destruction of the wetlands has resulted in the loss of habitat for the millions of ducks and geese that migrate annually through the central flyway.

EPA and the Corps of Engineers Omaha District established an interagency team comprised of technical representatives of the Nebraska Department of Environmental Control, U.S. Fish and Wildlife Service, the Nebraska Game and Parks Commission, and the U.S. Soil Conservation Service. The team has undertaken four concurrent efforts designed to increase the chances of preserving wetlands of the Rainwater Basin.

- ***Establishing an Inventory of the Existing Wetlands.*** *This is a particularly complex task in the Rainwater Basin area because these wetlands are extremely dynamic systems, sometimes disappearing completely during periods of drought.*
- ***Collecting Technical Data.*** *Limited information is available on the wetlands in the Rainwater Basin. Data are being collected systematically to document the scientific and environmental significance of these ecosystems. These data also will be used to develop criteria for identifying wetlands subject to Clean Water Act jurisdiction and for designating areas as suitable or unsuitable for disposal site specification.*
- ***Analyzing the Costs and Benefits of Wetlands Conversion.*** *Because careful consideration must be given to the economics involved in wetland designation, an analysis is being conducted of the profitability of converting wetlands to agricultural use, and the costs associated with wetlands destruction. Economic costs attributable to wetlands destruction could prove to be the most compelling argument in favor of preservation.*
- ***Conducting a Community Involvement Program.*** *EPA initiated a community involvement program to set the stage for the designation process, stress the values of wetlands and the implication of their destruction, and raise public awareness of the Clean Water Act section 404 program.*

The result of these efforts will be the identification and protection of those wetlands in the Rainwater Basin that will serve as a stopover and nesting ground for many future generations of wildfowl.

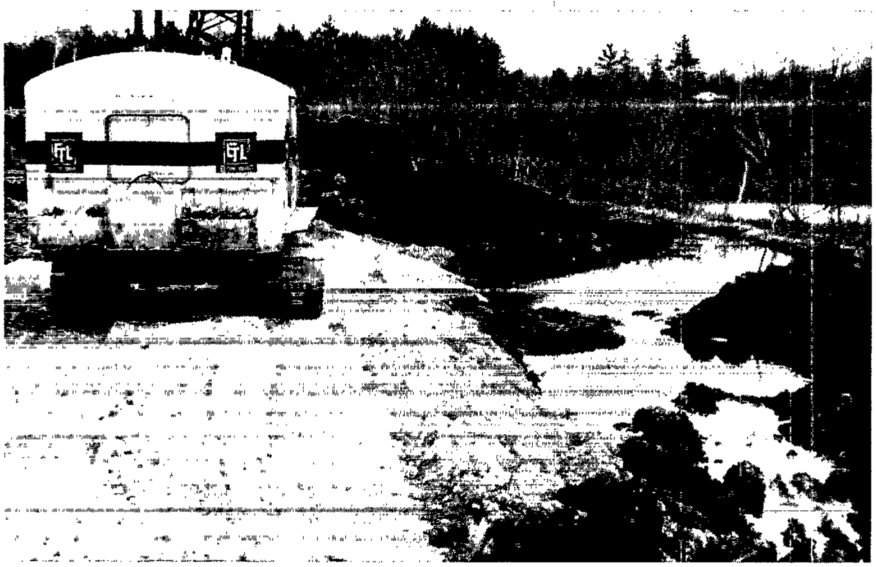
such as the Department of Agriculture's implementation of the Swampbuster provisions of the Food Security Act of 1985, and to eliminate policies that harm wetlands.

Expand Scientific Knowledge of Wetland Functions

Wetland ecology is a relatively young science with major information gaps. Thus, the Agency is implementing a five-year Wetlands Research Plan, adopted in 1986, that addresses: (1) the contribution of wetlands to water quality; (2) prediction of the cumulative impacts of wetland loss and the relation of individual permit decisions to that loss; and (3) techniques for creating and restoring wetlands.

Enhance Public Awareness of Wetlands Values

Ultimate protection of our nation's wetlands requires that all Americans understand the need to protect these natural resources. Private landowners, public land managers, developers, and the general public should be more aware of the ecological value of wetlands. Ongoing and proposed public education projects include public service announcements for television, informational brochures, and educational curriculum materials. The National Wetlands Policy Forum is also part of EPA's efforts to increase public awareness (see the highlight "National Wetlands Policy Forum").



Excavation and filling operations are a serious threat to wetlands.

National Wetlands Policy Forum

Through the Conservation Foundation, EPA has convened a National Wetlands Policy Forum to develop sound, broadly supported recommendations for effective wetlands management. The issues to be addressed are intended to go beyond those relating to the Clean Water Act section 404 program.

The Forum has been organized to involve people with varying opinions on the process of wetlands management. It is being chaired by New Jersey Governor Thomas Kean and its members represent state and local governments, environmental groups, academia, business, agriculture, and forestry interests. In addition, representatives of five federal agencies involved in wetlands management are participating in the Forum as ex officio members.

The purpose of the Forum is to address major national policy concerns about the protection and use of the nation's wetland resources, discuss goals for future wetlands initiatives, and establish a framework for comprehensive national wetlands policies. The forum expects to make its recommendations by mid-1988 on how federal, state, and local wetlands policy could be improved to benefit both environmental protection and economic development.

Near Coastal Waters and the Great Lakes

THE PROBLEM

Near Coastal Waters

The nation's near coastal waters encompass inland waters from the coast to the head of tide (i.e., the farthest point inland at which the influence of the tides on water level is detected). These waters include bays, estuaries, and coastal wetlands, and the coastal ocean out to where it is no longer affected by land and water uses in the coastal drainage basin. Taken together, these ecosystems support a wide range of ecological, economic, recreational, and aesthetic uses that depend upon good water quality.

Coastal waters and wetlands are home to many ecologically and commercially valuable species of finfish, shellfish, birds, and other wildlife. Eighty-five percent of our nation's commercially harvested fish are dependent upon near coastal waters at some point in their life cycles. These waters generate billions of dollars a year in income from commercial and recreational fisheries, tourism and travel, urban waterfront and private real estate development, recreational boating, marinas, and harbors. Millions of people enjoy the bays, beaches, wetlands, and coastal ocean for swimming, boating, fishing, hiking, birdwatching, and open space every year.

These environments are particularly susceptible to contamination because they act as sinks for the large quantities of pollution discharged from municipal sewage treatment plants, industrial facilities, and hazardous waste disposal sites. In many coastal areas, nonpoint source runoff from agricultural lands, suburban developments, city streets, and combined sewer and stormwater overflows poses an even more significant problem than point sources. This is due to the difficulty of identifying and then controlling the source of the pollution.

Coastal Wetlands

Physical and hydrological modifications from such activities as dredging channels, draining and filling wetlands, constructing dams, diverting freshwater for irrigation and drinking, and building shorefront houses may further degrade near coastal environments. Growing population pressures will continue to subject these sensitive coastal ecosystems to further stress. As a result, near coastal waters are suffering from a number of major environmental problems whose specific impacts vary from waterbody to waterbody. These problems include toxic contamination, eutrophication, pathogen contamination, habitat loss and alteration, and changes in living resources.

Toxic chemicals contaminate finfish, shellfish, water birds, and a number of near coastal habitats. Contamination often results in closures of shellfish bed harvesting areas and fishery bans or advisories against fish consumption. Eutrophication is the extensive algae growth that results from excessive nutrient loadings. Eutrophication recurs every summer along parts of the Gulf and East Coasts. Pathogen contamination causes many shellfish closures, as well as beach closures. From 1980 to 1985 alone, eleven coastal states suffered losses of 1,000 to 200,000 acres of productive shellfish beds.

Destruction of coastal habitats including wetlands and shallow open waters has been accelerating in recent years. As a result, coastal fisheries, wildlife and bird populations have been declining, with fewer species represented. Expanding development into previously pristine coastal areas is a major threat.

The Great Lakes

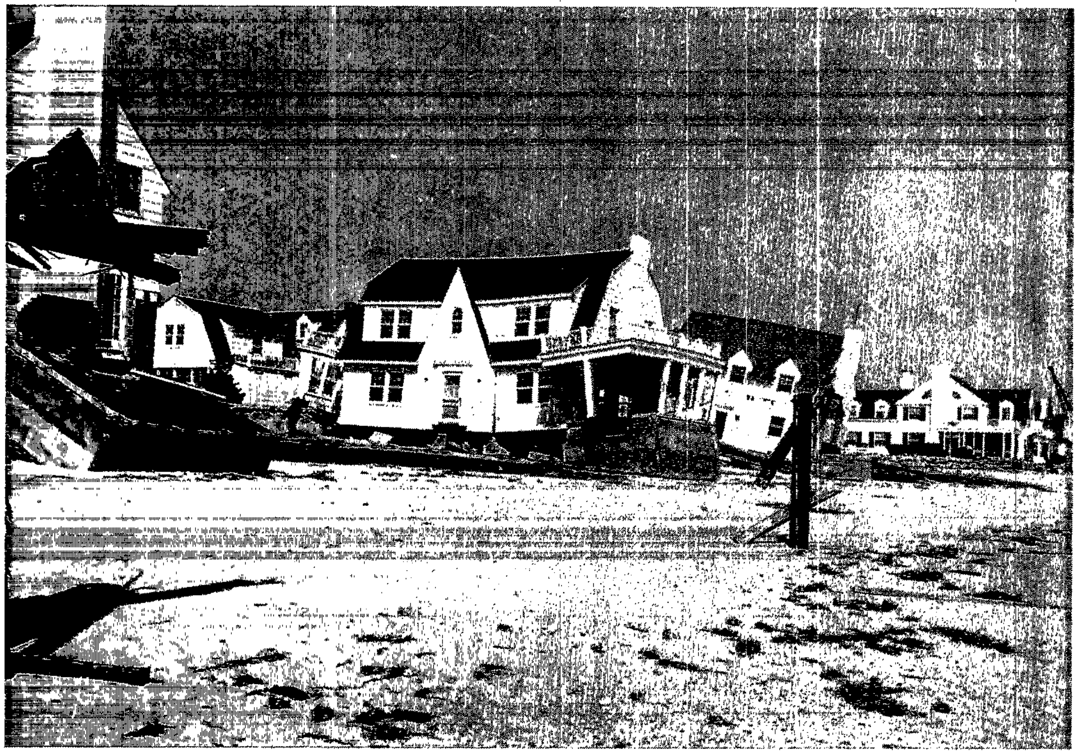
The Great Lakes provide an invaluable resource to the 45 million people living in the surrounding basin. The five lakes, which fall under the jurisdiction of eight states in the U.S. and one province in Canada, possess 95 percent of the entire U.S. fresh surface water. A 1970 study by the International Joint Commission, created under the Boundary Waters Treaty of 1901, identified nutrients and toxics problems in the lakes. The study found that Lake Ontario and Lake Erie in particular suffered from eutrophication problems caused by excessive nutrient inputs. Since then, joint efforts by the two countries have resulted in major successes in reducing the nutrient loadings, particularly phosphorus, and controlling the eutrophication. However, contamination of the water and fish by toxics from pesticides runoff, landfill leachates, and in-place polluted sediments remains a major problem. These issues now are being addressed by the U.S. and Canada.

EFFORTS TO DATE

As an indication of our continued and heightened commitment to protecting the nation's marine and coastal waters, EPA established the Office of Marine and Estuarine Protection in 1984. The Office administers all of EPA's ocean and coastal programs. The two major statutory authorities under which it operates are the Marine Protection, Research, and Sanctuaries Act, which covers ocean dumping and monitoring, and the Clean Water Act, which covers coastal and ocean discharges and the National Estuary Program. The Agency also has implemented programs to address the problems of the Chesapeake Bay and other estuaries.

Great Lakes Program

Our Great Lakes Program originated in 1972 under the Clean Water Act in response to major nutrient pollution problems, particularly in the Western Basin of Lake Erie. In the same year, the U.S. signed the first of its Great Lakes Water Quality Agreements with Canada, which focused on nutrient pollution, mainly phosphorus from urban and agricultural sources. The two countries expanded the agreement in 1978 and again in 1983. In addition to research on the problems from toxic compounds in the lakes, the agreement calls for five of the Great Lakes states to develop individual programs to meet phosphorus limits. In 1987, the U.S. and Canada agreed to address more closely toxicant concentrations in the Great Lakes.



Coastal storm damage.

The federal government has spent over $6 billion dollars on Great Lakes problems since the passage of the Clean Water Act in 1972. This money was for the construction and upgrading of more than 1,000 municipal sewage treatment facilities in the Great Lakes basin. Today, virtually all U.S. municipal facilities discharging to the Great Lakes basin are in compliance with the 1 mg/liter phosphorus limit set by the Great Lakes agreement.

Chesapeake Bay Program

In 1983, we completed a seven-year study of the causes of declining productivity in the Chesapeake Bay. The study was the first milestone in the ongoing Chesapeake Bay cleanup effort. The main report, A Framework for Action, concluded that the major problems affecting the bay were nutrient enrichment, toxic contamination, substantially increased areas of low dissolved oxygen, declines in striped bass, submerged grasses and other living resources, and substantial population growth and changes in land uses. Later in 1983, the states of Maryland, Virginia, and Pennsylvania, the District of Columbia, EPA, and the Chesapeake Bay Commission signed an historic Chesapeake Bay Agreement to work cooperatively in cleaning up the bay. The Chesapeake Bay Restoration and Protection Plan recommended that state and federal programs improve habitat and restore finfish and shellfish populations. It also calls for reducing nutrient and toxic substance contamination from industrial and municipal point sources and from agricultural and urban nonpoint sources.

In 1987, two additional milestones for the program were achieved. In February, the program was enacted into law as part of the new Clean Water Act. And on December 16, Maryland, Virginia, Pennsylvania, the District of Columbia, EPA, and the Chesapeake Bay Commission signed a new, more specific Chesapeake Bay Agreement. This agreement specifies goals for state implementation programs and commits the federal government to have a coordinated work plan in place by July 1988. The plan will outline all federal activities and resources that will be dedicated to protecting and restoring the Bay.

National Estuary Program

The experiences of the Great Lakes and Chesapeake Bay programs with successful management through partnership of the public and private sectors helped lay the foundation for EPA's National Estuary Program. This program began in 1985 with a $4 million appropriation from Congress. Passage of the Water Quality Act of 1987 signaled national recognition of the need to ensure protection of our estuaries by formally establishing the National Estuaries Program. The Act authorizes the Administrator to convene management conferences to develop Comprehensive Conservation and Management Plans for estuaries of national significance that are threatened by pollution, development, or overuse. These national demonstration programs are based on a cooperative three-phased approach: characterization of the environmental problems, development of a management plan, and implementation.

The Water Quality Act listed twelve estuaries to be considered for inclusion into the National Estuary Program. EPA has formally convened management conferences for six estuaries: Buzzards Bay in Massachusetts, Narragansett Bay in Rhode Island, Long Island Sound in New York and Connecticut, Puget Sound in Washington, Albemarle-Pamlico Sounds in North Carolina, and San Francisco Bay in California. Other waterbodies under consideration are New York-New Jersey Harbor, Delaware Bay in New Jersey and Delaware, Delaware Inland Bays, Sarasota Bay in Florida, Galveston Bay in Texas, and Santa Monica Bay in California.

Near Coastal Water Initiative

In 1985 EPA developed a long-term strategic plan to manage environmental problems in near coastal waters that were not being addressed by the ongoing bay and estuary programs. The Agency currently is conducting an assessment of near coastal waters to identify those in need of management attention. We are sponsoring three projects designed to demonstrate innovative and cost-effective techniques for cleaning up and protecting near coastal waters.

TODAY'S CHALLENGES

Protection of the coastal and marine environment in the face of accelerating growth will continue to present challenges for the nation. Current estimates predict that by the year 2000, 75 percent of the U.S. population will live within 50 miles of the coast. Near coastal water pollution problems became highly visible to the public during the summer of 1987 when a number of pollution incidents around the country were reported, including the death of fish and shellfish, closing shellfishing and swimming areas, bans on eating fish, and incidents of garbage washing up on New Jersey beaches.

The challenge for resolving the various pollution problems in coastal waters will be to get federal, state, and local governments to follow through on their commitments. For example, federal, state, and local agencies must work together to achieve nutrient reduction of 40 percent by the year 2000, in Chesapeake Bay.

As in most programs, success will largely depend on obtaining the necessary financial resources to improve environmental controls. In particular, managers will need to rely more on innovative financing strategies such as tax incentives, user fees, and promoting land acquisition by private parties. Incentives will be needed for farmers to change to less polluting agricultural practices and for industry to convert to recycling and reduction of chemical wastes. Finally, expanded public awareness of the effects of pollution from the watershed on near coastal waters is crucial to protection of coastal waters.

EPA'S AGENDA

A high priority will be to continue EPA's coastal waterbody management programs. EPA will be overseeing the National Estuary Programs in designated estuaries. EPA will continue to implement both the Chesapeake Bay and the Great Lakes agreements.

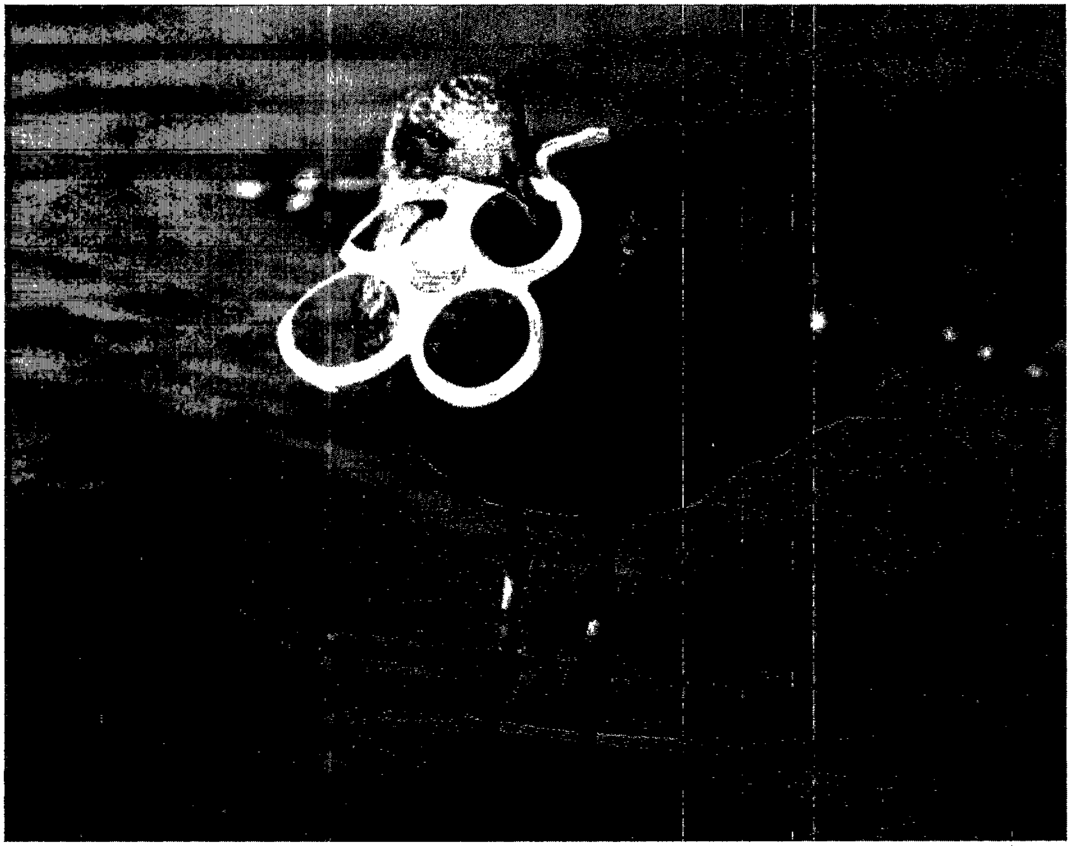
The Agency will be focusing more permitting and enforcement actions on coastal waters. Criteria to assess marine water quality and the extent of toxic contamination of estuarine sediments will be developed. More extensive research on near coastal water impacts will be conducted.

We will continue to update, with the assistance of National Oceanic and Atmospheric Administration and the coastal states, our national assessment of near coastal waters as a basis for identifying waterbodies needing management attention. Technology and information transfer of successful management techniques and solutions developed through the Great Lakes, Chesapeake Bay, National Estuary, and other programs will continue to be a high priority. Through work with state and local governments, scientists, fishermen, industry, and the public, we hope more people will be committed to protecting our valuable coastal water resources.

The Ocean
The Problem

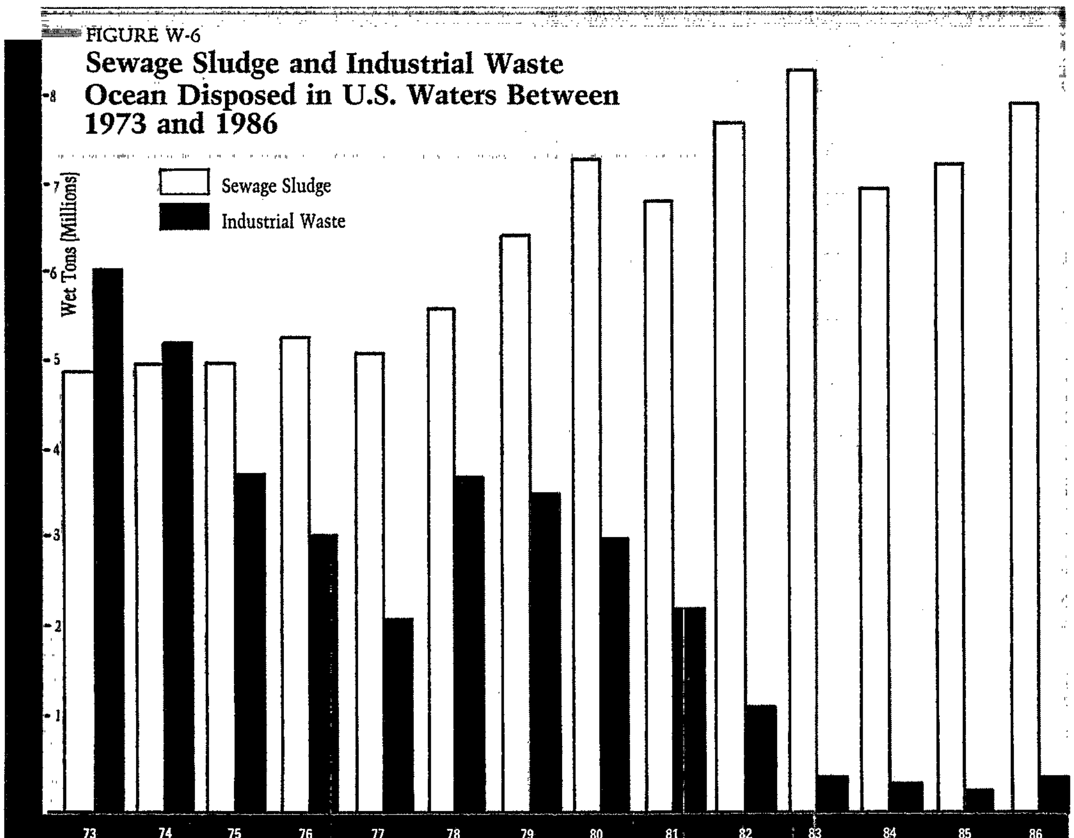
Ocean dumping of dredged material, sewage sludge, and industrial wastes is a major source of ocean pollution. Sediments dredged from industrialized urban harbors are often highly contaminated with heavy metals and toxic synthetic organic chemicals like PCBs and petroleum hydrocarbons. When these sediments are dumped in the ocean, the contaminants can be taken up by marine organisms. National concern for the threat of environmental quality impacts from ocean dumping led to passage of the Marine Protection, Research and Sanctuaries Act in 1972. Under this act, EPA and the U.S. Army Corps of Engineers are responsible for regulating the transportation and dumping of wastes in the ocean.

The Congressional Office of Technology Assessment 1987 report entitled *Wastes in Marine Environments* indicates that the ocean dumping of dredged materials, sludge, and industrial wastes is now less of a threat to the ocean. However, persistent disposal of plastics from land and ships at sea have become serious problems, particularly in the past several years. The most severe impact of this nonbiodegradable debris floating in the ocean is injury and death of fish, marine mammals, and birds. Debris on beaches from sewer and storm drain overflows, or mismanagement of trash poses public safety and aesthetic concerns and can result in major economic losses for coastal communities during tourist season.



Herring Gull entangled in plastic trash.

FIGURE W-6
Sewage Sludge and Industrial Waste Ocean Disposed in U.S. Waters Between 1973 and 1986



Note: For the purpose of this graph, Industrial Waste Category also includes Fish Waste and Construction Debris
Source: Office of Marine and Estuarine Protection, USEPA

EFFORTS TO DATE

Ocean dumping of industrial wastes has declined from 5 million tons in 1973 to 0.3 million tons in 1986 (see Figure W-6). Sewage sludge dumping in the ocean has increased from 5 million tons in 1973 to 7.9 million tons in 1986. This increase is due largely to construction and operation of new or improved sewage treatment plants that increased the production of sewage sludge. In December 1987, due to action taken by EPA, dumping at the relatively shallow sludge dumping site 12 miles offshore in the New York Bight ceased and dumping operations were transferred to a site located about 100 miles offshore. This action is expected to result in an improvement of the condition of the nearshore area.

TODAY'S CHALLENGES

The major challenge facing the oceans will be the resolution of the country's waste disposal crisis. In the past, dumping in the ocean was sometimes seen as the "quick fix" solution for waste disposal problems. The nation needs an integrated long-term waste management strategy, with ocean dumping as one of several waste management options. Resolution of the marine debris problem, particularly problems due to nonbiodegradable plastics, presents a different challenge. It involves lifestyle changes of the average citizen using and throwing away plastic products and of the fisherman who discards plastic fish nets at sea. Manufacturers need to be encouraged to use more biodegradable or recyclable material.

EPA'S AGENDA

EPA's long-term agenda for the oceans will be to work towards an integrated waste management strategy, that shifts away from ocean disposal alternatives. The short-term agenda will be to issue the revised ocean dumping regulations, and investigate the extent of the persistent marine debris problem. Where EPA has authority, we will work to improve existing controls. We will also work with other Federal agencies to determine how their laws, regulations, and policies can help address marine problems.

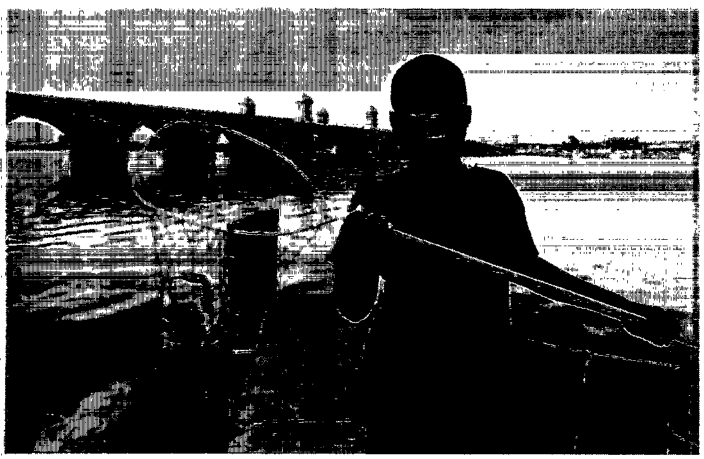
THE PROBLEM

Pollutants in our waterways impair or destroy aquatic life, threaten human health, or simply foul the water such that recreational and aesthetic potential is lost. They come from industries or treatment plants discharging wastewater into streams or from waters running across urban and agricultural areas and carrying the surface pollution with them (nonpoint sources). Restrictions in shellfish beds, fishing bans, and swimming and beach closings are all symptoms of water pollution. The most visible water pollution problems such as choked algae-coated lakes and rivers are due to pollutants such as nitrates and phosphates. Toxic pollutants present a less visible and ultimately more challenging problem to control. Early efforts to control toxic discharges focused on EPA establishing technology-based effluent standards that industries had to meet. We found, however, that these controls alone were insufficient. Rivers and streams continue to show impairment due to the presence of toxic pollutants. Toxicants continue to pass through municipal wastewater treatment plants which are not equipped to treat them: in 1986 it was reported that an estimated 37 percent of the toxic industrial compounds entering our surface waters did so by passing through treatment plants.

Municipal Wastewater

Raw or insufficiently treated wastewater from municipal and industrial treatment plants still threatens our water resources in many parts of the country. Nutrients in sewage foster excessive growth of algae and other aquatic plants. Those plants then die and decay, depleting the dissolved oxygen needed by fish. Moreover, poorly treated wastewater may contain bacteria and chemicals harmful to both human and aquatic life.

Sludge, the residue left from wastewater treatment plants, is a growing problem. Since 1972, municipal sludge has doubled in volume to about 7 million dry metric tons annually, and quantities are expected to double again by the year 2000. The toxic properties of sludge vary. Some sludges are relatively "clean", or free from toxic substances, and can be used for beneficial purposes such as soil conditioners. Other sludges may contain organic, inorganic, or toxic pollutants and pathogens. These sludges present disposal difficulties because there are limited disposal options for them and those options that are available are costly.



Industrial Discharges

An important source of toxic pollution is industrial wastewater discharged directly into waterways or indirectly through municipal wastewater treatment plants. Industrial wastes discharged directly into surface waters are controlled through National Pollutant Discharge Elimination System (NPDES) permits. Industrial wastes discharged indirectly to municipal waste water treatment plants are treated to remove toxic pollutants. This process is known as pretreatment (see the highlight "Pretreatment"). It is important since toxic wastes may interfere with the operation of the treatment plant, and pass through into surface waters creating health and environmental risks. The toxics also may end up in sludge making it harder to dispose of safely.

Pollution from Nonpoint Sources

Nonpoint sources present continuing problems for achieving national

FIGURE W-7
Pollutants and Their Sources

	Common Pollutant Categories							
	BOD	Bacteria	Nutrients	Ammonia	Turbidity	TDS	Acids	Toxics
Point Sources								
Municipal Sewage Treatment Plants	●	●	●	●				●
Industrial Facilities	●							●
Combined Sewer Overflows	●	●	●	●	●	●		●
Nonpoint Sources								
Agricultural Runoff	●	●	●		●	●		●
Urban Runoff	●	●	●		●	●		●
Construction Runoff			●		●			●
Mining Runoff					●	●	●	●
Septic Systems	●	●	●					●
Landfills/Spills	●							●
Silviculture Runoff	●		●		●			●

Source: Modified from 1986 305(b) National Report
Abbreviations: Biological Oxygen Demand, BOD; Total Dissolved Solids, TDS.

water-quality goals in many parts of the country. Some of the most common nonpoint pollutants and their sources are listed in Figure W-7. Sediment, the largest contributor to nonpoint source problems, causes decreased light transmission through water resulting in decreased plant reproduction, interference with feeding and mating patterns, decreased viability of aquatic life, decreased recreational and commercial values, and increased drinking water costs. Nutrients, the second most common nonpoint source pollutant, promote the premature aging of lakes and estuaries. Pesticides and herbicides hinder photosynthesis in aquatic plants, affect aquatic reproduction, increase organism susceptibility to environmental stress, accumulate in fish tissues, and present a human health hazard through fish and water consumption. Other

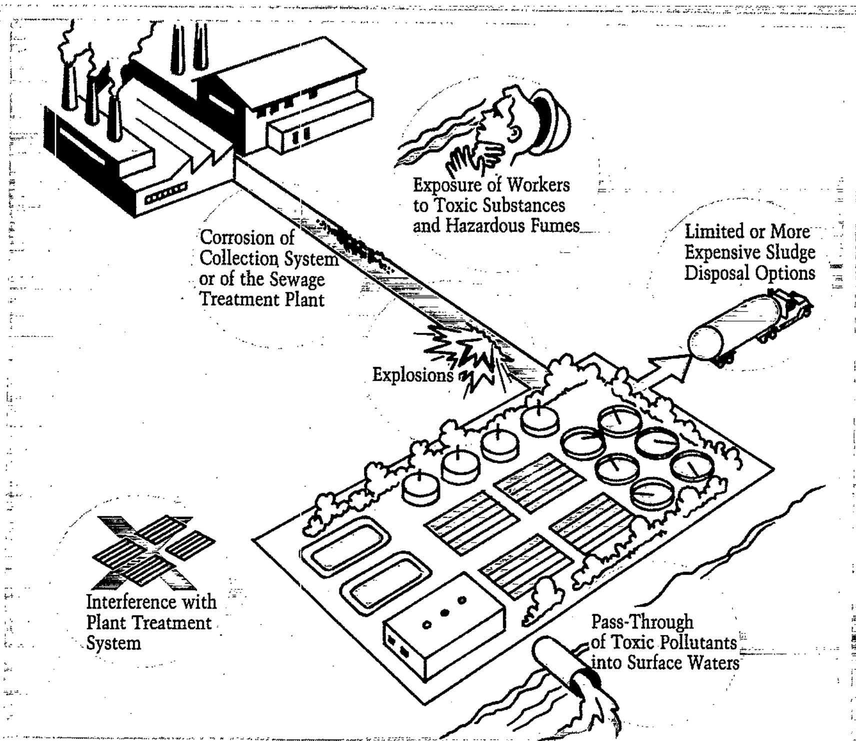
Pretreatment

Beneath the streets of every city and many smaller communities, a system of sewers and pumps conveys wastewater from homes, factories, offices, and stores. This disposed water, which may contain a variety of domestic, commercial, and industrial wastes, flows through the sewers to a wastewater treatment plant. There, pollutants are removed and the cleansed water is discharged into an adjacent river, bay, lake, or ocean. The residues of the treatment process (sludges) are used either as soil conditioners or are disposed as a solid waste.

Industrial plants are only one of many sources of wastewater discharged into municipal sewers. However, the industrial wastewater discharged by industry often is contaminated by a variety of toxic or otherwise harmful substances not common to other sources. Industrial wastewater often contains the by-products of industrial processes, such as cyanide from electroplating shops and lead from the manufacture of batteries. These industrial wastes can pose serious hazards because sewage collection and treatment systems have not been designed to treat them. The wastes can damage the sewers and interfere with the operation of treatment plants; they may pass through the systems untreated, resulting in contamination of nearby water bodies; and they can increase the cost and environmental risks of sludge treatment and disposal.

The undesirable effects resulting from the discharge of industrial wastewater into municipal sewers can be prevented. Industrial plants, using proven pollution control technologies, can remove pollutants from their wastewaters before discharging the wastewater into the sewer system. This practice is known as "pretreatment."

Industry already is pretreating its wastewater in many communities. The National Pretreatment Program, a cooperative effort of federal, state, and local officials, is implementing this practice on a nationwide basis. EPA identified 1500 municipal wastewater treatment plants which handled 82 percent of all industrial wastewater discharged to municipal treatment plants. We required that they develop programs to develop, implement, and enforce appropriate effluent limits for industries discharging wastes into their system. As of July 1987, 95 percent of these plants had developed these pretreatment programs. Many of these programs are just beginning to be implemented. By reducing the level of pollutants discharged by industry into municipal sewage systems, the program ensures that industrial development vital to the economic well-being of a community will be compatible with a healthy environment.



Problems that May Occur When Industrial Wastewaters are Discharged into Sewage Treatment Systems. All these Problems can be Controlled through Pretreatment.

EFFORTS TO DATE

nonpoint source pollutants have similar impacts including: increased treatment costs of drinking water, reduced commercial and recreational values, disrupted aquatic food chains, and reduced reproduction rates and life spans of aquatic species.

Nonpoint sources are also a major source of toxics, among them pesticide runoff from agricultural areas, metals from active or abandoned mines, gasoline, and asbestos from urban areas. Bottom sediments are also significant toxic contributors. They retain substances discharged in the past and release them to the water and aquatic organisms long after the discharge has ceased.

Another source of surface water pollutants is the atmosphere. By attaching themselves to small particles of dust, toxic substances may be transported far from their sources and deposited in surface waters through precipitation. A recent study demonstrated that certain pesticides used only in Texas and the southwest had been transported in the atmosphere to the Great Lakes. The atmospheric source of water pollution still needs to be fully investigated.

The extent and intensity of nonpoint sources of pollution has become more evident as better information is collected and as we successfully address point sources. Of the 52 states and territories ranking the relative impacts of nonpoint sources in 1986, 33 found them to be a major problem and 14 found them to be a moderate problem. Agricultural runoff is the most common nonpoint source of pollution, followed by runoff from urban and mining activities.

Many of the basic laws, policies, and organizations needed to manage our surface waters are in place: state standards for protecting waters; a nation-wide technology-based system of pollution control, augmented by pretreatment and a growing number of water quality-based controls; a national network of federal, state, and local agencies; and a nucleus of trained inspectors to ensure that the controls are in place and operating effectively. This infrastructure, a capital investment coupled with resources at federal and state levels, is our "core" program. The 1987 Water Quality Act built upon and in some cases expanded this core program. For example, the surface water toxics provisions in the act require us to go beyond technology-based controls for toxic pollutants to water quality-based controls where they are needed to restore and maintain water quality.

In addition, a number of provisions greatly strengthen our base program, such as the enhancement of our enforcement powers through the addition of administrative penalty authority.

Since 1972, EPA, state and local governments have invested heavily in the construction and upgrading of municipal wastewater treatment facilities. As a result of these expenditures, the nation's ability to treat wastewater has improved substantially. The population served by secondary treatment or better has increased from 85 million (42 percent of the nation) in 1972 to 127 million (54 percent of the nation) in 1986. Federal expenditures through the construction grants program have resulted in the completion of over 8,000 projects at 5,000 municipal wastewater treatment plants.

The Water Quality Act of 1987 continues a shift to eventual complete state and local responsibility for the construction, operation, maintenance, and replacement of municipal wastewater treatment plants One of the major changes involves a transition from a federal grants program to a state revolving fund program for financing municipal wastewater treatment. Under the state revolving fund program, the federal government can award initial seed money to the states for a water pollution control revolving loan fund. Each state will use its revolving fund primarily to make loans for local wastewater treatment facility construction, although nonpoint source and estuarine protection may also be supported. The repayments of principal and interest from these loans will be used to replenish the fund.

Setting and enforcing NPDES permits remains the cornerstone of the national water pollution effort. Currently, 39 states administer their own NPDES programs while EPA has the lead implementation responsibility in the remaining states and on Indian reservations. Even with this federal-state permitting and enforcement partnership, about 10 percent of all major facilities (generally larger facilities and/or facilities with potentially harmful discharge) are in significant noncompliance with their permit conditions. Facilities that are not in compliance with their permits are subject to federal and state enforcement action. Enforcement actions range from an informal phone call to formal judicial proceedings with possible financial penalties.

Runoff from fields is major source of sediment and pesticide pollution in rivers and lakes.

Biomonitoring

Plant and animal species have served as reference points for environmental quality throughout human history. For example, miners used a crude form of biomonitoring when they took canaries with them into the coal mines. When the canaries died from accumulating methane, the miners knew it was time to evacuate the mines. Disappearance of valued plants or wildlife is also a familiar indicator of environmental problems.

In recent years, biomonitoring techniques have become so reliable that they are now being built into the regulatory process. The Clean Water Act specifically refers to biological testing for assessing environmental hazards, especially where the mix of potential pollutants is complex. Instrumental techniques such as atomic absorption spectroscopy can detect concentrations as small as parts-per-trillion. However, they cannot demonstrate effectively the interaction of chemicals with each other. They also are not sensitive to other variables such as acidity, hardness, solubility, exposure time, or the effects on living organisms. Biomonitoring integrates these variables and can indicate when chemicals have reached toxic levels, even if the identity of the chemicals is not known.

Biomonitoring allows us to assess the cumulative effects on aquatic life of multiple sources of pollution. With biomonitoring, we can assess the health of a waterbody as a whole. Biomonitoring may be a controlled laboratory experiment, where test organisms are exposed to water containing a specific chemical or a complex mixture of chemicals. This type of experiment, known as a bioassay, is used to evaluate the relative potency of a chemical or mixture by evaluating its effects on living organisms under controlled conditions. Another type of biomonitoring takes place in the field. Aquatic biologists look for abnormalities in fish and aquatic insects. Population diversity, size, and structure, as well as physical characteristics of the population may indicate stress upon the ecosystem.

Biomonitoring, therefore, can serve two major needs. First, it allows us to screen waters for signs of stress, using fewer resources than chemical monitoring. Second, it can confirm the results of chemical monitoring data. In short, it is a very useful tool for assessing the safety of the water for living things.

Field biologists monitor the water quality of streams through collection of aquatic organisms.

TODAY'S CHALLENGES

In an effort to improve municipal compliance, EPA and the states developed the "National Municipal Policy" in January 1984. This policy requires municipalities to install secondary levels of treatment by July 1988. At the beginning of 1988, all but 22 of the 1500 facilities targeted under the National Municipal Policy had achieved compliance, were under enforceable schedules for compliance, or had been referred for judicial action.

By the mid 1980s it became clear that stricter control of nonpoint source pollution was needed to meet the goals of the 1972 Clean Water Act. The Act provided states with money to develop plans for both point and nonpoint pollution control (under section 208). Until passage of the Water Quality Act of 1987 there was no provision to implement the nonpoint source components of these plans. States are now required to identify and assess waters impaired due to nonpoint pollution and to develop management plans for these waters.

The major challenges facing EPA are to implement the new requirements embodied in the Water Quality Act of 1987 while maintaining existing water quality program achievements.

Municipal Wastewater Treatment

Since 1956 the construction grants program has provided financial assistance to municipalities for construction of wastewater treatment plants. The transition during the late 1980's to the state-administered revolving fund program will place many additional responsibilities on state agencies, including the lead role in designing and managing programs for funding construction projects. The advantage of state revolving fund programs and other alternative financing approaches is that each can be tailored to address specific state needs.

Toxics

Much remains to be done to address the impact of toxic pollutants as EPA and the states implement and enforce toxics control programs over the next few years. Efforts will focus on upgrading state programs for monitoring, adopting water quality standards for toxic pollutants, identifying impaired waters, and preventing degradation of existing water quality. As state programs are upgraded, improved toxic controls will be implemented by establishing more stringent NPDES permits based on ambient water quality considerations, and through implementation and evaluation of the pretreatment program. The 1987 amendments deal with toxic pollution discharges to surface waters. An important objective is to assure that wastewater treatment plants fully implement, enforce, and evaluate the effectiveness of pretreatment controls.

Sludge Disposal

Sludge cleaning and disposal is one of our most significant environmental challenges. Based on statutory and regulatory requirements, states will need to develop a comprehensive approach to reducing the health and environmental risks while maximizing the beneficial uses of sludge.

Stormwater

Stormwater transports pollutants into waterbodies from city streets, farmlands, and construction sites. Particularly intense storms often cause sewer overflows. In cases where storm sewers are combined with municipal sewage systems these overflows can result in untreated sludge being discharged into waterbodies. Our initial challenge will be to develop a permit program for stormwater discharges from industrial activities and for separate municipal sewers for stormwater.

Nonpoint Source Pollution

The principal nonpoint source pollution challenge will be the development and implementation of effective state programs. The Water Quality Act of 1987 established two new requirements: (1) state reporting on waters impaired due to nonpoint sources, the types of sources causing the problems, and state and local control programs; and (2) state programs for controlling nonpoint source pollution including methods and a time frame for remedying problems.

Better evaluative techniques are required to estimate nonpoint source impacts; appropriate best management practices must be implemented; and close cooperation is need among

Storms wash plastic litter into rivers and lakes.

the many federal, state, and local agencies involved to ensure we effectively address nonpoint pollution.

Keeping Up with Change

Conventional pollutant contamination is being controlled, but the efforts generally are just enough to keep pace with population growth. Water quality has been restored in many instances, but these waters — along with previously unpolluted, high quality waters — remain threatened from the effects of economic and population growth. Much of the technology installed in the 1970s is aging and must be maintained at great expense. We are challenged to maintain past gains while finding means to address new and emerging issues.

Clean Water Act Enforcement: Los Angeles

The Clean Water Act requires that cities meet stringent standards for treating wastewater from their sewage systems. EPA's National Municipal Policy, issued in 1984, makes clear that cities that fail to install needed treatment equipment will be forced to meet court-enforceable compliance schedules. EPA has undertaken more than 150 lawsuits under the policy, suing cities in 20 states, plus the District of Columbia, Puerto Rico, and the Virgin Islands. The agreement reached between EPA and the City of Los Angeles, entered as a federal court order, is an example of the success of EPA's National Municipal Policy.

EPA first sued Los Angeles for violating its discharge permits in 1977. After almost ten years of construction problems, funding holdups, and other delays, however, the city's main treatment facility, the Hyperion plant, was still pumping more than a million gallons of sewage sludge into Santa Monica Bay every day. In addition, the Hyperion plant was consistently in violation of its permit limits for suspended solids, oil, grease, and occasionally chlorine and various metals.

Under the 1987 agreement, Los Angeles had to pay the highest civil penalty assessed to a city under the Clean Water Act up to that time ($625,000). It also must carry out a storm water control project that may cost as much as $3.3 million. Most importantly, the city committed itself to wastewater treatment and management improvements that could cost more than $2.3 billion over the next 12 years. The city ended the ocean discharge of sludge in December 1987, and agreed to build a sludge treatment and disposal process known as the Hyperion Energy Recovery System by June 1989.

EPA'S AGENDA

Water related environmental data are essential for sound management decisions. We must be able to characterize water quality problems and trends in order to identify the most serious or sensitive problem areas. Water quality information is also important in developing the appropriate mix of management and technical solutions to problems. Finally, we must collect information that will allow us to revise programs to achieve our environmental goals. This is a complex and costly process, but it is one that we are committed to accomplish.

As states assume primary responsibility for wastewater treatment plants, EPA's role will be to ensure a smooth transition to the State Revolving Fund program and that the CWA objectives are achieved. EPA will continue to provide substantial assistance to states and communities on effective wastewater treatment, sludge management technologies, and local financing approaches. At the same time, the existing wastewater treatment infrastructure must be protected. EPA will help strengthen local municipal wastewater treatment operations and maintenance programs, especially in regard to sludge and toxics problems.

The states will be required to review and upgrade standards for toxics, to adopt specific criteria for certain toxic pollutants, and to complete upgrading of their programs for preventing water degradation. Permits incorporating limits for toxic pollutants will be issued, and compliance with these permits will be enforced.

The NPDES permit program will be expanded to meet stormwater and sludge requirements. EPA is in the process of revising regulations to add new permit application requirements for stormwater discharges from large (over 250,000 population) and medium sized (between 100,000 and 250,000) municipalities. EPA will develop technical requirements for sludge use and disposal, and will work with states to ensure that appropriate regulations and guidance are developed for state sludge management programs.

EPA is working with states as they develop State Clean Water Strategies. These strategies will establish priorities for addressing the remaining point and nonpoint source water quality problems in surface waters, streams, rivers, lakes, wetlands, and estuaries. The State Clean Water Strategies will serve as the road map for the states and EPA to identify the remaining troubled or threatened waters and find the most effective route to address them.

Although the Water Quality Act of 1987 provides for expanded enforcement authorities, it does not modify the existing industrial and municipal permit limits which must be enforced. The NPDES enforcement program priority continues to be implementation of the National Municipal Policy, ensuring municipalities are in compliance with secondary treatment requirements. However, all point sources must continue to meet in-place water quality and technology-based requirements. Enforcement is critical to maintaining the progress we have achieved. EPA will continue to maintain and enhance existing enforcement capacity.

LAND

LAND

Historically, land has been used as the dumping ground for wastes, including those removed from the air and water. Early environmental protection efforts focused on cleaning up air and water pollution. It was not until the 1970's that there was much public concern about pollution of the land. We now recognize that contamination of the land threatens not only future uses of the land itself, but also the quality of the surrounding air, surface water, and ground water.

The biggest challenge for the next decade is to reduce the amount of waste. We must invest in recycling programs, more efficient production processes, substituting less harmful products, and reducing unnecessary wastes like excess packaging. Some amount of waste, however, can not be avoided. Waste must be properly managed to make as little impact on the environment as possible.

Improper handling, storage, and disposal of chemicals can cause serious problems. Most of us are familiar with these examples:

- Gasoline leaks from underground storage tanks caused a gas station explosion in Council Bluffs, Iowa.
- In Love Canal, New York, and Times Beach, Missouri, improper land disposal of hazardous wastes resulted in contaminated land and water in the surrounding communities.
- Hundreds of drinking water wells have been contaminated by improper waste disposal throughout the U.S.
- A barge carrying 90 tons of garbage from the northeastern U.S. travelled for several months in the Caribbean and Gulf of Mexico as its operators searched for a place to dispose of the cargo in an appropriate manner.
- Accidental release of the gas methyl isocyanate killed 2,800 people in Bhopal, India.

To address the causes of these and other problems, Congress enacted legislation to clean up problem waste sites, address leaks from underground storage tanks, and regulate hazardous waste handling. Additional legislation promoted planning for chemical emergencies and the public's right to know about storage and use of chemicals in their communities.

This chapter begins with an overview of waste generation and disposal issues; EPA's legislative authorities to address hazardous substance storage and disposal; EPA's approach to waste management, clean up, and preparedness for chemical emergencies; and a summary of progress achieved so far. The remainder of the chapter describes four key problems facing the nation and EPA's plans to address those problems.

AN OVERVIEW

More than six billion tons of agricultural, commercial, industrial, and domestic waste are produced in the United States each year. Most waste presents few health or environmental problems. Half the total, for example, is agricultural waste, primarily crop residues, most of which is plowed back into the land. Other waste, particularly that from industrial sources, can imperil both public health and the environment (Figure L-1). Leaks from underground storage tanks and chemical emergencies also contribute to contamination of the land and ground water.

If not properly disposed, even common household wastes can cause environmental problems ranging from foul-smelling smoke from burning trash to breeding grounds for rats, flies, and mosquitoes. Even at properly run disposal sites, land contamination can contribute to air and water pollution because small quantities of toxic substances such as pesticides, paints, or solvents may be dumped with other household wastes. Rain water seeping through the buried wastes may form "leachate" that percolates down through soil and may contaminate ground water. Other organic wastes such as garbage and paper products decompose and can form explosive methane gas.

Industrial wastes may present particularly troublesome problems. Many components of these wastes, such as dioxins, may present serious health or environmental threats by themselves; others are hazardous only in combination with other substances. Potential health effects range from headaches, nausea, and rashes, to acid burns, serious impairment of kidney and liver functions, cancer, and genetic damage.

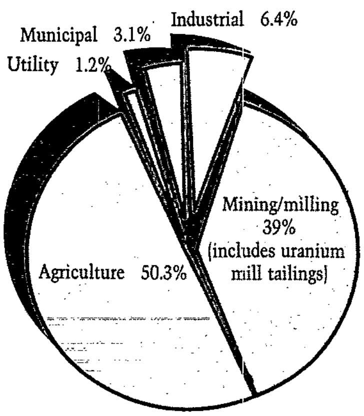
Congress enacted several laws to regulate the generation and disposal of hazardous wastes. These laws are aimed at three basic objectives:

- Proper management and disposal of wastes being generated now, and that will be generated in the future.
- Cleanup of sites where the results of past disposal practices now threaten surrounding communities and the environment.
- Minimizing generation of wastes and recycling materials where possible to lessen the burden on the environment.

FIGURE L-1

6 Billion Tons of Waste Are Generated in the U.S. Each Year

(excludes high-level radioactive waste)



Source: Office of Solid Waste, USEPA

Regulating Waste Management

Developing methods for proper disposal of the wastes Americans generate in their daily lives has been a focus of federal legislation for some time. In 1965, the Solid Waste Disposal Act was enacted to fund research and technical assistance for state and local planners.

In 1970, the program was expanded by enactment of the Resource Recovery Act. This law promoted the development of sanitary landfills and encouraged a shift from disposal toward conservation, recycling, and newer control technologies.

As the potential environmental problems posed by disposal of wastes generated by chemical and other industrial processes became clearer, Congress passed the Resource Conservation and Recovery Act (RCRA) in 1976. RCRA promotes "cradle-to-grave" management for hazardous waste, from their point of generation to their final disposal location. The program works through requirements for hazardous waste generators, transporters, and treatment, storage, and disposal facilities.

RCRA was amended by the Hazardous and Solid Waste Amendments (HSWA) in 1984. The amendments altered the focus of waste management in many ways. HSWA required EPA to focus on permitting land disposal facilities and eventually phasing out land disposal of some wastes. It expanded the RCRA-regulated community to include businesses that generate small amounts of hazardous waste. Recycling and waste minimization provisions also were included in the Act as promising methods of reducing the overall amount of waste generated.

HSWA also addressed previously exempted underground storage tanks containing petroleum and some hazardous substances. With these provisions, Congress gave EPA the responsibility under RCRA for regulating the storage of gasoline and other commercial products rather than only wastes.

Cleaning Up Existing Waste Problems

The problem of past hazardous waste disposal was brought to national attention in a series of incidents and the resulting news stories in the late 1970s. The first major incident was Love Canal in Niagara Falls, New York, where people were evacuated from their homes after hazardous waste buried for over 25 years seeped to the surface and into basements. Times Beach, Missouri represents another prominent story of hazardous waste mismanagement. There, oil contaminated with dioxin was used on roads and subsequently contaminated the soil and ground water in the community.

It soon became clear that hazardous waste problems caused by past mismanagement were outside of existing environmental statutes. A survey requested by a Congressional committee found that one-third of the 3,383 waste disposal sites used since 1950 by the 53 largest U.S. chemical companies were not covered under federal regulations.

The Federal Water Pollution Control Act of 1972 established a fund of $35 million for the cleanup of hazardous substances and

oil released into navigable waters. However, no similar fund existed for addressing hazardous waste releases solely on land. In response to this need, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or "Superfund," was enacted in 1980. CERCLA authorized $1.6 billion over five years for a comprehensive program to clean up the worst abandoned or inactive waste sites in the nation. CERCLA funds used to establish and administer the cleanup program are derived primarily from taxes on crude oil and 42 different commercial chemicals.

The reauthorization of CERCLA is known as the Superfund Amendments and Reauthorization Act of 1986 (SARA). These amendments provided $8.5 billion for the cleanup program and an additional $500 million for cleanup of leaks from underground storage tanks.

Under SARA, Congress strengthened EPA's mandate to focus on permanent cleanups at Superfund sites, involve the public in decision processes at sites, and encourage states and tribes to actively participate as partners with EPA to address these sites. SARA expanded EPA's research, development (especially in the area of alternative technologies), and training responsibilities. SARA also strengthened EPA's enforcement authority to get others to clean up hazardous waste problems for which they are responsible.

Emergency Planning and Community Right-to-Know

In the process of amending CERCLA, Congress passed the Emergency Planning and Community Right-to-Know Act, known as Title III. Title III was enacted to promote the public's awareness of the hazardous or toxic chemicals used or produced by industry. It also mandates that each community be prepared to respond to emergencies resulting from release or explosion of chemicals. Industrial and commercial facilities also will be required to report annually on the quantities of substances present in their facilities and released to the environment on a routine basis.

SOURCES OF THE PROBLEM AND EPA'S APPROACH

As Figure L-1 shows, every major sector of the economy contributes to producing waste in the United States. The kinds of wastes produced by these sources and their effects vary greatly. As a result, wastes need different levels and types of control. The principal sources of waste are discussed below.

Industrial Hazardous Wastes

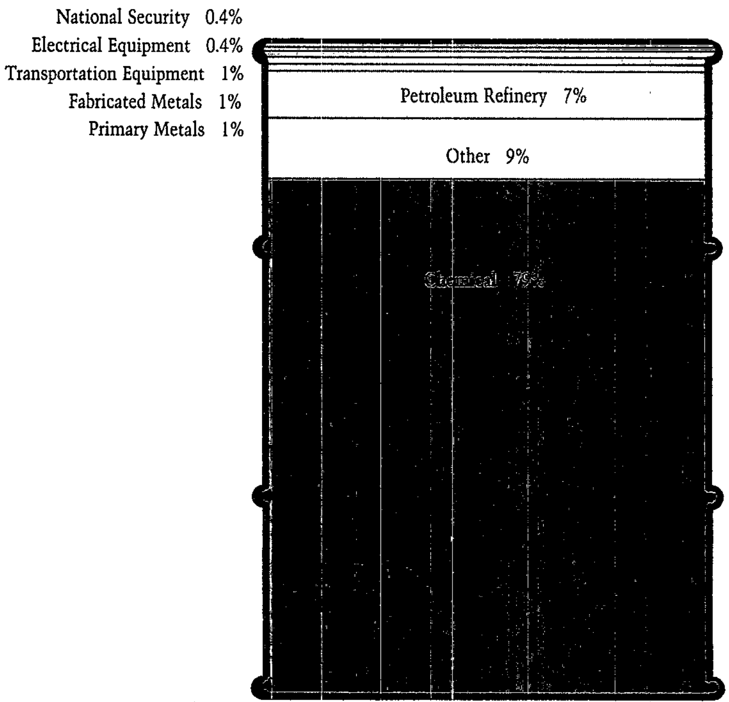
The chemical, petroleum, metals, and transportation industries are major producers of hazardous industrial waste (see Figure L-2). Ninety-nine percent of the hazardous waste produced and managed under the RCRA program is produced by facilities that generate large quantities (more than 2,200 pounds) of hazardous waste each month.

A much smaller amount of hazardous waste, about one million tons per year, comes from small quantity generators that each produce between 220 and 2,200 pounds of waste per month. These include automotive repair shops, construction firms, laundromats, dry cleaners, and equipment repair shops. Over 60 percent of these wastes are derived from lead batteries. The remainder includes acids, solvents, photographic wastes, and dry cleaning residues.

The large majority of hazardous waste is managed in the more highly industrialized areas of the United States, particularly those areas with active chemical and petroleum industries. The quantity of RCRA-regulated hazardous waste handled in the Rocky

FIGURE L-2

The Chemical Industry Manages the Bulk of Hazardous Waste in the U.S.



Source: *National Screening Survey at Hazardous Waste Treatment Storage Disposal and Recycling Facilities*, Office of Solid Waste, USEPA

Mountains and the far west is much smaller than the amount in the eastern, southern, and midwestern states.

EPA and the states share responsibility under RCRA for management of newly generated industrial hazardous waste. The ideal solution to the hazardous waste problem would be to not create these wastes right from the start. By employing more efficient production processes and substituting less harmful products we can lessen the risks posed by these wastes. Moreover, under RCRA there are permitting and inspection procedures to ensure that wastes are managed appropriately.

Under CERCLA, the Agency has established a comprehensive, national program for identifying sites that may pose threats, evaluating these to determine which are the most critical, and implementing remedies that reduce the threats. CERCLA authorizes EPA to act directly to clean up hazardous waste disposal sites where public health, welfare, or the environment is endangered.

Municipal Wastes

Municipal wastes include household and commercial wastes, demolition materials, and sewage sludge. Solvents and other harmful household and commercial wastes are generally so intermingled with other materials that specific control of each is virtually impossible. Leachate resulting from rain water seeping through municipal landfills may contaminate underlying ground water. While the degree of hazard presented by this leachate is often relatively low, the volume produced is so great that it may contaminate ground water. EPA issues requirements for municipal facilities under its program to regulate nonhazardous waste. State and local governments then are responsible for ensuring compliance.

Industrial societies with smaller farming populations and higher incomes produce considerably more waste per person than do developing countries. Figure L-3 shows the amounts of refuse generated per capita for selected cities. The United States produces the most waste per person among industrial nations. Taking certain materials out of those headed for the dump and recycling them is one way to manage the large volumes of waste generated. EPA encourages state and local governments to set up recycling programs, and has set a four year goal to achieve a nationwide 25 percent rate of recycling of nonhazardous wastes at their source.

Sewage sludge is the solid, semisolid, or liquid residue produced from treating municipal wastewater. Some sewage sludges contain high levels of disease-carrying microorganisms, toxic metals, or toxic organic chemicals. Because of the large quantities generated, sewage sludge is a major waste management problem in a number of municipalities.

In the past, sewage sludge was regulated as a solid waste under RCRA or a variety of other laws. The 1987 Water Quality Act provides for a comprehensive program to reduce environmental risks and maximize the beneficial uses of sewage sludge. The options for using and disposing of this sludge include land application, landfilling, ocean disposal, incineration, and marketed products. In 1987, the Agency proposed regulations for sewage sludge in National Pollutant Discharge Elimination System (NPDES) permits (see Water Chapter) and established requirements for state sludge management programs.

FIGURE L-3

Refuse Generation Rates in Selected Cities (circa 1980)

City	Per Capita Waste Generation Rate (pounds per day)
Industrial Cities	
New York, United States	4.0
Tokyo, Japan	3.0
Paris, France	2.4
Hong Kong	1.9
Rome, Italy	1.5
Low-Income Cities	
Lahore, Pakistan	1.3
Medellin, Colombia	1.2
Calcutta, India	1.1
Manila, Philippines	1.1
Kano, Nigeria	1.0

Source: Cynthia Pollock, "Mining Urban Wastes: The Potential for Recycling" (Worldwatch Paper, April 1987)

Mining Wastes

A large volume of all waste generated in the United States is from mining coal, phosphates, copper, iron, uranium, and other minerals and from ore processing and milling. These wastes consist primarily of overburden, the soil and rock cleared away before mining, and tailings, the material discarded during ore processing.

Mining wastes are a source of environmental problems particularly in a few western and southwestern states. Although mining wastes are generally considered to present low hazards, they present a disposal problem because of the estimated 2.34 billion tons generated per year. Runoff from these wastes increases the acidity of streams and pollutes them with toxic metals. Furthermore, the tremendous amounts of overburden generated in surface mining can pose local management problems.

Coal mining wastes are controlled at the federal level by the Department of the Interior under the Surface Mining Control and Reclamation Act of 1977. Under federal law, EPA has specific responsibilities for uranium mill tailings. EPA's primary role is to assess the effects of these wastes on the environment and, if necessary, propose additional controls. The Agency is currently developing a regulatory program under RCRA for mining wastes.

Radioactive Wastes

Radioactive materials are used in a wide variety of applications, from generating electricity to medical research. The U.S. has produced large quantities of radioactive wastes that can pose environmental and health problems for many generations.

The Department of Energy, the Nuclear Regulatory Commission, the states, and EPA share responsibility for managing radioactive wastes. EPA issues radiation standards that set limits on the levels of human exposure to radiation or on quantities of radioactive materials that may be released into the environment. In addition, the Agency develops recommendations for federal agencies that handle radioactive wastes, and provides technical assistance to other federal agencies and states for carrying out their radiation protection programs.

To reduce the risks from low-level radioactive wastes, EPA published criteria to help select low-level waste disposal sites. In 1985, the Agency issued environmental standards for the management and disposal of high-level radioactive wastes. The Agency currently is re-evaluating some of the technical aspects of these regulations.

The Agency also conducts emergency and routine monitoring of radiation levels in the environment. For example, several ongoing programs monitor radiation levels in air, precipitation, surface and drinking water, and milk samples. EPA also coordinated offsite monitoring activities during cleanup of the damaged Three Mile Island nuclear reactor in Pennsylvania, and closely tracked radiation levels after the Chernobyl nuclear accident.

Other Wastes

Of the six billion tons of waste generated each year, more than half are from agriculture and forestry. Most of this waste poses relatively small health and environmental hazards. Much of forestry waste is now burned for energy, and agricultural waste is mostly plowed back into the fields or burned. Some agricultural wastes, such as unused pesticides and empty pesticide containers, do require safe treatment and disposal and are regulated by EPA. (See "Pesticides: Human Health Concerns" in the Toxics Chapter.)

Utilities also contribute to the nation's waste production. The principal wastes produced by electric power plants are sludges from processes designed to prevent air and water pollution. Ninety percent (over 70 million tons annually) of all combustion waste generated in the U.S. is from coal-fired power plants. These wastes are generated in large amounts but generally are of low risk. Under RCRA, EPA is responsible for determining whether there is a need to regulate the sludges resulting from air pollution control equipment at these plants. The Agency is currently studying the effects of these wastes to determine the extent of regulation needed.

Underground Storage of Substances

Leaking underground storage tanks are another source of land contamination that can contribute to ground-water contamination. The majority of these tanks do not store waste, but instead store petroleum products and some hazardous substances. Most of the tanks now in place are bare steel and subject to corrosion. Many are old and near the end of their useful lives. Hundreds of thousands of these tanks are thought to be leaking, with more expected to develop leaks in the next five to ten years. Leaking tanks can contaminate local ground-water supplies, may endanger local drinking water systems, or may lead to explosions and fires.

A Few Important Definitions

Definitions of hazardous substances are not as straightforward as they appear. For purposes of regulation, Congress and EPA have defined terms to describe wastes and other substances that fall under regulation. The definitions below show the complexity of our regulatory task.

Hazardous Substance (CERCLA) *- Any substance that, when released into the environment, may present substantial danger to public health, welfare, or the environment. Designation as a hazardous substance grows out of the statutory definitions in several environmental laws: the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Clean Air Act (CAA), and the Toxic Substances Control Act (TSCA). Currently there are 717 CERCLA hazardous substances.*

Extremely Hazardous Substances (CERCLA as amended) *- Substances which could cause serious, irreversible health effects from a single exposure. For purposes of chemical emergency planning, EPA has designated 366 substances as extremely hazardous. If not already so designated, these also will be listed as hazardous substances.*

Solid Waste (RCRA) *- Any garbage, refuse, sludge, or other discarded material. All solid waste is not solid; it can be liquid, semisolid, or contained gaseous material. Solid waste results from industrial, commercial, mining, and agricultural operations and from community activities. Solid waste can be either hazardous or nonhazardous. However, it does not include solid or dissolved material in domestic sewage, certain nuclear material, or certain agricultural wastes.*

Hazardous Waste (RCRA) *- Solid waste, or combinations of solid waste, that because of its quantity, concentration, or physical, chemical or infectious characteristics, may pose a hazard to human health or the environment. Under RCRA, these wastes are further defined by characteristics described in the section, "Preventing Future Contamination From Improper Waste Disposal."*

Nonhazardous Waste (RCRA) *- Solid wastes, including municipal wastes, household hazardous waste, municipal sludge, and industrial and commercial wastes that are not hazardous.*

PROGRESS TO DATE

Regulations developed to implement the requirements of RCRA and its amendments now provide the basis for environmentally sound management of the millions of tons of hazardous waste generated each year. In addition, under CERCLA, EPA and the states are investigating potentially hazardous disposal sites. The most serious of these sites are being cleaned up. Congress has given EPA new responsibilities for controlling pollution from underground storage tanks, and the Agency is assisting communities in preparing for chemical emergencies.

Preventing Improper Management of Waste

Since the passage of RCRA and the 1984 HSWA amendments, one of EPA's greatest accomplishments has been to establish the framework to properly manage hazardous wastes as they are generated and to minimize associated risks to humans and the environment.

We are enforcing basic requirements governing waste storage, treatment, and disposal and have granted or denied final operating permits to hundreds of hazardous waste facilities. Rather than trying to meet the strict HSWA requirements for receiving an operating permit, many land disposal facilities have chosen to stop managing hazardous waste. EPA continues to work with the states and operators of these facilities to ensure no waste problems are left when the facilities close.

EPA and the states are taking the following steps to ensure that currently generated waste will not result in additional multi-million dollar cleanup problems.

- The land disposal restrictions program (land ban) required under HSWA is being implemented. Wastes that do not meet specified treatment standards will be banned from land disposal over the next several years.
- Wastes from cleaning up Superfund sites are being transported only to approved and frequently inspected RCRA hazardous waste facilities.
- Efforts to encourage waste minimization have been increased. By outlining short- and long-term goals and by further developing policies, EPA hopes to decrease the amount of waste generated in the nation.

Cleaning Up Releases of Hazardous Substances

Under CERCLA, EPA and the states take responsibility for cleaning up hazardous sites where there are no responsible parties or where those responsible for the spill or leak do not agree to a settlement for cleanup. Under these circumstances, cleanup costs are paid directly from the $8.5 billion Superfund with a minimum of 10 percent contribution from the state. The federal government will later sue the responsible parties to recover cleanup costs. Cleaning up one Superfund site often takes years and can cost millions of dollars.

Working with the states, the public, and tribal governments, the Agency has identified approximately 30,000 sites where there is a potential of release of hazardous substances. Initial investigation of the vast majority of these sites has determined that:

- 1177 have completed the Superfund screening process and have been included or proposed for inclusion on the National Priorities List;
- more than 8,000 sites require no further action under Superfund; and
- the rest await a final decision.

The Agency has investigated in detail over two hundred sites and has selected remedies to the contamination problems. Over 1,000 short-term actions to address immediate threats have been started throughout the United States.

Under RCRA, corrective actions are conducted to clean up all operating or closing RCRA facilities that released hazardous waste threatening health or the environment. The Agency has pursued corrective action by identifying facilities subject to the provisions of RCRA, identifying possible releases from these facilities, and requiring cleanup through permits or enforcement orders. EPA has completed initial assessments at 400 active RCRA facilities and estimates that a minimum of 60 percent will require further investigation.

Pollution From Underground Storage Tanks

An estimated five to six million underground storage tanks in use in the United States contain petroleum products or hazardous chemicals. Approximately two million of these tanks may be leaking and will come under RCRA regulation this year. EPA is developing regulations for new and existing underground tanks that address leak prevention and detection, corrective action, record-keeping, and reporting of leaks or spills. In addition, regulations are pending that require owners of these tanks to show they can pay for cleanup of leaks. States and EPA will be responsible for implementing this program. Some states have already moved ahead of the federal government in regulating underground tanks.

Chemical Emergency Planning

Title III is a relatively new law directed at chemical emergency planning and community right to know. EPA has already made significant progress in carrying out the mandates of this law. The Agency is establishing a data base, accessible to the public, with comprehensive information on chemical releases to all environmental media. In addition, we are helping state and local governments use the information in the data base to plan for chemical emergencies, and have published a list of 366 Extremely Hazardous Substances for release reporting and emergency planning purposes.

EPA, the states, and industry face many significant land pollution challenges. Four major challenges discussed in this chapter are:

- **Preventing future contamination from improper waste disposal.** Focusing on major generators, and storage, treatment, and disposal facilities, EPA is taking steps with the states to ensure the proper management of hazardous and municipal wastes. We are regularly informing citizens and large and small businesses of the necessity to dispose of waste properly, and we will continue to enforce compliance with the laws. Encouraging waste minimization at production facilities and recycling in businesses and homes will also be high priorities.

- **Cleaning up of releases of hazardous substances.** One of the Agency's highest priorities is to clean up the many uncontrolled hazardous waste sites across the country. The rate at which these sites are addressed, making use of the new authorities of SARA and HSWA, is accelerating.

- **Tackling pollution from underground storage tanks.** Focusing on a recently recognized problem, EPA will continue to develop programs to assist the states in managing underground storage tanks. The vast number of these tanks, coupled with the need to replace many of them, make this both a communications and a technological challenge. EPA will help states get started on cleaning up contaminated land and water where leaks have already occurred, and ensure that new tanks have protection to prevent future leaks.

- **Chemical Emergency Planning and Community Right to Know.** EPA will continue to work with state, tribal, and local agencies and citizens to ensure that facilities in each community provide full information about the presence and release of toxic chemicals in their communities. The Agency will also support state, tribal, and local emergency planning activities to mitigate the potential effects of any accidental releases that may occur.

Hazardous Substances Around the House

With the proliferation of new chemicals in our society, the types and number of consumer products have risen sharply. Products such as medicines, insecticides, cleaners, paints, and plastics, contain a variety of chemicals. Once the useful life of these products is over, they become wastes, some of them hazardous.

Household hazardous materials can be properly handled by carefully following label directions for use and disposal. Local health, waste management, or fire department officials are good sources for advice on disposal options. For example, used motor oil can be returned to a collection center to be burned as fuel or re-refined for use as a lubricant. If not properly handled, household hazardous wastes can contaminate water if poured into storm drains, streams, rivers, lakes, or on the ground.

Common Household Hazardous Materials

Here is a partial list of some of the household products that may be hazardous if not used or disposed of properly.

- *In the kitchen and bathroom:*
  - *drain openers*
  - *oven cleaners*
  - *wood and metal cleaners and polishes*
  - *discarded medicines*
- *In the garage:*
  - *oil and fuel additives*
  - *grease and rust solvents*
  - *carburetor and fuel injection cleaners and starter fluids*
  - *outdated chemistry sets*
- *In the workshop:*
  - *paint thinners, strippers and removers*
  - *adhesives*
- *For the lawn and garden:*
  - *herbicides*
  - *pesticides*
  - *fungicides and wood preservatives*

Like garbage, sewage, or any other type of waste, the less household hazardous waste there is, the less the threat to our environment and public health. One of EPA's goals is to reduce the amount of hazardous and nonhazardous waste produced. Homeowners are encouraged to buy only as much of a product as needed, and to recycle when possible. Leftover paint can be given to a neighbor, for example. Another way to minimize waste is by using less toxic substitutes that work for several household jobs.

Alternatives to detergents, polishes and potions.

Although not infallible, these methods have been found to be effective and economical.

***Drain Cleanser** - Pour boiling water down drain. Two handfuls of salt followed by boiling water should clear most pipes.*

***Cleanser** - For sinks, salt is an excellent scouring agent and possesses disinfecting qualities. For ovens and refrigerators, baking soda is a good cleanser and freshener.*

***Chrome, Stainless Steel Cleaner** - Dip dry cloth into flour and rub on surface.*

***General Furniture Polish** - 1/2 cup vinegar, 1/2 cup rubbing alcohol, 1 cup linseed oil. Shake well before applying. Test in small area before total application.*

***Air Freshener** - Bowls filled with white vinegar placed next to stove lessens cooking odors.*

***Moth Repellent** - Cover surface of apple or orange with cloves. Cover with white tissue and let dry for two weeks in dry, airy place. Unwrap and hang in closet. Cedar wood chips also repel moths.*

***Insect Repellent** - Companion planting, including certain plants throughout and around the garden can repel a variety of insects. Some of these plants: nasturtium, marigolds, rosemary, petunias, and garlic.*

***Slug and Snail Poison** - Pour beer in flat containers and place below ground level in infested area.*

* *Adapted from* Household Alternatives for a Safer Environment — *Connecticut Fund for the Environment*

Preventing Future Contamination from Improper Waste Disposal

Solidified chemicals at an abandoned hazardous waste site.

THE PROBLEM

The nation's waste disposal programs focus on two categories of wastes: hazardous wastes, and municipal and other non-hazardous wastes. The disposal problems associated with each waste category are summarized below.

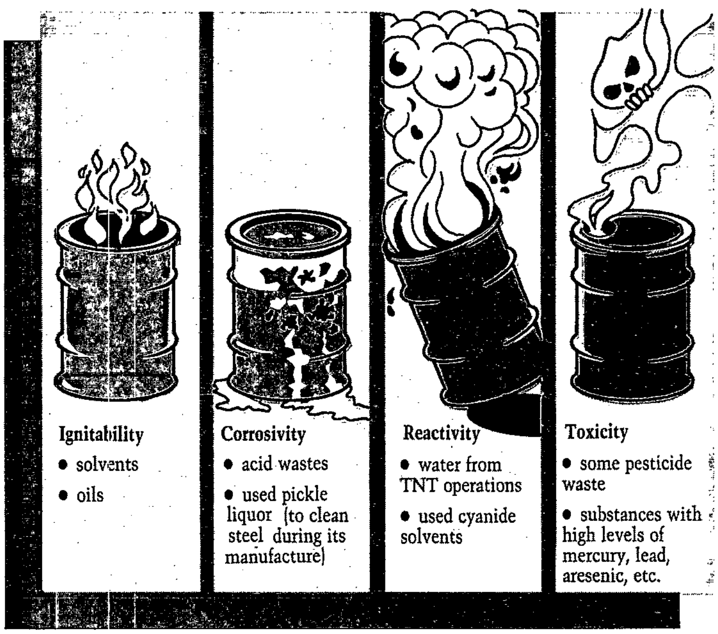
Hazardous Wastes

Before the early 1970s, the nation paid little attention to industrial production and the disposal of the waste it generated, particularly hazardous waste. In fact, until the passage of RCRA in 1976, there was no federal legislation dealing with the problems of hazardous waste management. As a result, billions of dollars must now be spent to clean up disposal sites neglected through years of mismanagement.

Every year about 3,000 facilities manage 275 million metric tons of RCRA hazardous waste in the United States. For the purposes of RCRA regulation, EPA may identify a waste as hazardous if it poses a fire hazard (ignitable); dissolves materials or is acidic (corrosive); is explosive (reactive); or otherwise poses danger to human health or the environment (toxic) (Figure L-4). Figure L-5 shows that most hazardous waste results from the production of widely used goods such as polyester and other synthetic fabrics, kitchen appliances, and plastic milk jugs. A small percentage of hazardous waste (less than one percent) is comprised of the used commercial products themselves, including household cleaning fluids or battery acid.

Wastes that are improperly disposed can pose dangers to human health ranging from headaches to cancer.

FIGURE L-4
Examples of Wastes and Hazardous Waste Characteristics They Exhibit



Hazardous wastes also could damage the environment, for example, by seeping into surface waters and killing fish or other organisms. Reducing the risks of exposure to hazardous materials by proper disposal will help assure our nation's long-term environmental well being.

Approaches to Management of Hazardous Wastes

Proper management to reduce the risks of hazardous wastes requires a mix of waste minimization, treatment, and disposal. Waste minimization is the most desirable approach, in that it reduces the amount of waste and therefore reduces the risk that they pose. Many companies have changed their production processes or have begun to use less hazardous products. As a result, they are generating less hazardous raw materials, and may lower their hazardous waste handling costs. Where waste minimization is not feasible, treatment or proper disposal is an additional tool for limiting the risks from hazardous wastes.

Choosing wisely among these options will ensure that waste is managed in the most economical way with full protection of human health and the environment. One of the great ironies in hazardous waste management, however, is the difficulty in the siting and construction of new management facilities because of public opposition to having such facilities in their communities. The lack of nearby disposal capacity means that producers of the waste can be forced to ship them long distances to a disposal facility. For instance, in 1986 Connecticut opted to send the majority of its hazardous waste to Canada, Pennsylvania, and New Jersey.

The number of facilities available for managing hazardous wastes is shrinking steadily. Many facilities that do not have the financial and technical means to ensure continued safe management are closing. Their closure from environmental and health standpoints is a welcome outcome, but if too many facilities close, there will be inadequate capacity remaining for correctly managing hazardous waste.

Nonhazardous Solid Waste

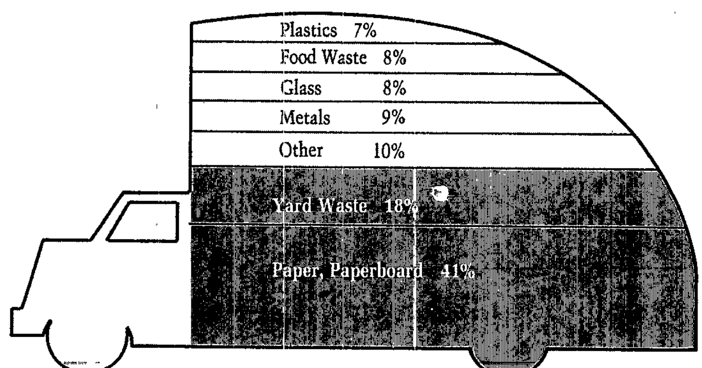
The bulk of "nonhazardous" wastes actually fall somewhere between hazardous and non-hazardous waste (like most municipal waste). Nonhazardous waste includes: industrial refuse, sludges from wastewater treatment facilities, and other discarded materials from commercial, mining, agricultural, and community

FIGURE L-5
The Products We Use

The Products We Use	The potentially hazardous waste they generate......
Plastics	Organic chlorine compounds, organic solvents
Pesticides	Organic chlorine compounds, organic phosphate compounds
Medicines	Organic solvents and residues, heavy metals (mercury and zinc, for example)
Paints	Heavy metals, pigments, solvents, organic residues
Oil, gasoline, and other petroleum products	Oil, phenols and other organic compounds, heavy metals, ammonia, salt acids, caustics
Metals	Heavy metals, fluorides, cyanides, acid and alkaline cleaners, solvents, pigments, abrasives, plating salts, oils, phenols
Leather	Heavy metals, organic solvents
Textiles	Heavy metals, dyes, organic chlorine compounds, solvents

Source: Office of Solid Waste, USEPA, 1980

FIGURE L-6
Paper and Yard Waste is More than Half of our Trash



Source: Office of Solid Waste, USEPA, 1986 activities. The quantity of solid wastes generated annually is several orders of magnitude greater than the amount of hazardous waste. For example, approximately 2.34 billion tons of mining wastes are produced annually. This alone amounts to more than five times the amount of hazardous waste managed each year.

Municipal waste is a substantial part of the waste generated in the U.S. every year. Americans throw out more trash every day than any other nation. On average, we discard about 4 pounds of trash a day, compared to the average Japanese who throws out 2.5, or the average Norwegian who throws out 1.7 pounds per day. Approximately 158 million tons of municipal solid wastes were discarded in 1986. As shown in Figure L-6, paper products and yard wastes make up about 59 percent of all municipal solid waste.

The United States has relied on landfills for the disposal of almost 160 million tons of municipal waste generated every year. But in recent years, questions have arisen whether land disposal alone affords the best disposal solution possible. Unless the wastes are carefully managed, they may contaminate drinking water supplies, release toxic vapors into the air, create explosive conditions near landfills, or otherwise threaten public health. Many municipal landfills are now close to overflowing and almost 70 percent of all such landfills are expected to reach capacity in 15 years. Furthermore, communities where old landfills have reached capacity are having trouble siting new landfills. The recent Islip, New York "garbage barge" odyssey further highlights the difficulties arising from the generation and management of trash.

Treatment and Disposal of Hazardous Wastes

Treatment and disposal differs for organic and inorganic substances. Organic substances are made principally of carbon, hydrogen, and oxygen. Some of these materials can be broken down into relatively harmless substances such as water and carbon dioxide. In contrast, no matter what type of treatment is used on certain inorganic substances, they can only be broken down into components that still pose a potential risk. For instance, metals can never be broken down beyond their basic metallic elements, therefore, they ultimately require land disposal.

Landfilling of wastes is the last stop in the waste management chain and is one method of waste disposal. Only a small portion of waste is ultimately land-filled. The long-term goal of a landfill is to serve as an indefinite holding place for wastes and to minimize the potential of exposure. Hazardous wastes often are disposed of by injection as a liquid into the ground in specially designed wells. Approximately 20-35 million metric tons (about 10 percent by weight) of dilute, hazardous waste is disposed of annually into deep-well injection systems. These wells penetrate to depths well below drinking water sources where natural brine makes water unusable.

The vast majority of the hazardous waste managed annually is treated in man-made surface ponds (or impoundments) and wastewater treatment plants. The volume of wastewater disposal into surface waters is great, but these wastewaters can be regulated by the Clean Water Act (see section titled "Surface Water" in the Water Chapter). A relatively small amount — about 2 million metric tons — is incinerated. A number of different treatment technologies are used on hazardous wastes to render them less toxic before final disposal:

- *Wastewaters are made less hazardous by biological decomposition, chemical neutralization, precipitation, or steam stripping. Steam stripping converts the hazardous constituents to gas, which is then captured in air pollution control equipment.*
- *The only alternative for metals and inorganics is recycling or solidification. Solidification involves combining the waste with a stabilizing agent, such as cement, to create a solid, impermeable material which lessens the likelihood of leaching into the soil.*
- *Enclosed incinerators primarily burn liquid organic waste and some sludges at high enough temperatures so that virtually complete combustion takes place.*

EFFORTS TO DATE

EPA and the states share the responsibility for regulating newly generated hazardous waste under RCRA. RCRA was created to minimize the risks from hazardous wastes at all points in their life cycle, from their generation to their disposal. It was also designed to require safeguards; to encourage the proper disposal of municipal, commercial, and industrial waste; to eliminate or reduce waste; and to conserve energy and natural resources.

Hazardous Waste and "Cradle to Grave" Management

RCRA involves a "cradle to grave" effort covering the generation, transportation, storage, treatment, and disposal of newly generated hazardous waste. EPA's system includes five basic elements:

- **Identification** — Generators and the types of waste that they produce must be initially identified.
- **Tracking** — A uniform "manifest" describing the waste, its quantity, the generator, and receiver, must accompany transported hazardous waste from the point at which it is generated to its final off-site destination and disposal (see Figure L-7).
- **Permitting** — All hazardous waste treatment, storage, and disposal facilities will be issued permits to allow EPA and the states to ensure their safe operation. There are about 7,000 facilities that must receive permits in order to continue operating.
- **Restrictions and controls** — Hazardous waste facilities must follow EPA's rules and guidance specifying acceptable conditions for disposal, treatment, and storage of hazardous wastes.
- **Enforcement and compliance** — Generators, transporters, and facilities are penalized if they do not comply with the regulations.

The cradle to grave system works through requirements for hazardous waste treatment, storage, and disposal facilities. Key to this system are RCRA operating permits. Basic operating permits identify administrative and technical standards with which facilities must comply. For example, the permits require operators of hazardous waste landfills to keep thorough records of the types and quantities of wastes they manage.

The number of permits EPA processes is very large. There are 1,460 land disposal facilities that need permits to continue operating. As of April 1, 1987, 170 had their permits issued. In addition, most of the 1,100 facilities that are closing will need post-closure care. Incinerators and storage facilities must also be permitted.

Operators of land disposal facilities must monitor ground-water quality near the facility and report contamination problems to the state or EPA. They must comply with restrictions regarding the handling of certain types of wastes and waste containers. For example, a liquid waste must be solidified before being disposed of in a landfill.

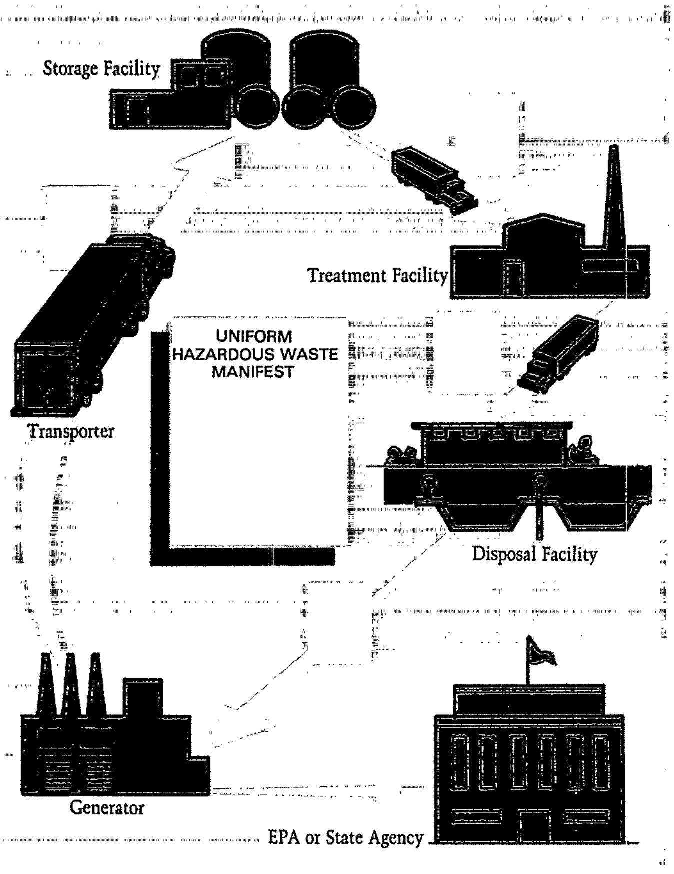
Owners and operators must comply with strict rules not only during, but also after closure of a unit if contaminants are left in place. The rules include construction of a protective cover or "cap," ground-water monitoring for thirty years, erosion control, prevention of rainfall entry, and security requirements.

The most recent revisions to RCRA, the 1984 Hazardous and Solid Waste Amendments (HSWA), greatly strengthened the hazardous waste program. Some of the major changes were:

- Recognizing that technical requirements (such as liners) and operating requirements do not always sufficiently protect human health and the environment from exposure to contaminants which are land disposed, HSWA authorized EPA to require treatment of all hazardous wastes to EPA-specified levels or methods before their disposal on the land. As a result of this "land ban" and other regulations, there will be more treatment of hazardous wastes.

FIGURE L-7

The Hazardous Waste Manifest Trail



A one-page manifest must accompany every waste shipment. The resulting paper trail documents the waste's progress through treatment, storage and disposal. A missing form alerts the generator to investigate, which may mean calling in the state agency or EPA.

Note: A manifest is unnecessary for waste treated and disposed of at the point of generation.

Liners are one of the design requirements for surface impoundments.

- Although treatment of hazardous waste will become routine, there will always be a need for landfills to isolate safely the unusable leftovers of treatment such as incinerator ash, stabilized wastes, and sludges from sewage treatment facilities. HSWA establishes more stringent requirements for hazardous waste land disposal facilities, including double liners, leachate detection and collection systems, and ground-water monitoring. As a result of these stringent new permitting requirements, about 1,000 active land disposal facilities will no longer handle hazardous waste.
- Approximately 100,000 small-quantity generators (businesses generating 220-2,200 pounds of waste per month) are no longer exempt from RCRA's hazardous waste requirements. 115,000 hazardous waste generators will now be regulated, whereas before HSWA only 15,000 were regulated. The new small businesses to be regulated by EPA include vehicle repair shops, metal manufacturing and finishing operations, laboratories, printers, laundries, and dry cleaners. Before HSWA, they could discard their waste at the same landfills where communities dispose of their garbage. Now these businesses will be required to dispose of hazardous wastes at EPA-permitted facilities.
- Facility owners are required by RCRA to clean up leaks of wastes that occur at their facilities. HSWA broadened this requirement and EPA is implementing its new authorities (see section, "Cleaning Up Releases of Hazardous Substances" in this chapter).

EPA continues to refine the process set up to manage hazardous wastes under RCRA. Recently the restrictions on land disposal have increased, particularly for those wastes named by Congress in HSWA. Several new regulations for permitting and closure have been finalized and others are underway. We will streamline the permit process, to help issue them more expeditiously.

EPA's general enforcement strategy has been to focus attention on facilities whose violations pose the greatest threat to human health and the environment. Inspections are an important tool in ensuring compliance; they focus on ground-water monitoring, corrective action, closing facilities, and federal facilities for priority attention. EPA is also emphasizing criminal enforcement as the limited number of legal disposal options may prompt illegal disposal activities.

Reducing Hazardous Waste: Environmental Quality with Economic Benefits

"The Congress hereby declares it to be the national policy of the United States that, whenever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible."

HSWA, 1984

Many companies have discovered that by generating less waste, they can reduce costs through lower waste storage and transportation expenses, fewer administrative and reporting burdens, less likelihood of financial liabilities from accidental releases, and lower insurance premiums. Insurance, however, is often not available to waste generators. EPA has developed a handbook to help waste generators better understand and calculate such returns on potential waste minimizing investments, and is assisting industry in identifying where their waste minimization opportunities may lie. Here are examples of waste minimization successes.

Product Substitution. *The Department of Defense has developed a process in which small plastic beads are air blasted at the surface of an airplane to remove paint. This removes the need for hazardous solvents. The department estimates that this process has decreased the amount of hazardous waste from 10,000 pounds of wet sludge to 320 pounds of dry paint chips and decomposed plastic material per aircraft. In addition, the amount of work required per aircraft to remove the paint by air blasting is eight times less than by traditional methods.*

Process Efficiency. *A California chemical plant changed the reactor rinse and cleaning procedures in its resin-manufacturing operations. This reduced the use of organics by 93 percent. Previously, phenol used in the manufacturing process was allowed to drip into the plant's sewage treatment system. The company now recovers the water-phenol mixture for reuse.*

Resource Recovery. *An assessment of a steel-making facility showed that calcium fluoride (fluorspar) in the sludge generated during neutralization of the pickling line wastewater could be recovered. By recycling the fluorspar, the company would save a substantial amount of money spent to buy it, and also reduce by thirty percent the volume of sludge requiring disposal.*

Management of Nonhazardous Waste

Recycling, land application, and permanent disposal are the three major ways in which nonhazardous wastes may be disposed. Recycling involves reusing materials, recovering components of materials that can be reused, or making materials into new products. EPA estimates that in 1986, 11 percent of municipal wastes were recycled (see Figure L-8). Certain wastes — like sludges and wastewaters — can be applied to the land and thereby incorporated into the soil. In some instances, the soil is used for agricultural purposes. The major method of permanent disposal for nonhazardous wastes is in landfills. Many landfills have elaborate systems to contain the wastes and to monitor the contents and ground-water quality.

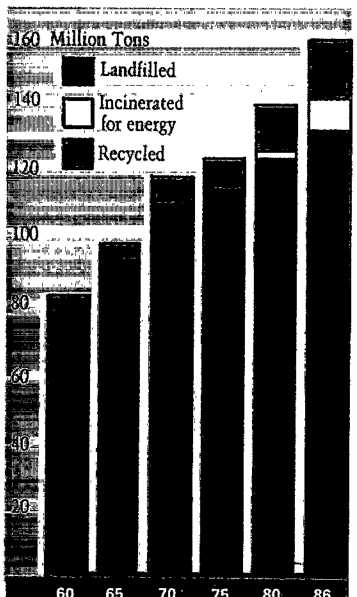
States are responsible for administering nonhazardous waste management programs. EPA currently is focusing on the new HSWA requirements for management of nonhazardous waste. For example:

- The Agency will soon revise the criteria for municipal solid waste landfills. At a minimum, the criteria now being developed for these facilities will require ground-water monitoring, location restrictions, and corrective action as appropriate. States will be required to incorporate the revised criteria into their programs.
- EPA will study and determine the need for more comprehensive requirements for municipal waste incinerators.
- The Agency has written guidelines to assist other federal agencies in the purchase of products made with a certain percentage of recycled material such as paper, retread tires, and used oil.

EPA also is evaluating the need for new federal controls of certain wastes produced during mining activities, wastes from oil, gas, and geothermal energy production, and coal-fired utility wastes. We are investigating these wastes because their great volume and low toxicity exempted them from hazardous waste regulations under RCRA. We are studying them thoroughly to determine if they should be regulated as hazardous waste.

FIGURE L-8

Recycling Is Becoming a More Important Option for Municipal Waste Disposal



Source: Office of Solid Waste, USEPA, 1986

TODAY'S CHALLENGES

How much to regulate is a very difficult issue. Under-regulation may foster poorly managed hazardous waste, and over-regulation may put economic burdens on those regulated and, ultimately, the consuming public. The Agency is constantly striving to refine the regulatory process to find the optimal balance as it issues permits for land disposal facilities and enforces regulatory requirements. Incentive approaches and other non-traditional control techniques can supplement regulation, especially where numerous small sources contribute to the problem. For almost all aspects of the program, success depends upon constructively involving the public and getting information to those who need it.

Issuing Permits

The large numbers of facilities to be permitted present a difficult challenge, especially given the technical and legal complexities of the task. Commercial land disposal facilities and incinerators are the most difficult to permit because of frequent local opposition. Communities often feel threatened by commercial treatment facilities located close to their homes.

Thorough assessments of each site are needed in order to develop operating requirements for permits. Specialists trained in engineering, hydrology, and chemistry are called on to develop site-specific permit conditions to minimize the risks. Much effort is devoted to coordinating the activities of these specialists.

Enforcement

Before HSWA, land disposal facilities were inspected annually for compliance with RCRA. Treatment and storage facilities were inspected less regularly. Now, all federal- or state-operated facilities must be inspected annually, and other commercial facilities at least every two years. If a serious violation has occurred, EPA or the state will issue an administrative order or initiate a civil or criminal law suit to make sure the facility is returned to compliance.

Involving the Public

Public participation in hazardous waste management is an integral part of the regulatory system. EPA tries to make sure the public has access to information and is given the opportunity to comment on EPA's actions, including permitting. Public notices, a 45-day comment period, and fact sheets are required during the permit process. Also, the 1984 amendments require that authorized states disclose information to the public about compliance, enforcement, and the results of inspections. Communicating to the public what this information means and coordinating with interested groups is an important part of the process.

Information Dissemination

Lack of information has been a barrier to companies who want to set up waste minimization or recycling programs. Identifying waste minimization opportunities can require specialized engineering knowledge that many small- or medium-sized companies do not have and may not be able to obtain independently. Improving information dissemination will help such companies reduce the wastes they generate.

Recycling to Reduce Large Quantities of Wastes

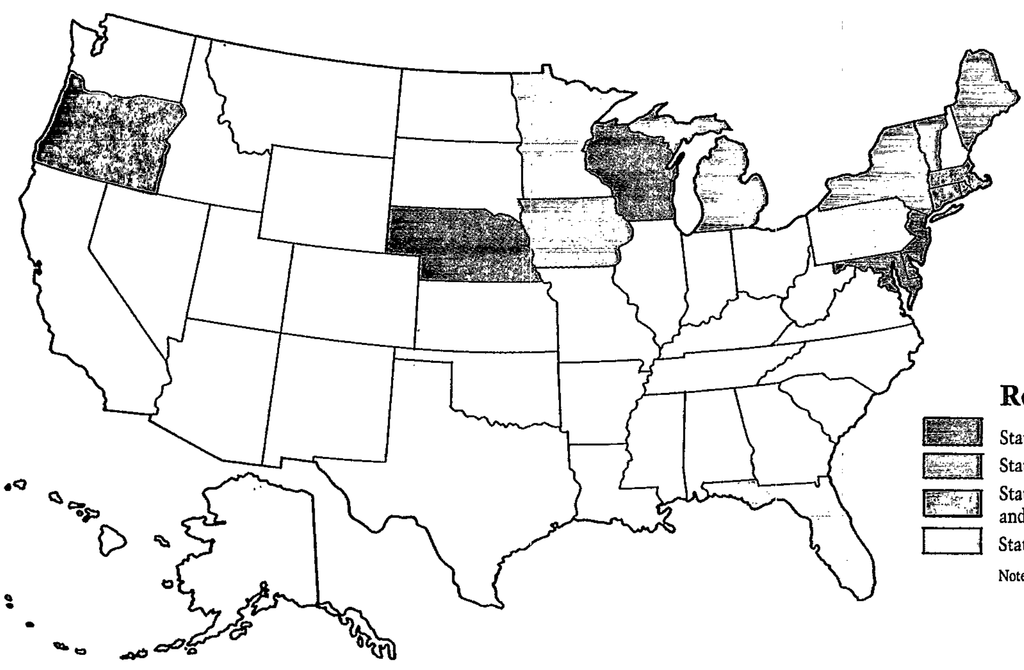
Recycling is an increasingly attractive option for handling our municipal wastes as municipal dumps fill up and communities become more resistant to new landfills and incinerators. Other countries such as Japan already have a recycling system in place. Japan recycles 50 percent of its wastes, and in one community they have shown that recycling can reduce garbage volume by as much as 65 percent.

In the United States, a few states have mandatory, statewide recycling laws (see map). In these states, residents have their recyclables picked up at the curb, much like regular garbage collection. A few states have new laws yet to be implemented, and as many as 8,000 localities have their own programs. Nine states have "bottle bills," whereby consumers pay a small deposit on cans and bottles, which is returned to them upon redemption. The cans and bottles then are collected by the distributor and recycled. Many states are considering taxes on both packaging and products made with nonrecyclable materials. These materials make up 33 percent of the garbage we throw out.

The federal government, to encourage use of recycled materials, will soon purchase paper and paper products containing the highest possible percentage of recycled materials. It is also considering purchasing cement and concrete made with incinerator ash and asphalt made from used tires and re-refined lubricating oils. EPA has recycled its own office paper for years and has plans to start recycling newspaper, bottles, and aluminum cans.

There is strong momentum for recycling around the country. EPA plans to capitalize on it through educational programs, providing technical assistance, encouraging market forces, and helping states develop solid waste/recycling plans.

Recycling paper increases energy savings by 95% and reduces solid waste.



Recycling Laws by State

- States with a statewide recycling law
- States with a bottle bill
- States with both a bottle bill and statewide recycling laws
- States where legislation is pending

Note: New York is a bottle bill state and has pending legislation for mandatory recycling

EPA's Agenda

EPA must meet the permitting and other regulatory deadlines of HSWA. Between 1988 and 1990, the land disposal restrictions program will be in full force. The deadline for issuing waste incinerator permits is 1989. The statute requires all land disposal facilities to be permitted by the end of 1988.

As part of the HSWA implementation process, the Agency will continue to revise facility performance standards. For certain land disposal units, double liners and leak detection systems are required in addition to other requirements such as ground-water monitoring. We also are writing regulations that will ban certain management practices and types of facilities from being located in sensitive environments. The Agency will also make existing incinerator regulations more stringent to address the potential problems caused by products of incomplete combustion. To this end, we are conducting various analyses that could ultimately lead to amendments to existing incinerator regulations.

EPA is proposing a correction in the permit modification system to allow more flexibility for hazardous waste facilities to respond to changing wastes, to perform corrective action activities, and to make improvements. There is a streamlined process for the issuance of permits for research, development, and demonstration facilities to encourage the growth of new technologies. Other planned activities in the hazardous waste area include listing of new wastes to be categorized as "hazardous," controlling air emissions from hazardous treatment facilities, and determining the hazards from certain wastes previously considered nonhazardous.

EPA will soon revise the criteria for the construction and placement of municipal waste landfills. The new criteria will require ground-water monitoring, location restrictions near critical wildlife habitat or in areas likely to flood, and provisions to address any spills or leakage from these.

EPA will continue to endorse and support voluntary collection programs for household hazardous wastes. Other possibilities for agency involvement in the municipal waste area are increased technical assistance to states and localities, reduction of wastes at the source, and recycling of aluminum, newspaper, office paper, and glass.

Hazardous Waste Management in Anchorage, Alaska

Anchorage developed one of the country's first household and business hazardous waste collection programs. The program was started in 1983 with the city's first annual hazardous waste cleanup week. Since then, the program has collected about 800 drums — or more than 30,000 pounds of hazardous wastes — from generators who produce too little waste to be regulated by RCRA.

Because enforcement is difficult, hazardous wastes from small businesses often end up in sewers and in the garbage or are dumped illegally. Proper hazardous waste disposal in Anchorage is a particular concern because the nearest approved disposal facilities are over 2,000 miles away in the lower 48 states, disposal costs are extremely high, and the Arctic environment is fragile and hence very sensitive to contamination.

During one week every year, individuals and businesses bring their hazardous wastes to a central collection point where they are packaged properly and shipped to EPA-approved facilities. These annual cleanups, however, are only a partial solution. During the 51 weeks when the wastes are not collected, generators may be improperly storing them or, worse, dumping them illegally.

For this reason, Anchorage is designing both a collection program and storage facilities that will provide a year-round means for the safe management of hazardous wastes from households and very small-quantity generators. A warehouse type structure will be used to store the wastes. The wastes will be analyzed, packaged, and stored with compatible materials in specially designed containers. When enough wastes are collected, they will be shipped to approved facilities in the lower 48 states. A drop-off station for up to five gallons of household hazardous wastes will be located at an in-town solid waste transfer station.

A major emphasis of the Anchorage program has been public education and awareness. A hazardous waste school curriculum has been prepared for grades four through six for use in the Anchorage School District. The curriculum gives students an opportunity to see what happens when hazardous wastes (food coloring) are introduced into a simple hydrological model (terrarium with clay and sand layers and a water table). The curriculum also shows students how to conduct a home survey with their parents to identify hazardous products and methods used for disposal. Taken together, these steps should go a long way toward encouraging safe disposal of hazardous wastes by both businesses and individuals.

Cleaning Up Releases of Hazardous Substances

THE PROBLEM

Uncontrolled disposal sites containing hazardous wastes and other contaminants present some of the most serious environmental problems our nation has ever faced. These sites can contaminate ground water, lead to explosions, and present other dangers to people and the nearby environment. In many cases, the people who disposed of the waste were unaware of the problems that the sites eventually would create for public health and the environment.

Most of the abandoned or inactive waste sites and many of the active hazardous waste facilities where hazardous wastes have escaped are linked in some fashion to the chemical and petroleum industries (see discussion of sources in the section, "Preventing Future Contamination from Improper Waste Disposal"). Many of the sites were once municipal landfills that may have become hazardous simply as a result of accumulated pesticides, cleaning solvents, and other chemical products discarded in household trash. A few sites are the result of transportation spills or other accidents. We have identified radioactive materials as one of the hazards at approximately twenty sites.

Many inactive waste sites are located in environmentally sensitive areas such as floodplains and wetlands. A number also are located close to populated areas. These sites threaten drinking water supplies when rain and melting snow seep through the site's surface and carry chemicals that contaminate nearby streams, lakes, and underground waters. At some sites, air is contaminated as toxic vapors rise from evaporating liquid waste or from uncontrolled chemical reactions. Some pollutants, such as metals and organic solvents, can damage vegetation, endanger wildlife, and threaten the health of people who unknowingly drink contaminated water. For other pollutants, the extent of the danger is not known.

Approximately 30,000 potentially contaminated sites that may pose a threat to human health or the environment have been identified nationwide. In addition, hazardous waste has leaked from some active hazardous waste treatment, storage, and disposal facilities now regulated under RCRA.

EFFORTS TO DATE

Cleanup under Superfund

Under CERCLA, responsible parties clean up sites themselves with EPA or state oversight. EPA and the states also can start actions to clean up sites after attempts at negotiation with the companies that created the problem have failed or there is an emergency. The government will later sue those companies to recover the costs of cleanup.

To implement CERCLA, the Agency designed a process that begins with site discovery. The basic steps are to assess the nature and degree of contamination, determine the relative threat, analyze the potential cleanup alternatives, and take actions to clean up the site.

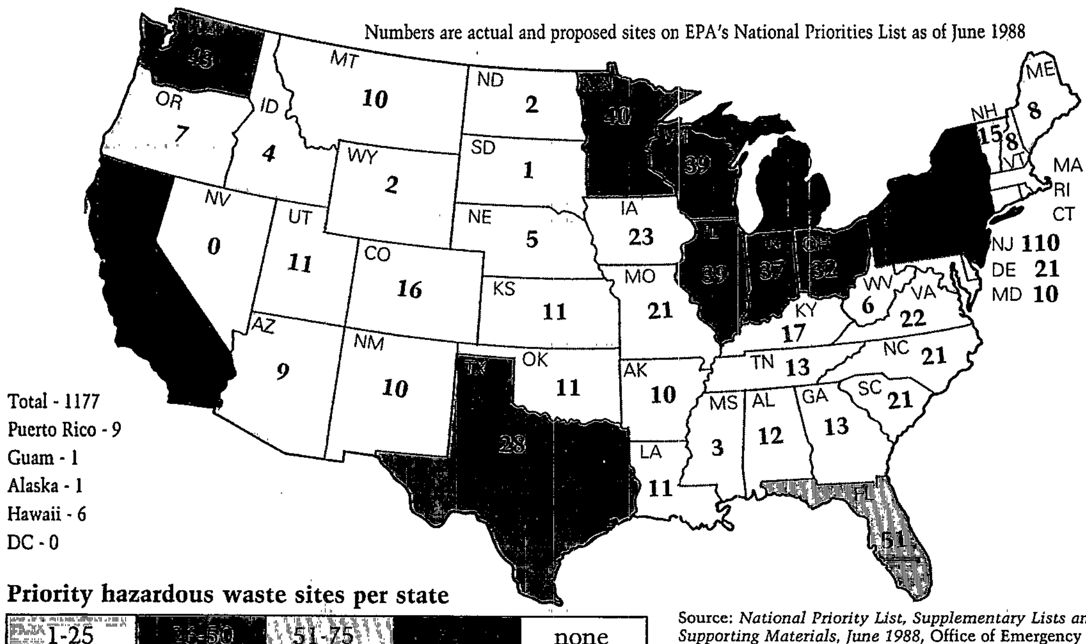
The process also provides for emergency cleanup of contamination. When a site is determined to present an immediate danger to public health, welfare or the environment, EPA will step in with funds to take any one of several actions to alleviate the threat. For example, we may provide an alternate water supply, put up fencing, remove discrete sources of contamination on the surface (e.g., drums) or in severe cases, temporarily relocate residents until the danger is eliminated. These "removal actions" can take place when a site is first discovered or at any time other work is being conducted at the site and a threat is encountered. Removal actions under Superfund are valuable for alleviating short-term threats and support long term efforts. Many of the sites where removal actions are taken need no further EPA action. If further action is needed, EPA actions will be designed to achieve long-term cleanup.

The Superfund process begins with site discovery. Sites may be brought to EPA's attention as a potential problem in a number of ways. For example, a hunter may come across a site where waste was dumped illegally; residents may notice a bad taste in their drinking water or a foul odor; or there may be an explosion or fire which alerts authorities to a problem. The approximately 30,000 potentially contaminated sites identified range from a closed-down hazardous waste incinerator in Maine to a leaking underground pipe in Florida.

After discovering a site, EPA or the state conducts a Preliminary Assessment to determine whether there is an imminent threat which would require immediate, emergency attention or whether additional investigation or further action is needed. Even when it is determined that no further action is needed at a site because no hazard appears to exist, the site remains in the Superfund inventory for record keeping and future reference. To date, the Agency has completed over 27,000 Preliminary Assessments.

If the Preliminary Assessment at a site indicates that further investigation is necessary, a more detailed Site Inspection is conducted. The results of the Site Inspection are evaluated, using the Hazard Ranking System. This is a

FIGURE L-9
The Number of Superfund NPL Sites Varies Widely from State to State



Source: *National Priority List, Supplementary Lists and Supporting Materials, June 1988,* Office of Emergency and Remedial Response (Superfund), USEPA technical evaluation which considers how contamination at a site could affect people or the environment. By factoring in criteria such as how many people may be exposed to chemical contamination from the site, the scoring system helps to set cleanup priorities for the Superfund program. Currently, sites that score 28.5 or above, using the Hazard Ranking System, are placed on the National Priorities List (NPL), EPA's official list of hazardous waste sites warranting attention under Superfund. Additionally, each state may propose to list a top-priority site.

Since the Superfund program was established in 1980 almost 9,000 sites have been determined to require no further action from EPA and over 8,000 Site Inspections have been conducted. One thousand, one hundred and seventy-seven sites have been listed or proposed for listing on the NPL. The location of these sites is shown in Figure L-9. Except for removal actions, listing on the NPL is a prerequisite for cleanup activities that would use federal Superfund money.

For sites included on the NPL, further in-depth study defines the nature and extent of contamination. Such studies have been initiated at over half of the sites currently listed on the NPL. In many cases states and the parties responsible for the site contamination have taken the lead in conducting these studies.

After the public has had an opportunity to comment on the in-depth study, the most effective remedy for long-term cleanup is determined. Before selecting a remedy, EPA or the responsible state considers whether the remedy would comply with the federal and state cleanup standards, the cost-effectiveness of the action, and the mandate to use treatment to the maximum extent practicable. Some commonly used remedies are incinerating contaminated soils to permanently destroy contaminants, depositing contaminated materials in a landfill that is designed to prevent any movement of the contaminants from the fill, and pumping and treating contaminated ground water to clean up an aquifer.

To date, over 140 long-term cleanups have been initiated at Superfund sites across the nation. EPA works with the state or responsible parties to develop the site-specific cleanup plan. After the Superfund action is completed, the state takes responsibility for long-term maintenance of the site to ensure that the remedy continues to work.

The Superfund Amendments and Reauthorization Act of 1986

The 1986 amendments of CERCLA, known as the Superfund Amendments and Reauthorization Act (SARA), authorized $8.5 billion for both the emergency response and longer term (or remedial) cleanup programs. The Superfund amendments focused on:

- ***Permanent remedies** - EPA must implement permanent remedies to the maximum extent practicable. A range of treatment options will be considered whenever practicable.*
- ***Complying with other regulations** - Applicable or relevant and appropriate standards from other federal, state, or tribal environmental laws must be met at Superfund sites where remedial actions are taken. In addition, state standards that are more stringent than federal standards must be met in cleaning up sites.*
- ***Alternative treatment technologies** - Cost effective treatment and recycling must be considered as an alternative to the land disposal of wastes. Under RCRA, Congress banned land disposal of some wastes. Many Superfund site wastes, therefore, will be banned from disposal on the land; alternative treatments are under development and will be used where possible.*
- ***Public involvement** - Citizens living near Superfund sites have been involved in the site decisionmaking process for over five years. They will continue to be a part of this process. They also will be able to apply for technical assistance grants that may further enhance their understanding of site conditions and activities.*
- ***State involvement** - States and tribes are encouraged to participate actively as partners with EPA in addressing Superfund sites. They will assist in making the decisions at sites, can take responsibility in managing cleanups, and can play an important role in oversight of responsible parties.*
- ***Enforcement authorities** - Settlement policies already in use were strengthened through Congressional approval and inclusion in SARA. Different settlement tools, such as de minimis settlements (settlements with minor contributors), are now part of the Act.*
- ***Federal facility compliance** - Congress emphasized that federal facilities "are subject to, and must comply with, this Act in the same manner and to the same extent... as any non-government entity." Mandatory schedules have been established for federal facilities to assess their sites, and if listed on the NPL, to clean up such sites. We will be assisting and overseeing federal agencies with these new requirements.*

The amendments also expand research and development, especially in the area of alternative technologies. They also provide for more training for state and federal personnel in emergency preparedness, disaster response, and hazard mitigation.

Over 1,000 short-term actions to address immediate threats have been initiated (see Figure L-10). By the Fall of 1987, the Agency reached agreements with responsible parties for 184 removal actions.

Identification of Responsible Parties

Throughout the Superfund process, EPA tries to identify the companies or individuals whose wastes caused or contributed to the problem. The parties responsible for the contamination must either clean up the site or reimburse EPA for cleaning it up. Identifying the responsible parties is not always easy and in some cases involves substantial investigation. For example, over 400 parties are under investigation for contributing contamination to one particular site.

In many cases, responsible parties have conducted the cleanup work at a site with EPA and state oversight. Figure L-11 shows that 19 percent of emergency actions and 38 percent of long-term actions are funded by responsible parties. Since 1980, responsible parties have agreed to conduct 444 cleanups at a total cost in excess of $642 million. EPA also has recovered more than $51 million in compensation for cleanups it has performed, and has suits pending for another $254 million. If a responsible party refuses to comply with an EPA order and EPA cleans up the site, EPA may choose to seek "treble damages," tripling the amount of the cleanup costs due the government.

Public Involvement

The Superfund site cleanup process encourages public involvement. At public meetings, citizens can raise issues and ask questions of EPA and state officials. The public has an opportunity to comment on proposed plans for all long-term actions.

FIGURE L-10

Superfund Emergency Actions Were Taken To Address Many Environmental or Public Health Threats *

Source: Office of Emergency and Remedial Response (Superfund), USEPA

* More than one threat may be present at a specific site. Consequently the number of threats is greater than the number of sites or actions.

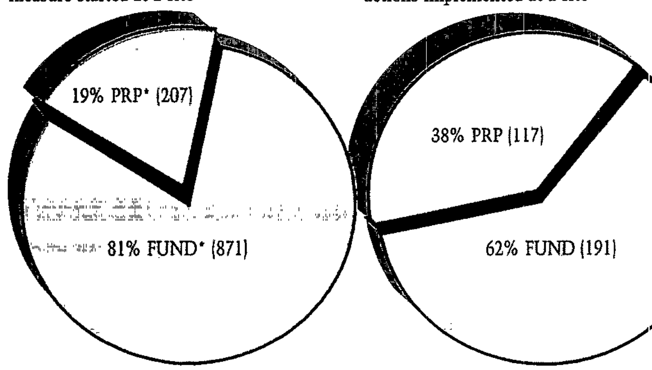
Each Superfund site has a community relations plan tailored to the needs of the affected community. The plan may include publication of a newsletter, site tours, and regularly scheduled public meetings. For NPL sites, community groups may obtain technical assistance grants to help them interpret technical information related to cleanups at Superfund sites.

FIGURE L-11

Cleanups can be Financed by the Superfund or by Responsible Parties

Removal Activities
Removal started OR initial remedial measure started at a site

Remedial Activities
Remedial design started OR remedial actions implemented at a site



*PRP - Potentially Responsible Parties who have agreed to pay for or conduct a cleanup needed at the site, through negotiations or EPA enforcement action.

FUND - Sites where Superfund monies will/or have been used to clean up the site. Responsible parties may be bankrupt or defunct. If possible, EPA will sue to recover cost at a later date.

Source: *Superfund Progress Report of September 30, 1987*, USEPA

Cleanup Under RCRA

The 1984 RCRA amendments authorized EPA to compel owners of RCRA hazardous waste treatment, storage, and disposal facilities to clean up releases of hazardous wastes and constituents at their facilities. EPA has designed a process called "corrective action" to clean up these releases. It builds upon the knowledge gained from implementing Superfund and is consistent with the Superfund site cleanup process.

In this cleanup effort, EPA first examines historical data on the facility's operations to identify releases. Additional studies are done to determine the nature and extent of any identified releases. If the data indicate the release may pose a threat to health or environment, the Agency will draft corrective action requirements in a permit or order.

EPA recently issued its strategy for corrective action and will begin proposing regulations shortly. Among the most important decisions will be determination of when corrective action is needed, and to what level cleanup is needed.

The steps in corrective action will be imposed through permit conditions or through enforcement orders (see section on "Preventing Future Contamination From Improper Disposal"). Priorities for action will be established yearly and will focus on those facilities that pose the greatest overall threat to human health and the environment. We have decided initially to target a limited number of facilities rather than address all facilities that may require action simultaneously.

The Steps in Cleaning Up an Uncontrolled Waste Site

After someone alerts EPA about a potential problem site, what happens? If the site is found to present a release or threat of release to public health or the environment that must be addressed quickly, EPA may take emergency measures to remove the threat. These removal actions range from installing security fencing to digging up and removing wastes for safe disposal at a RCRA approved facility. Such actions may be taken at any site, not just those on the National Priority List (NPL). These actions can take place at any time during investigation or cleanup at a site when a determination is made that response should not be delayed.

1. Identification and Preliminary Assessment

If response can be delayed without endangering public health and the environment, we can take additional time to evaluate the site further. We collect all the available information on the site from our files, state and local records, and U.S. Geological Survey maps. We analyze the information to determine the size of the site, parties most likely to have used it, local hydrological and meteorological conditions, and the impact of the wastes on the environment.

2. Site Inspection

Inspectors then go to the site to collect sufficient information to rank its hazard potential. They look for evidence of hazardous waste, such as leaking drums and dead or discolored vegetation. They may take samples of soil or water. Inspectors analyze the ways hazardous materials could be polluting the environment, for example, through runoff into nearby streams. They also check to see if the public (especially children) have access to the site.

3. Ranking Sites for the National Priorities List

Sites are evaluated according to the type, quantity, and toxicity of wastes at the site, the number of people potentially exposed, the pathways of exposure, and the importance and vulnerability of the underlying ground-water supply. This information is used to determine the Hazard Ranking System score. If the score is 28.5 or above, the site may be proposed for listing on Superfund's National Priorities List. Each state may also propose one site for listing if it is the top priority site in the state.

4. Negotiating with Potentially Responsible Parties

After the parties potentially responsible for the contamination are identified, EPA notifies them of their potential liability. We then negotiate with them to reach an agreement to undertake the studies and subsequent cleanup actions needed at the site. If negotiations are not successful, EPA may use its enforcement authorities to require responsible parties to take action, or the Agency may choose to clean up the site and seek to recover costs at a later date.

5. Remedial Investigation

The objective for hazardous waste sites placed on the NPL is long-term cleanup. To select the cleanup strategy best suited to each unique site, a more extensive field study or remedial investigation is conducted by EPA, the state, or the responsible parties. This study includes extensive sampling and laboratory analyses to generate precise data on the types and quantities of wastes present at the site, the soil type and water drainage patterns, and resulting environmental or public health risks.

6. Feasibility Study and Cleanup

Cleanup actions must be tailored exactly to the needs of each individual site. The feasibility study analyzes those needs and evaluates alternative cleanup approaches on the basis of their relative effectiveness and cost. Remedial actions must use permanent solutions and alternative treatment to the maximum extent practicable. They may include technologies such as ground-water treatment or incineration.

7. Post-Cleanup Responsibilities

After cleanup, the state is responsible for any long-term operation and maintenance required to prevent future health hazards or environmental damage.

TODAY'S CHALLENGES

There are a number of complex technical, legal, and administrative challenges in the Superfund and RCRA site cleanup programs.

- Each site cleanup may involve the efforts of dozens of people in responding to a large number of scientific and policy issues. Involving the community, state agencies, and responsible parties early in site decisions requires significant effort and coordination.
- EPA must manage an increasingly complex technical program while ensuring that the ambitious cleanup goals set by Congress in the Superfund Amendments and Reauthorization Act of 1986 are met.
- The technical difficulty of cleaning up these sites can only be overcome by conducting research, developing technologies, and gaining further experience in detoxification of wastes. Tremendous effort will be required to develop the scientific and technical expertise necessary to understand fully the nature of contamination at these sites.

Long-Term Cleanup at a Superfund Site in Massachusetts

The Baird & McGuire Superfund site encompasses a 20-acre area south of Boston in Holbrook, Massachusetts. For over 70 years at the site, a company formulated and produced soaps, disinfectants, floor waxes, pesticides, and herbicides.

Over 100,000 gallons of hazardous materials were stored in a number of tanks at the site. Of 129 possible Superfund priority pollutants, 100 have been found there, the town's wellfield has been contaminated, and three of its public water supply wells have had to be closed.

In 1984, EPA began a series of extensive emergency removal actions at the Baird & McGuire site. EPA removed 50 truckloads of contaminated soil, installing a ground-water recirculation system, temporarily capping part of the site, and closing sluice gates on a nearby reservoir. In addition, a 5,700-foot fence was installed around the site after dioxin was discovered.

At the same time the imminent threats were being stabilized, EPA conducted a remedial investigation and feasibility study to determine the nature and extent of site contamination. When the studies of the site began, the community became actively involved in the cleanup process. A Citizens Advisory Committee was formed, and the EPA site manager presented information and answered questions at biweekly meetings.

After completing the remedial investigation and feasibility study in 1986, EPA selected a remedy to address permanently the remaining contamination at the site. The remedy calls for incineration of contaminated soils, ground-water treatment, and wetland restoration. Because no responsible parties were able to pay for the cleanup, federal and state dollars will be used to pay the estimated $45 million cleanup cost.

Before and after cleanup at a Superfund site.

- The Agency must strive to develop and implement permanent remedies to the maximum extent practicable that meet relevant environmental and public health standards. The development and use of technologies such as bioremediation (see highlight) that cost-effectively destroy hazardous wastes, will be a key to meeting this challenge.
- Through the 1986 Superfund amendments, many enforcement tools are available to us to encourage responsible parties and facility owners to comply with the law. The challenge will be to use these tools effectively to reach settlements with parties and recover the costs of cleanups funded by EPA.
- The RCRA corrective action authorities are broad and the universe of facilities to which they may apply is diverse. The challenge is to recognize the diversity and provide sufficient flexibility, while protecting human health and the environment.

Interstate 70 Acid Spill Near Wheeling, West Virginia

A truck carrying a 40,000-pound load of bottled concentrated acids crashed on a major interstate near Wheeling, West Virginia, spilling hazardous substances. Toxic fumes were generated by interaction of the acids, endangering nearby schools, residences, and a trout stream.

Given the urgency of the situation which was exacerbated by severe weather conditions, the EPA official in charge promptly began a Superfund-financed response. Several measures were taken in response to the incident. Incompatible chemicals that could explode if mixed were isolated. Damaged containers were repackaged for disposal. Acids spilled on the ground and near a drain were neutralized to prevent further damage, and contaminated soil was excavated for proper disposal. The threat was expeditiously eliminated, and public health and the environment were protected.

Using Biological Organisms to Clean Up Hazardous Waste

Tests dating to the early 1970s have demonstrated the success of using biotreatment to address contamination. More recent tests indicate that techniques using micro-organisms to "eat" hazardous waste may be a promising solution for disposing of many organic wastes and cleaning up contaminated ground water. Where cleaning up one site with bioremediation may cost $45-50 million, it may cost $140 million if a lagoon has to be drained and an incinerator built to dispose of the wastes. We are studying closely the use of these large-scale biological techniques to help clean up some hazardous waste sites.

To use bioremediation at a site, we must first discover more about the wastes in the site and identify potential methods of biodegradation. At many waste contamination sites, microorganisms that break down organic wastes have developed over time. The bioremediation technique generally starts by collecting and isolating these micro-organisms to determine what nutrients and climatic conditions (e.g., pH, moisture, temperature, oxygen levels) enhance the degradation process. Such micro-organisms are usually transferable to other sites contaminated with the same wastes.

In one study, scientists have found numerous types of fungi and bacteria — up to 10 million per gram of soil — 850 feet below the surface of the earth, which is almost 30 times deeper than the previously recorded limit. Many aquifers used for drinking water also are found at such depths, and scientists believe that these indigenous organisms may be best suited to cleaning up the aquifers. If some of the organisms are not already adapted to break down specific ground-water pollutants, it might be possible to manipulate them through genetic engineering so that they can digest the toxic compounds.

EPA's Agenda

Over the next few years, EPA will continue to focus on cleaning up threatening CERCLA and RCRA sites. Accordingly, we are committed to accomplish the following six goals.

Respond to Immediate Threats

With the 1986 amendments, EPA now is allowed up to one year to complete removal actions and may use up to $2 million per site in the process. These actions will be consistent with any longer-term remedial and enforcement objectives. Where feasible, EPA will use removal authorities to complete cleanup at the site, thus reducing the number of long-term remedial cleanups.

Streamline the Cleanup Program

The Agency will take many steps to increase the efficiency and accelerate the pace of cleanups and focus on Congressional deadlines. This includes initiating more cleanup actions and completing actions at sites quickly, where feasible. To facilitate this faster pace, regional EPA staff, who are most familiar with a site's cleanup efforts, will manage site contracts. In addition, a single project manager will carry the site through remedial planning, design, and implementation.

Secure Action by Responsible Parties

EPA will continue to require RCRA facility owners or operators who are responsible for contamination to take corrective actions under RCRA. To achieve swift settlements with responsible parties in the Superfund program, the Agency will use their new settlement tools that should help them reach agreement with responsible parties more easily. Among these tools are mixed funding agreements through which EPA and responsible parties share the financial burden of cleanup. De-minimis settlements are another tool to expedite settlements with parties who contributed small amounts of hazardous substances. EPA will identify parties early in the cleanup process and sue nonsettlers where necessary to recover the costs of clean up.

Encouraging Development of Innovative Technologies

As part of SARA, Congress directed EPA to focus on permanent remedies for Superfund sites, with less preference to be given to containment of untreated wastes onsite. In 1987, 75 decisions about remedies were made at sites.

Selected Remedies for Superfund Sites in 1987

Treatment Technology	Number of Sites Where Used
Incineration/Thermal	32
Solidification	13
Stabilization/neutralization	7
Volatilization/Aeration	2
Soil Washing/Flushing	3
Biodegradation/Land Application	1
Other	4
Containment	35
On-site Containment	24
Temporary Storage	8
Off-site Disposal	3
Ground Water	45
Pump and Treatment	32
Alternate Water Supply	13

Although we are making progress using these technologies, we suspect there may be other useful methods to clean up a site. To promote the development and use of innovative technologies for treating hazardous wastes, EPA has established the Superfund Innovative Technology Evaluation Program (SITE), required under SARA. Funded by Congress at a level of up to $20 million per year through 1991, SITE is a research, demonstration, and evaluation program.

Under SITE, EPA solicits proposals from developers of technologies that destroy, immobilize, or reduce the volume of hazardous wastes. The selected developers operate their waste disposal units, and the Agency takes samples and evaluates test results. With these data, EPA is able to assess the performance, reliability, and cost of innovative technologies.

Examples of technologies being evaluated under the SITE program include:

- ***In-situ vacuum extraction:** This process will be used to extract volatile contaminants, such as trichloroethylene (TCE), from soils at the Groveland Wells Superfund site in Massachusetts.*
- ***Solidification and stabilization process:** At the Douglass Disposal Superfund site in Union Township, Pennsylvania a unit will demonstrate a new way to solidify soil contaminated with a wide variety of organics and metals.*

EPA will document the SITE demonstration results in reports made available to federal, state, and private cleanup managers and other interested parties.

Maintain and Improve a Strong EPA/State Partnership

The Agency will help states develop a greater role in the Superfund cleanup process by developing regulations requiring meaningful state involvement. We will work with states to conduct cleanups through Cooperative Agreements and will negotiate with states to outline Superfund site cleanup priorities and important issues of cooperation. States will also begin to take more responsibility in Superfund enforcement actions over the next several years. In addition, EPA will continue to work with states to assume greater roles in the RCRA program.

Enhance Community Outreach Efforts

The 1986 Superfund amendments reaffirmed the necessity of public involvement in Superfund site decisions. Superfund site cleanups are often very complex and difficult to understand. EPA will work to enhance the public's input into the decisionmaking process in several ways. Opportunities for public meetings and community relations plans will continue to be provided for every site on the NPL. Technical assistance grants will be provided to citizen groups to help them interpret technical data and understand the implications of Superfund site work.

Implement the RCRA Corrective Action Program

EPA and the states are responsible for management of the corrective action program. Permits will be modified to reflect corrective action provisions, and the public will be involved in decisions about the action needed. Discussions with facility owners and operators about the scope of the actions needed will be necessary. EPA, in conjunction with the states will identify a limited number of facilities for priority attention in the corrective action process. When a facility is clearly not able to undertake cleanup, action will be taken as soon as possible to determine if it should be addressed under the Superfund program.

A Landmark Federal Facility Hazardous Waste Agreement

EPA's Regional office in Chicago and the state of Minnesota negotiated with the Army to reach the first federal facility interagency cleanup agreement under the new Superfund law. One of the primary sources of the contamination at the New Brighton/Arden Hills/St. Anthony Superfund site is the U.S. Army's Twin City Ammunition Plant. The site has contaminated ground water extending over 20 square miles.

Both the Army and EPA have provided adequate potable water supplies for affected ground-water users. This includes connecting residents to municipal water supplies, providing treatment to municipal water supplies at St. Anthony, and developing new wells for the affected municipalities.

The history of the site shows its complexity.

- *1982 - The site was listed on the Superfund National Priorities List, primarily because of ground-water contamination.*
- *1983 - The Army reimbursed Arden Manor Trailer Park for costs of replacing contaminated water supply.*
- *1985 - The state completed its first phase of the $1.4 million investigation of the contamination, which indicated the ammunition plant as a likely contributor to the contamination.*
- *1986 - New Brighton abandoned drinking water wells and replaced its water supply because of contamination. EPA finalized a plan for cleanup of one well in New Brighton.*
- *1987 - St. Anthony replaced its water. EPA finalized a plan for carbon treatment of existing closed wells.*

After numerous ongoing studies since 1978, EPA, Minnesota, and the Army entered into a joint agreement in August 1987. The agreement is the first of its kind between the Army, EPA, and a state under the newly authorized Superfund law. It ensures cooperation among the organizations and defines the scope of activities necessary to address the site.

The agreement is the culmination of negotiations between the state, EPA, and the Department of the Army. Among other things, the agreement establishes provisions for:

- *coordination of overlapping requirements of RCRA and CERCLA;*
- *policies and procedures consistent with those for non-federal facilities;*
- *EPA approval of selected remedies; and*
- *EPA and state oversight of the Army's activities at the site.*

LAND

Tackling Pollution from Underground Storage Tanks

THE PROBLEM

Leaking underground storage tanks are large — and even small leaks add up to big problems over time.

Environmental contamination caused by leaking underground storage tanks has not received the national attention paid to many Superfund sites. Yet leaks from underground storage tanks are a result of simple, everyday tank use and are far more commonplace and widespread. Furthermore, leaks from underground tanks (or their piping) can pose serious environmental and health problems for many communities.

An estimated five to six million underground storage tanks containing hazardous substances or petroleum products are in use in the United States. Originally placed underground as a fire prevention measure, these tanks have substantially reduced the damages from stored flammable liquids. However, an estimated 400,000 underground tanks are thought to be leaking now, and many more will begin to leak in the near future. Products released from these leaking tanks can threaten ground-water supplies, damage sewer lines and buried cables, poison crops, and lead to fires and explosions.

Under RCRA, underground storage tanks are defined as tanks with 10 percent or more of their volume, including piping, underground. Figure L-12 shows that almost half of the tanks to be regulated by EPA are petroleum storage tanks owned by gas stations, and another 47 percent are petroleum storage tanks owned by a group of other industries that store petroleum products for their own use. Airports, firms with large trucking fleets, farms, golf courses, and manufacturing operations may all own tanks. The remainder of the tanks that will be regulated are used by a variety of industries for chemical storage.

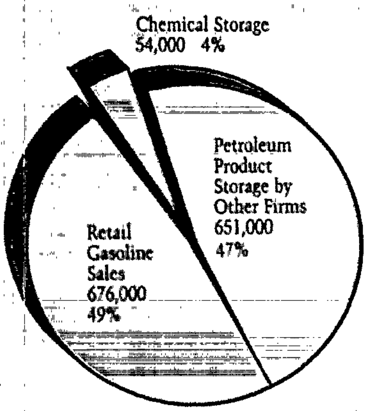
Many of the petroleum tank systems were installed during the oil boom of the 1950s and 1960s. Two 1985 studies of tank age distribution indicate that approximately one-third of the existing motor fuel storage tanks are over 20 years old or of unknown age. Figure L-13 shows that most of these aging tank systems are constructed of bare steel, not protected against corrosion, and nearing the end of their useful lives. Many of these old tank systems have already had a leak, or will soon leak unless measures are taken to improve or remove them. When these old tanks are pulled from the ground, many of them have holes where a dip stick was dropped hundreds of times to measure the amount of fuel in the tank.

Exacerbating the problem of old tanks still in use are the thousands of gas stations that closed during the oil crisis of the 1970s. Although these tanks are not the only ones of concern, the abandoned tanks at these stations frequently were not closed properly, and ownership and responsibility for future problems is difficult to determine.

The primary reason for regulating underground storage tanks is to protect water, especially ground water that is used for drinking water. Fifty percent of the U.S. population depends on ground water for drinking water. Rural areas would be seriously affected if their ground water were contaminated, since it provides 95 percent of their total water supplies. Ground water drawn for large-scale agricultural and industrial uses also can be adversely affected by contamination from leaking underground tanks.

FIGURE L-12

Almost Half of Underground Storage Tanks are Owned by Gas Stations

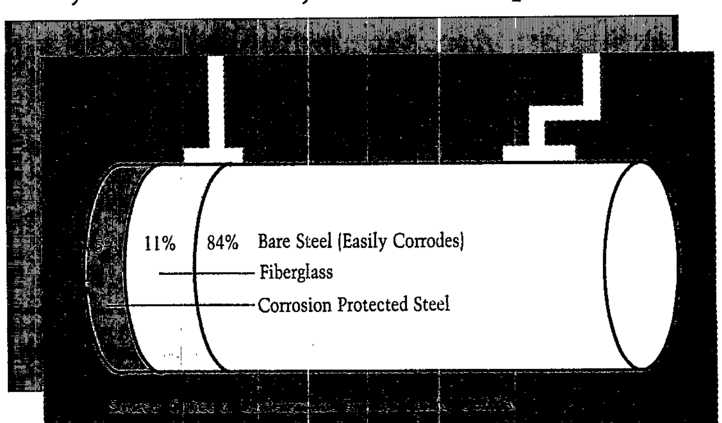


Note: Based on number of regulated tanks, total estimated tank universe is 506 million.

Source: Office of Underground Storage Tanks, USEPA

FIGURE L-13

Many Tanks Currently in Use are Unprotected



EFFORTS TO DATE

Federal laws were enacted in response to the increasing problems resulting from leaking underground storage tanks. These laws generally are based on many state and industry ongoing efforts. Congress provided for federal regulation of underground storage tanks as part of the 1984 RCRA amendments but it exempted residential heating oil and small farm tanks. As a first step, Congress required that all owners or operators register their tanks with the appropriate state agency, indicating tank age, location, and contents. Thus for the first time, states had to set up an inventory of tanks in their jurisdictions. The amendments also included interim design requirements to tanks installed after May 1985 (this "Interim Prohibition" is in effect until EPA publishes regulations in 1988). Congress further directed EPA to develop regulations requiring owners to detect leaks from new and existing underground storage tanks and clean up environmentally harmful releases from such tanks. Tank owners also must demonstrate that they are financially capable of cleaning up leaks from tanks and compensating third parties for damages resulting from such leaks.

As required by HSWA, EPA has been developing a comprehensive regulatory program for underground storage tanks. EPA proposed three sets of regulations pertaining to underground tanks. The first addresses technical requirements for petroleum and hazardous substance tanks, including new tank performance standards, release detection, release reporting and investigation, corrective action, and tank closure. The second proposed regulation addresses financial responsibility requirements for underground petroleum tanks. The third addresses standards for approval of State tank programs. These regulations are expected to be finalized during 1988.

While amending CERCLA in 1986, Congress also amended RCRA to provide $500 million over the next five years for a Leaking Underground Storage Tank Trust Fund. Generated by a 1/10 of a cent federal tax on certain products, primarily motor fuels, the Trust Fund has been made available to the states to help them cleanup leaks from underground petroleum storage tanks if certain conditions for use of the fund are met.

Because the number of tanks that require investigation and attention is too great for EPA to tackle alone, the Agency has developed a program that will be carried out primarily by state and local governments. The national tank program is designed primarily to be a network of state and local programs. EPA will provide research, regulations, training, technical support, and enforcement backup as necessary.

Over 20 states and a number of local governments have already developed programs to regulate underground storage tanks. The Agency will work to accommodate these programs under its requirements. However, some of these programs will likely need to adapt their requirements to make them as stringent as the forthcoming federal requirements.

New provisions in SARA authorize EPA and states that enter into cooperative agreements with EPA to issue orders requiring owners and operators of underground storage tanks to undertake corrective action where a leak or spill is suspected or has occurred. This corrective action could include testing tanks to confirm the presence of a leak, excavating the site to determine the exact nature and extent of contamination, and cleaning contaminated soil and water. It also may include providing an alternative water supply to affected residences, or temporary or permanent relocation of residents.

EPA has signed cooperative agreements with most states and transferred millions of dollars from the Trust Fund to do this work. With these funds, states have begun cleanups at many of these sites around the country.

Fiberglass tanks are commonly used to replace corroded metal tanks.

Why Underground Tank Systems Leak

The four primary types of tank system leaks involve tanks themselves, piping failures, spills and overfills, and loose fittings.

Tanks *— The major cause of tank leaks is corrosion of steel tanks. Most of the tanks currently in the ground are constructed of unprotected bare steel. When the external surface of a steel tank comes in contact with the soil, it naturally seeks to return to its original state — iron oxide, more commonly known as rust. Metal corrodes under almost any naturally occurring soil condition, but the rate of corrosion is affected by the amount of oxygen and moisture in the soil and other site-specific factors.*

"Galvanic" corrosion is the primary type of corrosion of unprotected steel. In this situation, the tank and its underground surroundings act like a battery; part of the tank can become negatively charged, and another part positively charged. Various soil conditions provide the connecting link that finally turns on the tank "batteries," causing the negatively charged part of the tank (where the current exits from the tank) to deteriorate. As electric current passes through this part, the hard metal begins to turn into soft ore, holes form, and the tank leaks.

Several types of tanks are available now that largely eliminate external corrosion as a cause of tank failure. Cathodic protection can be used to reverse the electro-chemical forces that cause steel to corrode. Special attachments to the tank focus electricity on the attachments, instead of the tank. Fiberglass-reinforced plastic tanks also are not subject to soil corrosion. Composite tanks use a thick fiberglass-reinforced plastic coating to isolate a steel inner tank from the surrounding soil. These three new style tanks rarely fail, but poor installation and maintenance practices have caused some problems.

Spills and overfills *— Spills and overfills are the most frequent causes of release at many underground storage tank installations. Spills occur when the delivery hose is disconnected from the fill pipe before the hose has drained completely into the tank. Overfills result from trying to transfer more product to the tank than the tank can hold. Spills and overfills are over extended periods of time usually smaller than tank or piping leaks, but they occur frequently and can eventually add up to a large release. Both spills and overfills result from human error, and there are simple mechanical devices available that can prevent their occurrence.*

Piping failures *— The piping that connects the tank to the dispenser can leak for many reasons, including poor installation and corrosion. Pressurized piping, which works like a garden hose, is of particular concern because a lot of gasoline being "pushed" under pressure through the piping can escape through a loose joint. Suction piping, which works like a soda straw, is of lesser concern because leaks tend to allow air to enter the pipe instead of allowing gasoline to escape. Leak detection for pressurized piping, therefore, is critical to protecting human health and the environment.*

Loose fittings *— Most underground storage tanks have several fittings along the top of the tank for attaching vent lines, pumps, and fuel pipes. These fittings sometimes are not tightened properly at installation. In addition, they often loosen with age, as does the delivery piping. Normally, loose fittings pose no problem; however, if the tanks are overfilled, these fittings will leak. These loose fittings also cause many tanks to fail "tightness tests." Careful attention to proper tightening of these fittings during installation can reduce these leaks. Overfill prevention devices also prevent releases from loose fittings.*

TODAY'S CHALLENGES

The problem of leaking underground storage tanks presents several major challenges not only for the Agency but also for states, local governments, and industry. Perhaps the biggest challenge is to achieve better but less expensive tank design, and leak detection technology. Research and development in this area is strong and the potential for improvement is great. Effective and affordable technology should encourage voluntary compliance among tank owners. It will become less expensive to comply with the law and, at the same time, the environment will be protected from leaks and spills from underground storage tanks. Research and development in this area is strong and the potential for improvement is great.

The large number of underground tanks presents significant regulatory challenges. This is best illustrated by a comparison to the hazardous waste program. In New England alone, approximately 5,000 handlers of hazardous waste are regulated under RCRA and there are 59 sites on the Superfund National Priorities List. In the same region, the number of underground tanks falling under EPA or state regulations is 150,000 or 30 times larger than the number of regulated RCRA facilities.

Congress directed EPA to require that tank owners demonstrate that they are financially capable of cleaning up leaks from their underground storage tanks and compensating third parties for damages resulting from such leaks. These costs could include cleaning up leaked petroleum, supplying drinking water, or compensating individuals for personal injury or property damage. More recently, SARA imposed the requirement that owners or operators of underground storage tanks have a minimum insurance coverage of $1 million per occurrence. A major challenge that EPA, state and local governments and the regulated community face involves this assurance of tank owner's financial responsibility.

The lack of an adequate pollution liability insurance market makes finding affordable insurance extremely difficult. Insurance programs, state funds, and other assurance mechanisms are sorely needed. EPA will be working with states and with the insurance industry on ways to develop such mechanisms to help tank owners.

The cleanup of areas contaminated by leaking underground storage tanks is another major challenge that EPA faces. Often the contamination is in the soil directly above ground water. The challenge lies in quickly finding the most seriously contaminated sites. These sites need to be addressed before petroleum reaches ground-water supplies.

EPA's Agenda

EPA is using a new approach to implementing the Congressional mandate to address underground tanks, the "franchise concept." The Agency sees itself as the franchiser with the responsibility to see that the franchisees, in this case the states and counties, run their operations successfully. The Agency initially will focus on assisting the states to establish basic tank programs and then providing a range of services to help them improve their performance.

This will be a significant departure from the traditional approach under which EPA manages all areas of a program until a state demonstrates it can operate independently. Our agenda, therefore, is to provide the necessary assistance for the states to succeed in implementing and enforcing this program. This includes providing special expertise, developing training videotapes (e.g., for tank installers and inspectors), publishing handbooks, and training state and local employees.

As we work with states and local communities to do a better job of communicating the dangers of leaking tanks to the estimated 750,000 tank owners, more and more owners will replace older tanks with protected, safe tanks. Figure L-14 shows what we hope to accomplish in the next few years.

Three Communities Where Underground Storage Tank Leaks Were Discovered

- ***Council Bluffs, Iowa*** - *In 1984, gasoline that leaked out of an underground storage tank at a service station seeped down through the soil to the water table, and spread out across the surface of the ground water. When heavy spring rains caused the water table to rise, the moisture that seeped into the station's basement carried gasoline with it. The fumes eventually reached explosive levels. A spark from the air compressor that controlled the lift ignited the vapors, and the gas station building was destroyed in an explosion.*

- ***Friendship Village, Maine*** - *A leak from an underground storage tank at a local service station in 1984 contaminated ground water, affecting 14 wells. Property values dropped dramatically. Twelve families were forced to rely on bottled water for months. Some residents were affected by headaches, nausea, and eye and skin irritations.*

- ***St. Paul, Minnesota*** - *When a homeowner in a residential neighborhood noticed a pool of gasoline near the foot of his driveway, an investigation uncovered a pinhole leak in a petroleum pipeline. Fortunately, most of the neighborhood was connected to the municipal water system and did not rely on wells for drinking water. But the private wells that did exist in the neighborhood had to be sealed as a precautionary measure. Three recovery systems, involving about 60 monitoring wells and more than 100 recovery wells, had to be established in the neighborhood as part of the cleanup operation.*

FIGURE L-14

Our Goals For Addressing Underground Storage Tanks

LEAK DETECTION

15% have it now	1996 - 90% should have leak detection

PROTECTED TANKS

15% currently have corrosion protection	1998 - 85% or more will be protected

FINANCIAL RESPONSIBILITY

25% of owners now have financial assurance coverage	1991 - 90% of owners will have financial assurance* to cover leaks or spills

*State funds, etc.

Source: Office of Underground Storage Tanks, USEPA

Chemical Emergency Planning and Community Right-to-Know

In December 1984, an accidental release of methyl isocyanate from a pesticide facility killed 2,800 people in Bhopal, India. This incident focused international attention on the seriousness of chemical accidents. It also created an awareness of the possibility of a major chemical accident in the United States. Six months later, a chemical accident in the United States brought even greater attention to the problem. A release of methylene chloride and aldicarb oxime occurred in Institute, West Virginia, causing concern among many of the town's residents and indicating that better chemical emergency response procedures were needed (see highlight on "Lessons from Institute, West Virginia").

Chemical accidents can be caused by human error, equipment malfunction, explosion, highway accidents or other factors. The extent to which each community is vulnerable to a serious chemical emergency depends on these factors and its particular meteorological and topographical conditions. These conditions will determine how chemicals might disperse after an explosion or accidental release. Communities at greater risk are those near facilities that produce or use toxic chemicals; a transportation corridor where large-volume chemicals are moved from one facility to another; or a waterway where ships carry or dock and unload chemical cargoes.

Depending on the chemical, amount released, and proximity to population, the health effects from an accidental release may range from immediate, short-term effects, such as mild irritation or respiratory distress, to longer term effects including cancer or reproductive disorders. Accidental releases may also result in damage to private and public property, as well as damage to aquatic and wildlife habitats.

Communities can evaluate the extent of their risk and prepare to respond to chemical emergencies. To begin with, all are faced with similar questions: 1) does the community know enough about the operations of its industrial facilities to judge the probability that a sudden, accidental release might occur; and 2) has the community planned how it will respond if such an accident does occur? To respond, communities need to know the types and volumes of hazardous chemicals each local company transports, stores, and uses, and what actions are taken by the company to prepare for emergencies. Most communities have not had access to this information in the past.

In addition to information regarding possible accidental releases, communities need to know the types and volume of chemicals routinely released from nearby plant sites. If several facilities are routinely releasing small amounts of toxic substances in a community, the community may judge that the collective risks posed are unacceptable and may call for pollution mitigation measures.

Lessons from Institute, West Virginia

August 11, 1985

9:25 a.m. *Operators at the Union Carbide plant in Institute heard a rumbling noise in the methyl carbamate reactor. A gasket on the reactor had failed, releasing an opaque vapor of aldicarb oxime. The plant's computer predicted that the plume would extend to the plant's boundary; residents also reported seeing a white cloud over the plant. The plant's toxic gas alarm was activated, triggering a series of responses by emergency personnel.*

9:36 a.m. *Union Carbide first notified the County Emergency Services Center. At 9:42, when the West Virginia pollution control agency contacted the plant in response to a resident's call, a spokesperson stated that the release was confined to the plant. At 9:56, a deputy sheriff arrived at the plant and the county emergency siren was activated.*

10:06 a.m. *When it became evident that the leak was no longer confined to the plant, the Emergency Broadcast System was activated. Residents were warned to stay indoors and turn off air conditioners. Local highways were blocked to traffic. Hospitals were called to prepare for proper treatment, and temporary first aid centers were established. Another broadcast informed residents about the first aid centers. In response to calls from panicked residents, the state's Department of Natural Resources provided information on their answering service about the release.*

11:55 a.m. *The Emergency Broadcast System reported that the emergency was over. As a result of the release, over 130 people sought medical help. During the event, there was constant communication among county, state, and federal personnel. Nonetheless, an investigation of the accident concluded that the response could have been improved. As a result of the Institute accident, we learned many lessons about preparing for such emergencies. For example:*

- *The public should be educated on the meaning of warning sirens and the appropriate response.*
- *All localities should be notified immediately in the case of an accidental release.*
- *Command centers should be established and used so that response operations are not organized at the scene of the accident.*

EFFORTS TO DATE

The Emergency Planning and Community Right-to-Know Act (better known as Title III of SARA) was passed in 1986. This legislation expanded on EPA's Air Toxics Strategy developed in 1985 in response to growing concern about chemical accidents. This strategy acknowledged the need for a program to foster planning and preparation within communities for hazardous substance emergencies. Title III builds on this strategy and:

- mandates that states and local communities prepare for chemical emergencies;
- requires facilities to notify their states and communities of the presence of an extremely hazardous substance and to report spills or releases of these substances immediately; and
- requires facilities to report annually on the volumes of certain hazardous chemicals produced, used, and stored within the facility, if that amount exceeds a specified volume. They are also required to report annually on the amount of certain toxic chemicals they routinely release to the air, land and water.

Title III is based on the premise that the federal government cannot be solely responsible for protecting each community's environment and health against toxic chemical releases. Therefore, the law charges state and local governments with the primary responsibility for taking action. It enlists local officials together with industrial facilities in a collaborative planning effort to protect their communities in the event of an accidental release of a hazardous chemical. States review the plans and cooperate in their execution and enforcement. Each community must examine its own vulnerabilities and resources to respond to possible chemical accidents.

Under Title III, governors are required to set up State Emergency Response Commissions which in turn create Local Emergency Planning Committees. Indian tribes that choose to work directly with the federal government may set up tribal emergency planning commissions similar to the state commissions. These committees are responsible for developing comprehensive chemical hazard emergency plans. The committees should include the expertise and experience of local government officials, facility representatives, health and fire officials, citizens groups, news media, and others who may have a role in this process (see Figure L-15). Facilities must participate in cooperative activities with their local committee, and have reporting requirements to different levels of government (see Highlight, "Major Provisions of Title III").

Although Title III is relatively new legislation, EPA has made significant progress in carrying out its mandates and in working with other federal and state governments to promote coordinated implementation. For example, we have published a list of 366 Extremely Hazardous Substances, and the volumes of concern of these chemicals. We are reviewing ways to detect and monitor hazardous releases, and models for use in onsite emergency response. We will also be encouraging the use of these systems at the state and local level.

While many requirements of Title III are the responsibility of industry and state and local governments, EPA has the following activities underway:

- developing regulations and assisting facilities in understanding and meeting their reporting obligations;
- establishing a publicly available Toxics Release Inventory, the first consistent and comprehensive, national database of toxic chemical releases to all environmental media;
- conducting workshops and preparing documents to help state and local governments design emergency plans and establish emergency notification procedures;
- offering state and local governments technical assistance in information management techniques and tools, so that they might better manage and use the massive amounts of data they will receive;
- developing and administering training programs (in cooperation with the Federal Emergency Management Agency) for planners and response personnel, and making $5 million available to states to enhance their training programs; and
- establishing enforcement policies to ensure industrial compliance, and coordinating enforcement activities with states and localities.

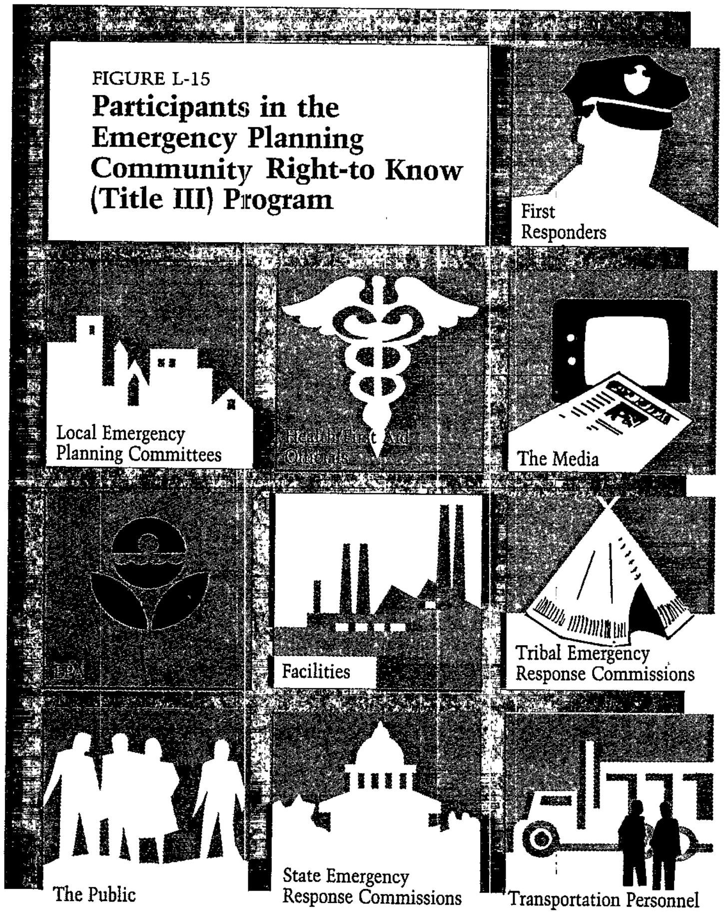


FIGURE L-15
Participants in the Emergency Planning Community Right-to Know (Title III) Program

TODAY'S CHALLENGES

Title III poses a great challenge in information management, stemming from the unprecedented amount of data that will be collected (estimated to be greater than all other current EPA reporting requirements combined). In addition, the sheer number of people, governments, and organizations to whom this information will be transferred or communicated complicates the task further. Finally, information about tens of thousands of chemicals must be interpreted for the public.

Information Management

To achieve the goals of Title III, a large volume of information must be shared among numerous program participants with varied interests and backgrounds. In addition to EPA and other federal agencies, the participating organizations and individuals will include more than 50 state and territorial emergency response commissions; more than 3,000 local emergency planning committees and at least an equal number of fire departments; representatives of an estimated 1.5 million industrial facilities; and thousands of citizens, including members of environmental and public interest groups.

Federal, state, and local governments will be the repositories for large volumes of data on facilities, chemicals, and releases. Effective information management, information transfer, and communication are crucial to the successful implementation of Title III.

Community Awareness

The law's success depends also on how well individual citizens are prepared to receive, understand, and make decisions based on the information gathered. Accidental release and annual emissions reports will be available, either from industry, a community's Local Emergency Planning Committee, the state, or through EPA's national computerized data base.

Initially, these data may be of unknown reliability since they are being reported by businesses that have little or no experience in such reporting. In the first years of compliance with Title III, the data may be useful primarily for identifying potential "hot spots" of apparently high levels of emissions. The Agency plans to evaluate the validity of the data and improve the reliability and usefulness of these data over time.

Planning for Emergencies

Under Title III, each community will need to develop an effective plan for responding to chemical emergencies. Each community's emergency response plan must be a cooperative effort of the people who administer the local emergency response agencies, manage the facilities from which releases might occur, and live in that community. For people with such disparate responsibilities and points of view to work together effectively will require a strong commitment by all participants to the success of the planning effort.

Major Provisions of Title III

Emergency Planning

Title III established a broad-based framework at the state and local levels to receive chemical information and use that information in communities for chemical emergency planning.

Emergency Release Notification

Title III requires facilities to report certain releases of extremely hazardous chemicals and hazardous substances to their state and local emergency planning and response officials.

Hazardous Chemical Inventory Reporting

Title III requires facilities that already have prepared Material Safety Data Sheets (MSDS) under Occupational Safety and Health Administration Worker Right-to-Know rules to submit those sheets to state and local authorities by October 1987. It also requires them to report by March 1988 and annually thereafter information on chemicals on their premises to local emergency planning and fire protection officials, as well as state officials.

Toxic Release Inventory Reporting

Title III requires facilities to report annually on routine emissions of certain toxic chemicals to the air, land, or water. Facilities must report if they are in Standard Industrial Classification code 20 through 39 (i.e., manufacturing facilities) with 10 or more employees; manufacture or process more than 75,000 pounds of a specified chemical, and use more than 10,000 pounds in one calendar year of specific toxic chemicals or chemical compounds. The reporting thresholds for manufacturing and processing drops to 50,000 pounds for reports covering 1988, and to 25,000 pounds for 1989 and thereafter. EPA is required to use these data to establish a national chemical release inventory data base, making the information available to the public through computer, telecommunications, and by other means.

EPA's Agenda

State, tribal, and local government officials and managers of industrial facilities will bear the responsibility for implementing Title III. EPA will act as initiator and facilitator. To support state and local efforts, we will continue our emergency response activities, assisting in preparedness and planning. The Agency will present workshops and conferences focusing on Title III issues such as effective planning, implementing emergency response procedures, information resource management, and community awareness. We will participate in conferences at which community planners, industry representatives, and other officials will share information on emergency response to chemical spills. EPA also will be available to respond to requests for technical assistance, information sharing, and data interpretation.

To address the information management needs, EPA is developing a variety of additional support initiatives. These include developing case studies, fact sheets, and instructional documents that interpret the EPA regulations; describing and promoting consistent information management practices; supplying needed chemical toxicology information; and promoting coordination for all Title III activities by providing communication links between the various levels of government.

We are also exploring the usefulness of certain state-of-the-art technologies, to support state and local analysis of Title III data. EPA is promoting the development of several promising computer modeling systems that can be used on personal computers to help community planners and on-site managers to determine hazards, exposures, and risks.

Certainly one of the most exciting initiatives is the computerized data base, the Toxics Release Inventory, that in addition to furthering the community right-to-know provisions of Title III, will provide an opportunity for EPA to identify and screen toxic chemical problems on a nationwide, multi-media basis. EPA has developed a three-phase program to:

1) design and implement the data base and communications systems to make it available on-line to the public;

2) develop programs to assist communities in understanding and utilizing the information; and

3) explore and maximize the potential this data base has for adding to the information base of each EPA program office.

This program-oriented information-sharing approach will be developed in coordination with state governments.

In summary, EPA will strive to coordinate all of the activities to be conducted under the Act. This means encouraging increased public awareness of the potential chemical hazards within each community and promoting preparedness for accidental releases of hazardous chemicals.

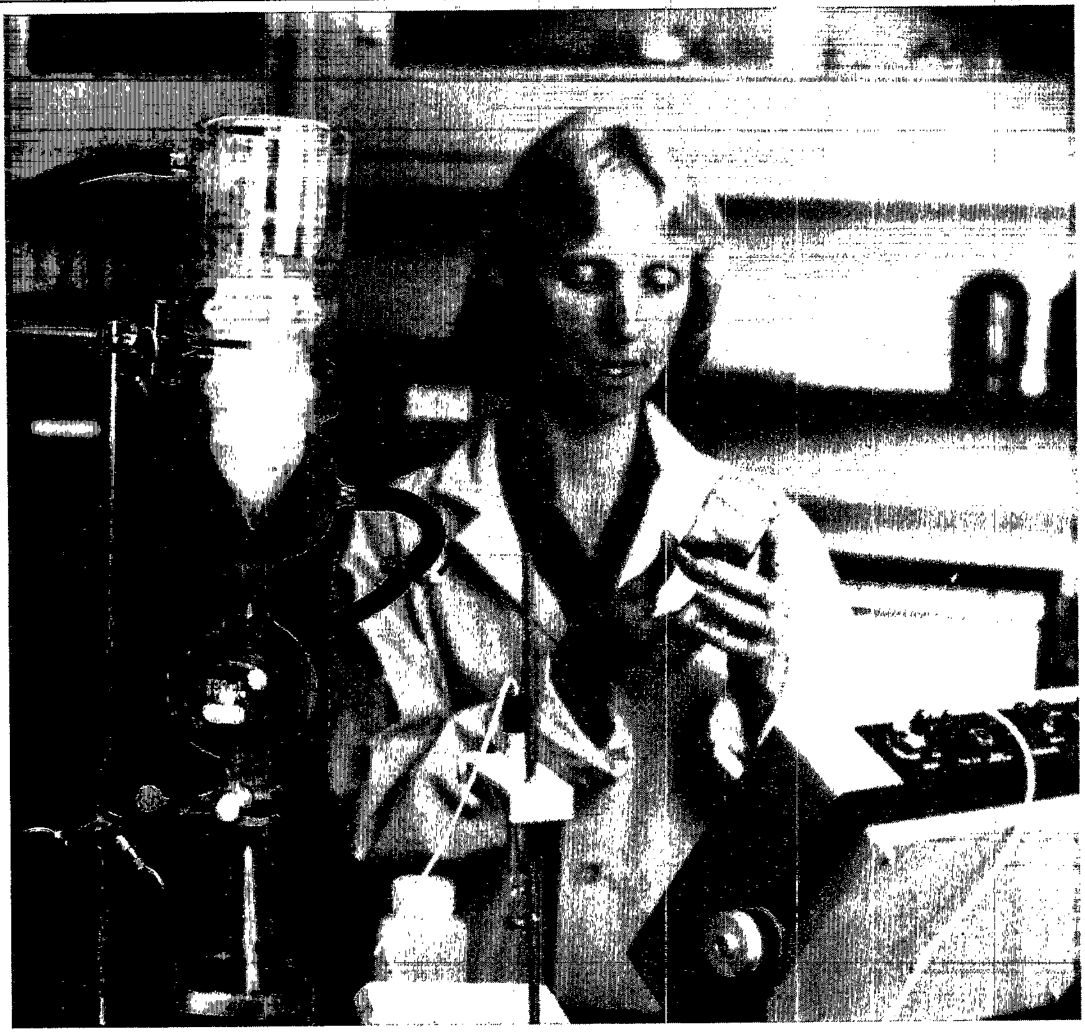
TOXIC CHEMICALS

TOXIC CHEMICALS

Our high standard of living would not be possible without the thousands of different chemicals produced. Most of these chemicals are not harmful if used properly. Others can be extremely harmful if people are exposed to them even in minute amounts. They may cause health effects ranging from cancer to birth defects and may seriously degrade the environment.

The serious health and environmental consequences from uncontrolled exposure to pesticides and toxic chemicals can be seen in a number of cases, including:

- Exposure to asbestos used as insulation and fire-proofing in numerous buildings, resulting in thousands of cases of cancer or lung disease;
- Contamination of food and ground water with the pesticide ethylene dibromide, a substance widely used to protect crops and stored grain until it was found to cause cancer;
- Contamination of harbors, lakes, and rivers with polychlorinated biphenyls (PCBs) that accumulate in fish and shellfish; and
- Past buildups of pesticides such as DDT, aldrin, and chlordane in the tissues of people and wildlife, resulting in the decline of birds such as the bald eagle and osprey.



The nation has made strides in addressing many of these problems. For example, levels of pesticides and toxic substances such as DDT and PCBs have declined in humans and wildlife. However, we must continue to ensure that humans and wildlife are not exposed to unreasonable dangers from toxic chemicals.

As described in other chapters of this report, EPA is endeavoring to control exposure to toxic chemicals by regulating their release to air, water, and land. In this chapter, EPA's efforts to control the production and use of pesticides and commercial chemical substances are described.

AN OVERVIEW

People have long recognized that sulfuric acid, arsenic compounds, and other chemical substances can cause fires, explosions, or poisoning. More recently, researchers have determined that many chemical substances such as benzene and a number of chlorinated hydrocarbons may cause cancer, birth defects, and other long-term health effects. Today, we are evaluating the hazards of new kinds of substances, including genetically-engineered microorganisms.

EPA has a number of legislative tools to use in controlling the risks from toxic substances (Figure T-1). This chapter concentrates on issues associated with pesticides and commercial chemical substances that are dealt with primarily under two laws: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Toxic Substances Control Act (TSCA).

FIFRA encompasses all pesticides used in the United States. When enacted in 1947, FIFRA was administered by the U.S. Department of Agriculture and was intended to protect consumers against fraudulent pesticide products. When many pesticides were registered, their potential for causing health and environmental problems was unknown. In 1970, EPA assumed responsibility for FIFRA, which was amended in 1972 to shift emphasis to health and environmental protection. Allowable levels of pesticides in food are specified under the authority of the Federal Food, Drug, and Cosmetic Act of 1954.

The Toxic Substances Control Act (TSCA) of 1976 authorizes EPA to control the risks that may be posed by the thousands of commercial chemical substances and mixtures (chemicals) that are not regulated as either drugs, food additives, cosmetics, or pesticides. Under TSCA, EPA can, among other things, regulate the manufacture and use of a chemical substance and require testing for cancer and other effects.

Under both TSCA and FIFRA, the Agency is responsible for regulating certain biotechnology products, such as genetically engineered microorganisms designed to control pests or assist in industrial processes. In addition, the Emergency Planning and Community Right-to-Know Act of 1986 directs EPA to require industries to report on the quantities of certain hazardous substances released from facilities and to assist communities in preparing for chemical emergencies (see section titled "Emergency Planning and Community Right-to-Know" in the Land Chapter).

FIGURE T-1
Major Toxic Chemical Laws Administered by EPA

Statute	Provisions
Toxic Substances Control Act	Requires that EPA be notified of any new chemical prior to its manufacture and authorizes EPA to regulate production, use, or disposal of a chemical.
Federal Insecticide, Fungicide and Rodenticide Act	Authorizes EPA to register all pesticides and specify the terms and conditions of their use, and remove unreasonably hazardous pesticides from the marketplace.
Federal Food, Drug and Cosmetic Act	Authorizes EPA in cooperation with FDA to establish tolerance levels for pesticide residues on food and food products.
Resource Conservation and Recovery Act	Authorizes EPA to identify hazardous wastes and regulate their generation, transportation, treatment, storage, and disposal.
Comprehensive Environmental Response, Compensation and Liability Act	Requires EPA to designate hazardous substances that can present substantial danger and authorizes the cleanup of sites contaminated with such substances.
Clean Air Act	Authorizes EPA to set emission standards to limit the release of hazardous air pollutants.
Clean Water Act	Requires EPA to establish a list of toxic water pollutants and set standards.
Safe Drinking Water Act	Requires EPA to set drinking water standards to protect public health from hazardous substances.
Marine Protection Research and Sanctuaries Act	Regulates ocean dumping of toxic contaminants.
Asbestos School Hazard Act	Authorizes EPA to provide loans and grants to schools with financial need for abatement of severe asbestos hazards.
Asbestos Hazard Emergency Response Act	Requires EPA to establish a comprehensive regulatory framework for controlling asbestos hazards in schools.
Emergency Planning and Community Right-to-Know Act	Requires states to develop programs for responding to hazardous chemical releases and requires industries to report on the presence and release of certain hazardous substances.

SOURCES OF THE PROBLEM AND EPA'S APPROACH

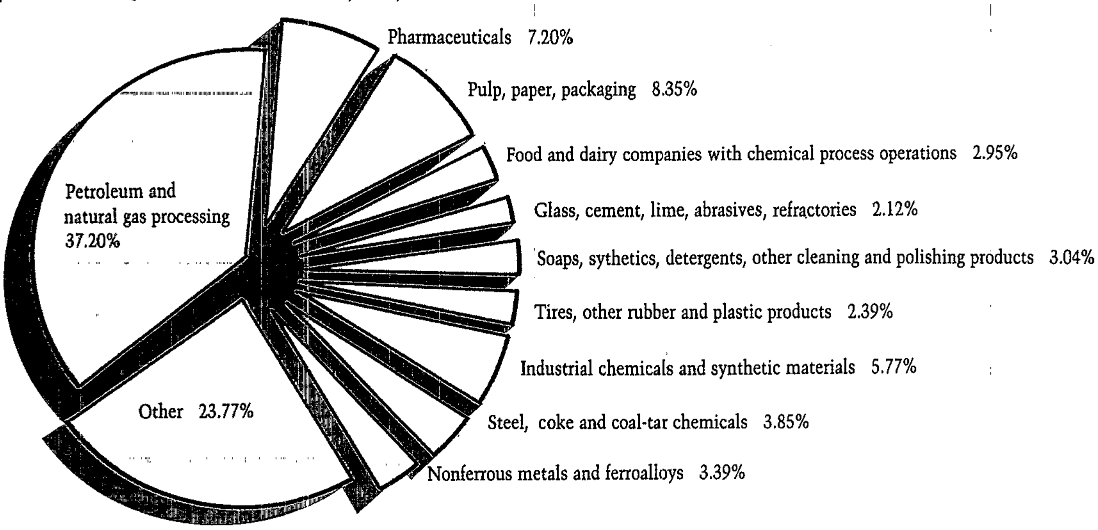
A tremendous variety of chemicals are produced and used in the United States each year (Figure T-2). Many of these are organic compounds derived from oil, while the remainder are inorganic chemicals such as ammonia, chlorine, and metals. These chemicals are important in many facets of daily life, from preserving food to assisting in transportation and communication. Others are largely unseen by the general public, but are extremely important in research and manufacturing processes.

Despite their usefulness, chemicals can be extremely dangerous. They may cause immediate, short-term effects, such as respiratory irritation, as well as long-term and permanent effects, such as cancer and birth defects. Often health effects result only after long-term exposure to toxic chemicals. In other cases, effects may develop many years after a single exposure. Toxic substances can also work together or in combination with other substances, such as those in cigarette smoke, to increase the likelihood of long-term health effects.

FIGURE T-2

Chemicals are a Major U.S. Industry

(Total 3rd Quarter Sales = 234,324) Based on third quarter, 1987 sales Source: Chemicalweek



Commercial Chemical Substances

TSCA authorizes EPA to control the risks from over 65,000 "existing" chemical substances on the market. In addition, through a premanufacture review process, EPA regulates the manufacture, processing, distribution, and use of proposed "new" chemicals, as well as new uses of already existing chemicals.

New Chemicals

Before a proposed or new commercial chemical may be produced, EPA requires a manufacturer to submit a "premanufacture notice" that contains the chemical's name, structure, production process, intended uses, and other available information about the health and environmental effects of the chemical. EPA may prohibit or limit the production and use of a new chemical if it presents an unreasonable risk to health or the environment. EPA has similar authority to review and control significant new uses of existing chemicals or chemicals newly imported into the United States.

Existing Chemicals

Once a chemical is on the market, it is considered an existing chemical. Existing chemicals also encompass the thousands of chemicals and chemical mixtures already on the market when TSCA was passed in 1976. EPA may regulate the manufacture, processing, distribution, use, and disposal of existing chemicals if there are unreasonable public health or environmental risks associated with them. Regulatory tools range from labeling and use restrictions to outright bans on their manufacture.

Information Collection

TSCA authorizes EPA to require that industry test a chemical when there are insufficient data to assess the risks and there is likely to be substantial exposure or unreasonable risk. EPA also may require industry to maintain records of allegations of significant adverse reactions by workers and to report new information that suggests there may be substantial risks associated with the substance.

Pesticides

Each year, about three billion pounds of pesticides are used in the United States (Figure T-3). Pesticides can improve crop yields significantly by controlling weeds, insects, and plant disease. As might be expected, farmers are the biggest users of pesticides. Health officials also need pesticides to control the spread of diseases carried by mosquitos and other insects.

Because pesticides are designed to kill living organisms, they can cause serious health and environmental problems if not used properly. Some pesticides persist in the environment over long periods, moving up through the food chain from plankton or insects to animals and humans. Thus human dietary exposure is often unavoidable. They also may move downward through soil to contaminate ground water. Through these exposures, many pesticides may cause chronic health effects such as cancer or birth defects.

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA is responsible for controlling the risks of pesticides through a registration process. Pesticide registration is designed to ensure that, when used properly, a pesticide presents no unreasonable health or environmental risks; that is, its risks do not outweigh its benefits to society. The registration process thus involves the careful weighing of health and environmental risks against the benefits of pesticide use.

Registration of New Pesticides

Before a new pesticide may be marketed, it must be registered with EPA. The pesticide manufacturer submits test data with the registration application. Test data include information related to the risk of cancer, birth defects and other chronic effects as well as the risks to wildlife. If test data show that using a pesticide may cause harmful human health or environmental effects, EPA can refuse to register it, can restrict its use to certain applications, or can require that only certified applicators apply the pesticide. Once a pesticide is registered, manufacturers must label the product, clearly indicating the approved uses. In emergencies, state or federal agencies may be authorized to use pesticides not yet registered.

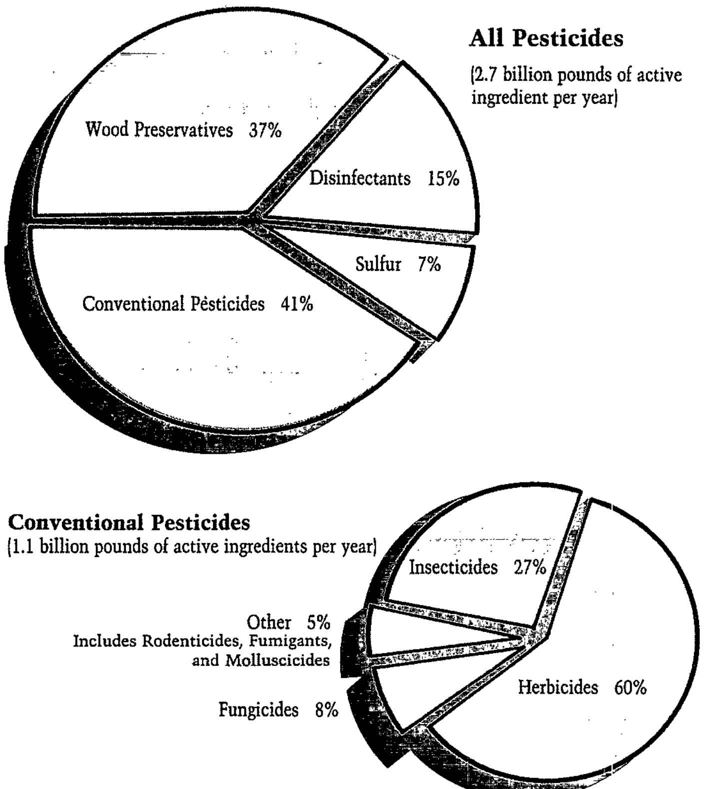
Reregistration of Existing Pesticides

Over 50,000 pesticide products have been registered since FIFRA was enacted in 1947. Most pesticides were registered before their long-term health and environmental effects were understood fully. As required by the 1972 amendments to FIFRA, existing pesticides must be re-evaluated or reregistered, taking into account new information.

Reregistration involves several steps. First, EPA reviews all current information on a given active ingredient. About 600 different active ingredients, or those "active" in attacking a given pest, require reregistration. We identify in initial registration standards any additional health and environmental data that are needed before the reregistration process can be completed. Letters requesting the information are sent to manufacturers. Next, the new data are reviewed for health and environmental effects, and EPA determines whether there is a need for modifications in labeling, packaging, or formulations of the pesticide. Finally, EPA specifies in Final Registration Standards and Tolerance Reassessments that existing and future products containing the active ingredient include appropriate restrictions, warnings, or changes in formulation.

FIGURE T-3

Pesticide Use in the U.S. (1986 Estimates)



Source: Office of Pesticide Programs, USEPA

Special Review

If the data on an old pesticide indicate that it may be posing a potential safety problem, EPA may undertake a special review. A special review is an intensive review of the pesticide's risks and benefits. The Agency first identifies and quantifies the health and environmental problems and the benefits being derived by agriculture or other users. Depending on the data, EPA may decide to continue current uses, restrict some or all uses, or permanently cancel uses of the pesticide.

If use of a pesticide is found to cause unreasonable risks, EPA may issue a notice of intent to cancel its registration. Such a notice does not automatically bring cancellation. Manufacturers and others who would be affected by cancellation may request a hearing within 30 days; if there is no appeal, registration is cancelled. Cancellation hearings may take two or more years, during which marketing of the pesticide may continue. However, EPA may suspend the registration pending the outcome of the hearings if there is evidence that the risks of continued use outweigh the benefits.

Tolerances

Under the Federal Food, Drug, and Cosmetic Act, EPA, in cooperation with the U.S. Food and Drug Administration, sets allowable limits for pesticide residues in food. These limits, called "tolerance levels," are designed to protect human health while allowing for the production of an adequate, wholesome, and economic food supply. Tolerance levels are established during the registration progress; for existing pesticides, tolerances are re-evaluated during reregistration.

Monitoring and Enforcement

EPA monitors the distribution and use of pesticides and issues civil and criminal penalties for violations of FIFRA regulations. For example, it is a violation to use a pesticide in a manner not stated on the pesticide's label. EPA also conducts laboratory inspections to verify the quality of test data and may suspend a product's registration if the required data is not submitted.

States and Indian tribes have primary responsibility for enforcing laws and regulations regarding pesticide use through cooperative agreements with EPA. Individual states or tribes may have more stringent controls than the federal program and may take independent action to restrict certain pesticides. EPA also may take action if a state does not take adequate steps. EPA contributes to the support of state and tribal enforcement with federal funds.

PROGRESS TO DATE

Biotechnology

Biotechnology involves the use of biological science to produce chemicals or living organisms for commercial use. Fermentation is one of the oldest examples of biotechnology, in which microorganisms are used to convert sugar into alcohol. Microorganisms also have been used for some time as pesticides. For example, the first microbial pesticide, registered in 1948 by the U.S. Department of Agriculture, was a bacterium used to kill Japanese beetles.

The techniques of genetic engineering, a type of biotechnology, have made it possible to develop microorganisms with new combinations of characteristics. Through gene splicing, scientists are developing microorganisms that help in industrial reactions, produce human hormones, and degrade pollutants. Yet despite these benefits, the release of such genetically engineered microorganisms into the environment has raised public concern. One concern is that introducing such microorganisms could change the existing balance of microorganisms in the environment.

EPA has authority to evaluate the risks of certain genetically engineered microorganisms. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA regulates the use of genetically engineered microorganisms and non-native microbes as pesticides. Under the Toxic Substances Control Act (TSCA), we regulate genetically engineered microorganisms that are not already regulated as pesticides under FIFRA, or as drugs, cosmetics, or food under other laws. For example, TSCA governs the regulation of biotechnology products used to produce chemicals, degrade pollutants, accelerate plant growth, or extract oil and minerals.

Commercial Chemical Substances

EPA screened more than 10,000 new chemicals proposed for commercial production between 1976, when TSCA was enacted, and the end of 1987. The majority of these chemicals were determined to present no unreasonable risk to human health or the environment. On the basis of these reviews, EPA has prohibited or restricted the manufacture of 533 new commercial chemicals. For 149 of these new chemicals, manufacturers were required to conduct additional health and environmental testing.

After more than a decade of experience in reviewing proposed new chemicals, EPA now acts more quickly to identify potential problems. In addition to environmental impacts, our risk assessments screen chemicals for their potential to cause cancer, genetic mutation, birth defects, damage to the nervous or immune system, and reproductive failures.

For the many existing chemicals, or those already on the market, data on the long-term health and environmental effects of chemicals are available for only a small fraction. Identifying which among the thousands of existing commercial chemicals to test is a very important first step in managing the risks from these chemicals. By December 1987, EPA had decided to request additional health and environmental testing by the manufacturers of 63 chemical groups. During fiscal year 1987, we reviewed 75 existing chemicals or chemical groups for possible regulatory controls. Some examples of these are described in Figure T-4.

Earlier actions taken under TSCA have shown dramatic results. For example, restrictions on the use and disposal of PCBs have resulted in a significant decline of these residues in the environment, food, and human tissues. While trace levels of PCBs are now almost uniformly present in the U.S. population, the number of individuals with high PCB levels has declined from over eight percent to less than one percent of the population.

FIGURE T-4
Some Chemicals in the Regulatory Review Process

Acrylamide - Used to make acrylamide polymers. The polymers are then used in substances to take solids out of drinking water, to grout sewers and in sugar processing. It is a suspected carcinogen, and we are also concerned about non-cancer health effects.

Paradichlorobenzene - Used primarily in mothballs and air fresheners. We are evaluating control options, along with the Consumer Product Safety Commission. Concerns are as an indoor air pollutant, possible health effects, and suspected carcinogen.

Chlorinated solvents - Used in dry cleaning, metal degreasing, aerosols, and paint stripping. Three chlorinated solvents are suspected carcinogens; chlorinated solvents that might be substituted may cause other health problems. For each category of use, we are evaluating the risks from all chlorinated solvents and are working with other federal agencies to determine appropriate action.

Chromium Emissions - Used to inhibit corrosion in cooling towers. Concern is potential to cause lung cancer when inhaled. We are using TSCA authorities to address the problem of emissions, because the Clean Air Act did not have the authority. Industry is already using substitutes, such as phosphates and molybdates.

Formaldehyde - Emitted from certain pressed wood products, such as particleboard, hardwood plywood, and medium-density fiberboard. Concerns include cancer as well as respiratory irritation. We are evaluating the need for regulations on the manufacture and use of such products.

In 1978, the Agency banned the nonessential use of chlorofluorocarbons (CFCs) in aerosol sprays because of concern that CFCs decreased ozone in the earth's stratosphere. In 1987, 31 nations representing the majority of CFC-producing countries signed a protocol to freeze CFC consumption at 1986 levels by mid-1990 and to halve production levels by 1999 (see section titled "Global Atmospheric Change" in the Air Chapter).

EPA also has been working to remove or reduce the risks from the widespread use of asbestos in schools and other buildings. For example, we have implemented programs to help officials identify and control asbestos exposure in the nation's schools under two new asbestos laws passed since 1984. We also have established regulations to protect workers and proposed an immediate ban on many uses of asbestos, along with a phased elimination of other uses.

Finally, the Agency has taken action against companies that introduce new chemicals without notifying EPA, or that import or use chemicals in the United States in violation of TSCA. For example, Mitsubishi International of Japan paid $98,000, Canon U.S.A. Inc. of Japan paid $400,000, and Sandoz Chemicals of West Germany paid $25,000 for violations of TSCA. American Telephone and Telegraph also agreed to pay a penalty of $1,000,000 for illegal use of a chemical not approved by EPA. In some settlements, the Agency has required companies to provide detailed reports of further instances of import, manufacture, or chemical use violations. We have also required some companies, such as Canon, to produce and finance public service announcements and training for corporate personnel or other members of the regulated community.

Pesticides

EPA has banned many uses of pesticides that have been shown to cause health and environmental problems. For example, virtually all uses of DDT, aldrin, dieldrin, toxaphene, and ethylene dibromide (EDB) were cancelled, as well as the agricultural and termiticide uses of chlordane and heptachlor, because of their toxicity and persistence in the environment (Figure T-5). Since their cancellation, the levels of these pesticides have declined in humans and wildlife. These pesticides in turn have been replaced by products that are less persistent in the environment, that are more precise in attacking a given target, and that require much lower rates of application. We have also promoted research in the area of integrated pest management, which takes into account the biology of a pest to achieve greater pest control with less pesticide.

EPA is working to improve the timeliness of new registrations in order to replace existing pesticides with less hazardous ones. In many cases, registration of a brand-new active ingredient has taken several years. To help speed the introduction of new, safer chemicals, EPA is now giving greatest attention to reviewing new pesticides (i.e. new active ingredients). The Agency is also requiring manufacturers to provide all the necessary scientific information with their initial application for registration.

For the hundreds of pesticides approved before today's more stringent standards were in place, the Agency has focused on updating health and environmental information (see highlight on "Completing the Reregistration Cycle"). EPA has been evaluating pesticides in clusters of similar-use products so that different pesticides with the same use are reviewed in the same way. Priority has been given to those chemicals which have the greatest potential for exposure, such as those used on food and in high volume. As a result of this process, we have completed 173 initial registration standards that identify additional data needed to reevaluate the risks of a pesticide. These initial standards account for one-third of the 600 active ingredients that must be reregistered, or 80 percent of the total volume. In addition, through requests to industry to provide data, EPA is obtaining toxicity data needed to reregister all food-use chemicals.

Finally, the Agency has taken legal action against individuals or companies that have not complied with restrictions or bans on the use of certain pesticides. We also have taken action against those that either fail to submit data or that submit false or incomplete data on a pesticide. For example, the sale of over 2,000 products was suspended because required data had not been submitted to EPA. When 200 of these products were shown to be in compliance with pesticide regulations, the ban on their sale was lifted.

As the primary enforcers of pesticide regulations, states have taken an active role in inspecting pesticide use. When violations are found, states either take legal action or refer the violations to EPA. In 1987 alone, the states conducted over 55,000 inspections and initiated over 10,000 enforcement actions. For example, investigators in Maine discovered that 108 growers were using Fusilade 4E on potatoes, although the pesticide was not registered for this use. The state fined each of the growers and required a legally-binding agreement by the growers to refrain from using the pesticide on potatoes. Several pesticide dealers were also required to pay fines, maintain sales records, and participate in training.

TODAY'S CHALLENGES

FIGURE T-5

A Number of Pesticides Have Been Taken Off the Market

Pesticides	Use	Concerns
Aldrin	Insecticide	Oncogenicity
Chlordane (Agricultural uses; termiticide uses suspended or cancelled)	Insecticide/Termites, Ants	Oncogenicity; reduction in non-target and endangered species
Compound 1080 (Livestock collar retained, rodenticide use under review)	Coyote control; Rodenticide	Reductions in non-target and endangered species; no known antidote
Dibromochloropropane (DBCP)	Soil Fumigant - Fruits and vegetables	Oncogenicity; mutagenicity; reproductive effects
DDT and related Compounds	Insecticide	Ecological (eggshell thinning); carcinogenicity
Dieldrin	Insecticide	Oncogenicity
Dinoseb (in hearings)	Herbicide/Crop dessicant	Fetotoxicity; reproductive effects; acute toxicity
Endrin (Avicide use retained)	Insecticide/Avicide	Oncogenicity; teratogenicity; reductions in non-target and endangered species
Ethylene Dibromide (EDB) (Very minor uses and use on citrus for export retained)	Insecticide/Fumigant	Oncogenicity; mutagenicity; reproductive effects
Heptachlor (Agricultural uses; termiticide uses suspended or cancelled)	Insecticide	Oncogenicity; reductions in non-target and endangered species
Kepone	Insecticide	Oncogenicity
Lindane (Indoor smoke bomb cancelled; some uses restricted)	Insecticide/Vaporizer	Oncogenicity; teratogenicity; reproductive effects; acute toxicity; other chronic effects
Mercury	Microbial Uses	Cumulative toxicant causing brain damage
Mirex	Insecticide/Fire Ant Control	Non-target species; potential oncogenicity
Silvex	Herbicide/Forestry, rights-of-way, weed control	Oncogenicity; teratogenicity; fetotoxicity
Strychnine (Rodenticide use and livestock collar retained)	Mammalian predator control; rodenticide	Reductions in non-target and endangered species
2,4,5,-T	Herbicide/Forestry, rights-of-way, weed control	Oncogenicity; teratogenicity; fetotoxicity
Toxaphene (Livestock dip retained)	Insecticide - Cotton	Oncogenicity; reductions in non-target species; acute toxicity to aquatic organisms; chronic effects on wildlife

Oncogenicity—Causes tumors
Mutagenicity—Causes mutation
Carcinogenicity—Causes cancer
Teratogenicity—Causes major birth defects
Fetotoxicity—Causes toxicity to the unborn fetus

Here are some of the major challenges EPA faces today in managing risks from commercial chemicals, pesticides, and biotechnology. The remaining sections of this chapter discuss each of these in more detail.

Evaluating Existing Chemicals

Dioxin, asbestos, and PCBs are chemical substances that EPA has addressed because they present significant risks to health or the environment. The Agency must use all of its authority and work closely with other agencies to identify and address the risks of other highly toxic and pervasive substances.

Reviewing New Chemicals

The best way to ensure that a substance presenting excessive risks does not become widespread in the environment is to prevent it from ever going into production or to limit the quantities that can be produced and used. EPA will continue to place strong emphasis on reviewing new chemicals before they are introduced into commerce.

Reducing Human Health Risks from Pesticides

Consumers are exposed to pesticides through their diet, drinking water, and the use of pesticides such as disinfectants and lawncare products. Farm workers and professional pesticide applicators routinely come into contact with pesticides and thus may face even greater health risks. Even the storage and disposal of pesticides whose use is no longer permitted may pose risks. EPA's continuing challenge is to reduce the health risks from pesticides.

Reduce the Risks of Pesticides to Fish and Wildlife

Fish and wildlife may be exposed to pesticides through contamination of their food, water, and habitat. Certain pesticides have been known to affect the growth, reproduction, and existence of wildlife. The nature of effects on endangered species is a particular concern. We must continue to improve scientific understanding of the effects of pesticides in the environment and to educate users about the dangers pesticides can pose.

Ensure the Safe Testing of and Public Confidence in Biotechnology Products

Microorganisms with new characteristics can now be developed using the techniques of gene-splicing. However, the public has expressed concern about the health and environmental risks posed when such genetically engineered microorganisms are released into the environment. EPA must ensure that such microorganisms are safely tested while maintaining public confidence in biotechnology.

Chemical products are now an accepted part of everyday life.

Completing the Reregistration Cycle

Through the pesticides reregistration process, EPA has been updating data on the health and environmental effects of existing pesticides. As a result, EPA has extensive toxicity data on many existing pesticides. Now the Agency must review these data to determine the potential dangers to health and the environment, and to prescribe the appropriate changes in product formulations, labeling, or use.

EPA thus is beginning a comprehensive review of all new health and environmental data that have been gathered on existing pesticides. Based on our review, we will issue Final Registration Standards and Tolerance Reassessments (FRSTR), which specify any revisions in tolerances, product labeling, and product formulation. Two FRSTRs were completed in fiscal year 1987, and the Agency plans to increase the rate to ten FRSTRs in fiscal year 1988 and twelve FRSTRs in fiscal year 1989. This step translates new information about a pesticide into changes in consumer products.

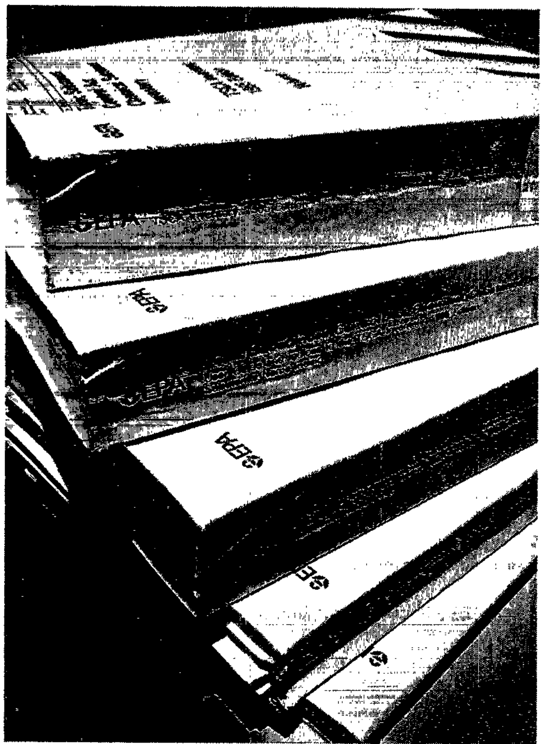
The development of FRSTRs completes a major phase of reregistration. Nonetheless, the process of evaluating pesticides is a continuing one, so that pesticide standards are never truly "final." In spite of today's more stringent standards, what we think is adequate today may not be adequate in the future. For example, the potential for even normal (i.e., approved) uses of pesticides to contaminate ground water was not evaluated when many of today's pesticides were registered. The problem simply was not anticipated. As we learn more about pesticides, we also may learn to ask new questions.

THE PROBLEM

Tens of thousands of chemicals were being manufactured and used when the Toxic Substances Control Act was passed in 1976. At that time, there was little information about long-term health and environmental effects of the chemicals. A program to identify the universe of existing chemicals and determine which chemicals required regulatory attention was needed. A program also was needed to monitor the risks from new chemicals once they were approved for commercial production.

Polychlorinated biphenyls (PCBs) and asbestos provide examples of the problems that toxic substances can present. PCBs were used in many commercial activities, especially as heat transfer fluids in electrical transformers and capacitors. They also were used as hydraulic fluids, lubricants, and dye carriers in carbonless copy paper, and in paints, inks, and dyes. Over time, PCBs accumulated in the environment, either from leaking electrical equipment or from other materials such as inks. PCBs eventually reached humans through the food chain and caused serious health problems in high concentrations.

Like PCBs, asbestos was widely used for many purposes, such as fireproofing and pipe and boiler insulation in schools and other buildings. Asbestos was often mixed with a cement-like material and sprayed or plastered on ceilings and other surfaces. Now these materials are deteriorating, releasing the asbestos. Unfortunately, the physical characteristics that make asbestos so resistant to heat also make it harmful. Asbestos breaks into tiny fibers or dust, which can float in the air, be inhaled, and lodge in lung tissue. Exposure to these airborne fibers can then cause lung cancer and asbestosis, a chronic scarring of the lungs that hinders breathing.



The Chemical Substances Inventory contains information on over 62,000 chemicals.

EFFORTS TO DATE

Since enactment of the Toxic Substances Control Act (TSCA), EPA has worked to address problems associated with specific chemicals including PCBs, asbestos, dioxin, and CFCs. The Agency also gathers information on the toxicity and releases of a larger number of chemicals. All of these activities are summarized below.

ACTIONS TO CONTROL SPECIFIC HAZARDOUS CHEMICALS

PCBs

In TSCA, Congress specifically directed EPA to ban the manufacture, processing, distribution, and use of PCBs except in totally enclosed electrical equipment. Since the 1976 ban, the levels of PCBs have declined in food, humans, and the environment (see Figure T-6).

EPA imposed requirements to reduce the risk of PCB transformer fires, which can spread PCBs, dioxins, and furans (chemicals related to dioxins). These requirements included banning further installation of PCB transformers in or near commercial buildings, labeling of transformer locations, installing electrical protection on certain transformers, registering transformers with fire departments and building owners, and phasing out the use of certain transformers.

The Agency also established regulations for the disposal of PCBs and for the safe cleanup of PCB spills. In this effort, EPA has promoted the development of new technologies for the safe destruction or disposal of PCBs. These include mobile incinerators and chemical and biological methods for detoxifying PCBs.

Asbestos

EPA has worked to reduce the exposure of school children to asbestos through two asbestos laws passed since 1984. Under the Asbestos School Hazard Abatement Act of 1984, approximately $135 million in interest-free loans or grants has been provided to schools for over 1,500 asbestos control projects. As a result, the exposure of children and school employees has been reduced by millions of hours (Figure T-7).

Under the Asbestos Hazard Emergency Response Act of 1986, which amends TSCA, schools are required to identify and respond to their asbestos problems. Using EPA or state-approved professionals, schools must identify dangerous crumbling asbestos. They must then submit plans for addressing the problem to their state governor and begin implementing the plans.

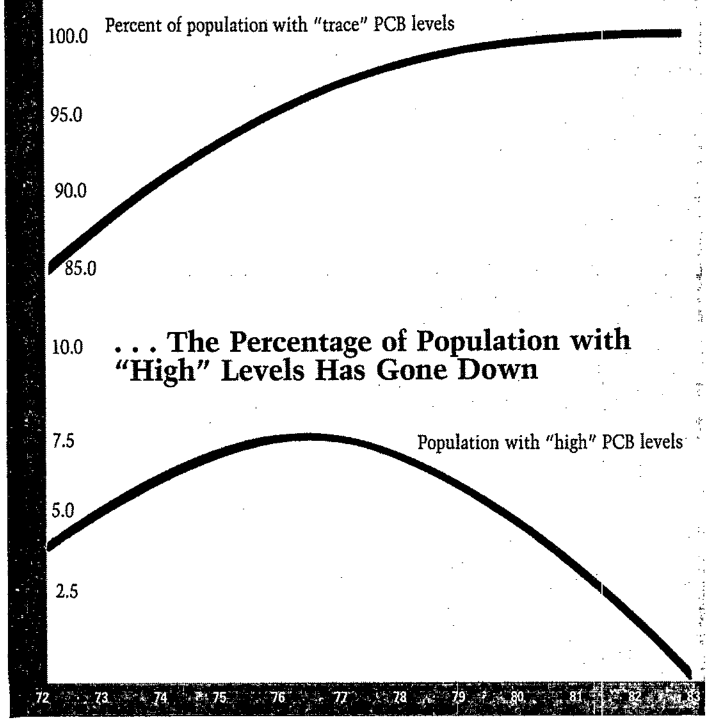
EPA has established centers to provide training on proper asbestos inspections and control procedures at ten universities (see highlight on "Hands-On Training for Asbestos Control"). Through EPA grants and technical assistance, states also have established training and certification programs for asbestos control personnel. The number of such programs increased from five in 1985 to over 39 in 1988.

Finally, the Agency has studied asbestos in public and commercial buildings and provided recommendations to Congress on how to address the problem. In addition, we implemented measures to protect certain state and local government workers involved in asbestos removal. These employees are not covered by the asbestos standards issued by the Occupational Safety and Health Administration that cover most workplaces.

Crumbling asbestos pipe insulation.

FIGURE T-6

While Nearly Everyone Now Has "Trace" Levels of PCB's . . .



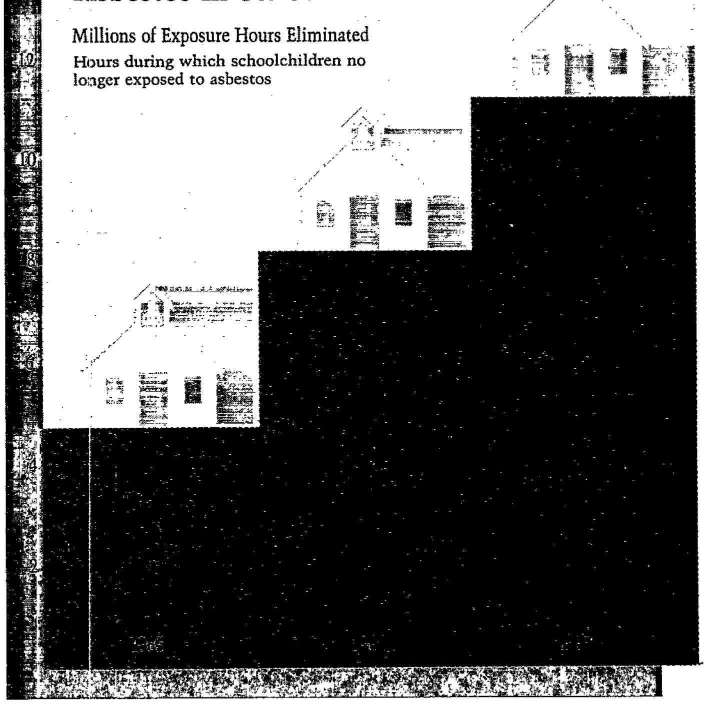
Source: Office of Toxic Substances, USEPA

FIGURE T-7

EPA Programs Have Reduced Exposure To Asbestos in Schools

Millions of Exposure Hours Eliminated

Hours during which schoolchildren no longer exposed to asbestos



Source: Office of Toxic Substances, USEPA

Hands-on Training for Asbestos Control

Since 1985, EPA has helped establish and fund asbestos information and training centers at Tufts University, the Georgia Institute of Technology, the University of Kansas, the University of Illinois, and the University of California. We have also started satellite training centers at five other universities.

Over the past several years, more than 10,000 inspectors, contractors, workers, and other asbestos control professionals have been trained in these facilities. The centers help provide the hands-on training important in state certification programs. Under EPA's model for state accreditation, instruction for inspectors, planners, asbestos control project designers, supervisors, and workers must include some "hands-on" instruction in proper asbestos control practices. The centers may also provide other services such as asbestos telephone hotlines, newsletters, technical bulletins, and national meetings on asbestos issues.

To train workers on site in a safe but effective way, the University of Kansas National Asbestos Training Center has a unique approach. Using retrofitted tractor trailers as asbestos control areas, the center brings the classroom to the student. The mobile classroom has a "clean area" where students become familiar with personal protective gear and learn to decontaminate themselves and their equipment. The bulk of the training takes place in the larger section designed to resemble an asbestos control site, complete with ceilings or building fixtures covered with asbestos substitutes. Here students are taught how to maintain or remove pipe and boiler wraps, and repair or remove ceiling materials. They also learn to use sophisticated asbestos removal equipment. The facility can accommodate as many as 20 trainees at once, depending upon the procedure involved.

The University of Kansas Center presently has four vans which travel around the country. They have been particularly useful in providing hands-on training at technical conferences. The vans also make it economical for small groups of employees to receive training by reducing the expense of travelling to training courses. Other asbestos information and training centers are now investigating the potential use of mobile vans in their programs. Working together, university and federal personnel have developed a creative way to provide hands-on training for asbestos control personnel.

Dioxin

Dioxin refers to a family of chemicals with similar structure, although it is common to refer to the most toxic of these - 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD - as dioxin. It may cause both immediate and short term effects, such as skin disease, cancer, reproductive problems, and reduced resistance to disease. Dioxin is an inadvertent contaminant of the chlorinated herbicides 2,4,5-T and silvex, which were used until recently in agriculture, forest management, and lawn care. It is also a contaminant of certain wood preservatives and the defoliant Agent Orange used in Vietnam. Dioxins and the related chemicals known as furans also are formed during the combustion of PCBs.

Several other sources of dioxin contamination have been identified in recent years. These include pulp and paper production, and the burning of municipal wastes containing certain plastics or wood preserved by certain chlorinated chemicals. To gain a clear picture of the problem, EPA implemented a national study to determine the extent of dioxin contamination. During the study, the Agency identified fish contamination thought to be associated with the pulp and paper industry. These results are being evaluated further.

EPA has taken a number of actions to control dioxin contamination. These include cancelling all uses of the dioxin-containing pesticides 2,4,5-T and silvex. Anyone handling dioxin-containing wastes now is required to notify EPA before moving or disposing of them. These wastes also must be specially-treated before disposal on land. Cleanup of sites containing dioxin, such as Times Beach, Missouri, is being addressed under the Superfund program (see the Land Chapter). In addition, the use of chlorinated wood preservatives and PCB-containing transformers has been restricted.

Chlorofluorocarbons

In 1978, the use of chlorofluorocarbons (CFCs) as a propellant in aerosol cans and other nonessential uses were prohibited by EPA. The Agency took this action as a result of evidence that CFCs caused a decrease in stratospheric ozone. In 1987, 31 nations representing the majority of CFC-producing countries agreed to the Montreal Protocol. The Protocol, which must be ratified by at least 11 countries before it becomes official in 1989, requires developed nations to freeze CFC consumption at 1986 levels by mid-1990 and to halve CFC use by 1999 (see the Air Chapter).

Other Chemicals

Other chemicals have been identified for control under TSCA. Recent examples include the following: hexavalent chromium, a cooling tower additive; acrylamide, a material used as grouting within public water systems; lead, which can enter air and ground water from the ash of municipal waste combustion; and chlorinated solvents, which are used in metal degreasing, drycleaning, and aerosols (see highlight on "Chlorinated Solvents: New Directions in Toxics Control").

GATHERING AND SHARING INFORMATION

Information on the health and environmental effects of a chemical is necessary to determine its risks. EPA also needs information on the likelihood and routes of exposure to a chemical, for while a chemical may be very toxic, it poses little danger unless people or wildlife come in contact with it. Using a variety of data-gathering provisions in the Toxic Substances Control Act (TSCA), EPA collects information on chemical substances to determine the nature and extent of the risks they pose.

TSCA Inventory

One of the first tasks EPA completed under TSCA was compiling an inventory of all chemicals commercially produced or processed in the United States between January 1, 1975 and July 1979. The first inventory was published in 1979 and contained information on over 62,000 chemicals. Information for the inventory came from manufacturers and importers and included production volume and plant location. In 1986, manufacturers and importers were required to report current data on a subset of the substances on the inventory and to update the information every four years. EPA received over 25,000 reports on 8,500 substances during fiscal year 1987.

Production and Use Data

Under TSCA, EPA can collect additional information on use and exposure for selected chemicals. These are chemicals for which there is reason to believe that they may pose unreasonable risks. The information is then used to screen or conduct a preliminary evaluation of risk. To collect the information, we have developed a generic information-gathering regulation which requires manufacturers and importers to provide readily available information about their chemicals. EPA designates a list of chemicals or categories of chemicals for which it wants information and must justify why it wants such information.

To date, the Agency has collected information on 350 substances. For example, EPA listed 18 chlorinated and brominated benzene chemicals because they can lead to formation of dioxins and furans. We also specified 47 other chemicals and mixtures for which more detailed information is required and expect to add other chemicals to the list in the future.

Health and Safety Studies

TSCA allows the Agency to require past and current manufacturers, importers, processors, and distributors to submit unpublished health and safety data on a list of specified chemicals. The list includes chemicals which are suspected of causing cancer or other health effects. The unpublished test data, including both formal studies and reports of incidents or spills, are contained in the Toxic Substances Control Act Test Submissions data base. These data are used to evaluate risks associated with exposure and to determine whether toxicity testing should be done if it has not already been conducted. Such information has been used to support a number of regulatory programs in EPA. For instance, in 1987, we added 102 chemicals to our list, including substances needed to regulate drinking water, set water quality standards, and protect consumer safety.

Substantial Risk Notices

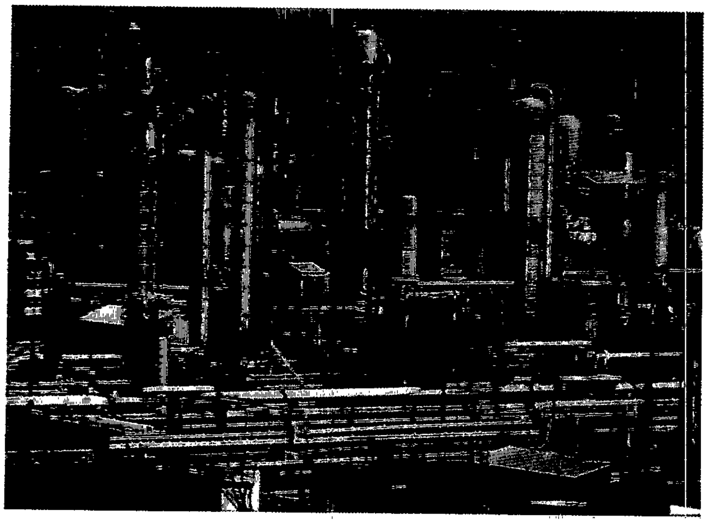
TSCA requires chemical manufacturers, processors, and distributors to inform us immediately when they obtain evidence that a chemical presents a substantial risk of injury to human health or the environment. Such notices include unpublished toxicity and exposure studies and may lead to further action by EPA or other agencies. To date, the Agency has received over 700 substantial risk notices.

Toxicity Testing

When there are insufficient data to evaluate the potential hazards of existing chemicals, EPA may require manufacturers, importers, and processors to conduct tests. An interagency committee periodically recommends chemicals for which testing may be needed. We have also required additional testing in response to a citizens' petition and other regulatory programs. To require such testing, the Agency issues a test rule that specifies the chemical to be tested, the kinds of tests to be conducted, and who must do the testing. In 1987, the Agency received 58 completed test studies from industry and issued a total of 16 final and proposed test rules.

Monitoring

To identify potential hazards, EPA monitors the exposure of humans and the environment to chemicals. For example, under the National Human Monitoring Program, EPA has monitored the levels of PCBs and chlorinated pesticides such as DDT in humans since the 1960s. EPA also has developed improved methods for monitoring chemicals in human tissues and fluids such as a method to measure dioxin in fatty tissue.



The Agency also has conducted a number of chemical exposure studies. For example, EPA conducted an evaluation of the risks from exposure to formaldehyde in mobile and conventional homes. Formaldehyde is often emitted from certain pressed-wood products, such as particleboard, hardwood plywood, and medium-density fiberboard, that are used in homes and furnishings. The Agency now is evaluating the need for regulations regarding the manufacture and use of these products. Other surveys conducted by EPA include a survey of consumer use of household products containing chlorinated solvents; a study of the exposure of sewer workers to acrylamide grouting; and a survey of chloroparaffins in water near a manufacturing site.

THE TOXIC SUBSTANCES RELEASES INVENTORY

In addition to TSCA, EPA has authority for collecting information on toxic chemicals under Title III of the Superfund Amendments and Reauthorization Act of 1986, also referred to as Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986. Facilities that manufacture, process, or use any of 309 designated chemicals in greater than specified amounts now must report routine releases of those chemicals. These reports, which are sent to EPA and to designated state agencies, are a new, nationwide source of information about toxic chemical releases to all media. The Toxics Releases Inventory is designed to assist citizen groups, local health officials, state environmental managers, and EPA to identify and control toxic chemical problems. The Agency is required to make information from the reports available to the public. (See section titled "Emergency Planning and Community Right-to-Know" in the Land Chapter.)

TODAY'S CHALLENGES

Asbestos and PCBs

Further reduction of the hazards of PCBs and asbestos remains a challenge. Although asbestos use has declined sharply in recent years, approximately 30 million tons of asbestos has been applied to ceilings, pipes, and many other parts of buildings since 1900. Brake linings also are one of the major uses of asbestos in the United States. Substitutes are being developed and marketed for most asbestos uses, but some of them cost more than the asbestos products. Since EPA is required to consider economic as well as the health effects of chemical controls, developing a strategy for eliminating asbestos exposure is especially difficult.

Similarly, about 400 million pounds of PCBs are still being used or stored in the United States. We expect that much of this supply will require disposal over the next three years as the use of certain PCB electrical equipment is phased out. At the same time, the Agency has learned of some improper disposal practices and abandoned PCB disposal sites. Thus, EPA must continue to guard against such disposal practices.

New Hazards

In addition to the first group of chemicals addressed under TSCA, EPA must continue to evaluate existing chemicals to determine whether they pose significant health and environmental hazards. For those that do, the Agency must determine the best way to reduce these risks. Toxic chemicals can be released to all environmental media, i.e., air, water, and land. EPA in turn has a variety of regulatory approaches for controlling toxic substances. Before taking action, we must determine which approach is the most effective and economical way to reduce the risks.

Chlorinated Solvents: New Directions in Toxics Control

Chlorinated solvents are in many ways a modern-day miracle, making it possible to clean many things ranging from tiny electronics components to bulky clothing (i.e. dry cleaning). Chlorinated solvents are also used in aerosols, paint stripping, and degreasing tools and equipment. In 1985, EPA received evidence that one of these solvents, methylene chloride, caused cancer in laboratory animals. Other chlorinated solvents include perchloroethylene, trichloroethylene, methyl chloroform, carbon tetrachloride, and chlorofluorocarbon 113. Some of these solvents were also suspected of causing health and environmental problems.

Given the widespread use of these solvents, action to control methylene chloride alone would most likely result in the substitution of other chlorinated solvents with the potential to cause problems. In addition, EPA's approach to regulating toxic chemicals traditionally has been statute by statute, each of which governs releases to specific media such as air or water. Regulating the chlorinated solvents in one media potentially could shift the problem to another media.

EPA took a new approach for chlorinated solvents. First, staff from a number of regulatory programs within EPA and from other agencies participated, including the Occupational Safety and Health Administration (OSHA) and the Consumer Product Safety Commission (CPSC). Second, for each major use — degreasing, dry cleaning, paint stripping, and aerosols — EPA investigated the hazards posed by all chlorinated solvents, rather than focusing on a single chemical.

Coordinating the various programs and agencies was difficult because each was responsible for implementing different statutes. For example, OSHA regulates hazards to workers, while the CPSC regulates hazards to consumers. To date, EPA and the other agencies have developed a comprehensive approach for controlling the hazards of chlorinated solvents from dry cleaning. It was determined that the Clean Air Act and the Occupational Safety and Health Act would be the most effective authorities to control chlorinated solvents in the dry cleaning industry.

EPA expects to begin similar approaches to controlling the use of chlorinated solvents in metal degreasing, paint stripping, and aerosols. In the future, this integrated approach to controlling other toxic chemicals may be common. By evaluating all potential risks of a substance and making use of a variety of regulatory mechanisms, EPA and other agencies can control risks more effectively.

Implementing Community Right-to-Know

The new Toxic Releases Inventory will provide an unprecedented amount of information on the manufacturing, processing, uses, and releases of certain toxic chemicals. The information must be communicated to many people, including citizens, government officials, and representatives of other organizations. EPA's challenge is to interpret the information in the Inventory to help state and local officials evaluate and manage the risks posed by substances present in their communities. In addition, the Agency must help the public understand the risks and alternatives for dealing with them.

EPA'S AGENDA

Continue Actions to Reduce Risks From Asbestos and PCBs

EPA has proposed immediately banning many uses of asbestos and phasing out the rest over the next ten years. This action would ban the import, manufacturing, and processing of five categories of asbestos products - roofing felt; flooring felt and asbestos-backed sheet flooring; vinyl-asbestos floor tile; asbestos-cement pipe and fittings; and asbestos clothing. For the remaining products, such as brake linings, EPA has proposed a phased ban to give industry time to develop and market good substitutes. In addition, the Agency will continue actions to ensure that the hazards of asbestos in buildings are properly controlled.

Similarly, the use of certain PCB-containing electrical equipment is being phased out, with those uses presenting the highest risk being eliminated first. For example, the use of certain PCB transformers with high secondary voltages in or near commercial buildings will be phased out by October 1990. The use of large PCB capacitors also is prohibited after October 1, 1988, unless they are in areas with restricted access. Because such equipment and its PCB contents require proper disposal, EPA is focusing its attention on improving the permitting and monitoring of PCB storage and disposal facilities. The Agency is also developing a program for tracking PCB wastes from the waste generator to disposer and will take action against those who violate PCB disposal regulations.

Improve Information Collection and Sharing

Under TSCA's information gathering authority, EPA has a unique tool for an integrated approach to the control of toxic chemicals. The Agency will continue to collect and share information among all of its regulatory programs, as well as those of other agencies. For example, an outreach service has been established to help EPA regional offices and the states improve their risk assessments. The service, called the Chemical Assessment Desk, provides other parts of the Agency with toxicity and risk information on chemicals reviewed in the toxic substances program. In addition, through the Organization for Economic Cooperation and Development, EPA is working with other countries to coordinate the information gathering, testing, and evaluation of existing chemicals of common concern. Through such joint efforts, the Agency hopes to ensure coordinated and comprehensive regulation of toxic chemicals.

Communicate Information on Toxic Releases to the Public

EPA will make the information in the Toxic Releases Inventory available to the public through an automated data base. In addition, we will help state and local officials, community leaders, and certain organizations to interpret the data and understand its implications for individual communities. Finally, the Agency will use the data to identify toxic chemical hazards that require further investigation or action.

THE PROBLEM

The nation's use of chemicals has increased rapidly over the last 40 years. At present, there exist more than 65,000 chemical substances that may be manufactured or processed for commercial use in the United States, with over 1,000 new substances introduced each year. By the end of 1988, the Agency will have received over 13,000 proposed new chemicals for review (Figure T-8). Given past trends, the rate at which new chemicals are proposed each year will probably continue.

Under the Toxic Substances Control Act (TSCA), EPA evaluates the risks presented by new chemicals before they are manufactured or imported for commercial purposes. By screening chemicals before they are produced in significant quantities and people are exposed to them, EPA can prevent or reduce the risks associated with their use.

EFFORTS TO DATE

The TSCA premanufacture notification process enables EPA to review hundreds of new chemicals proposed for production each year. Chemicals are first screened to separate those likely to pose risks from those that are not hazardous. About 80 percent of the new chemicals received appear to present no unreasonable risks. The remainder must go through a more detailed review. If the effects of a substance are uncertain, EPA may require more toxicity data. Depending upon the data, EPA may restrict the manufacture, import, processing, distribution, use, or disposal of a chemical, or prohibit manufacture altogether.

For those chemicals requiring further review, EPA conducts a structure-activity analysis to screen for potential health and environmental effects. Under this method, a chemical's physical and chemical behavior is predicted by comparing the chemical's molecular structure with that of other chemicals for which the behavior is already known. For many categories of chemicals, structure-activity analysis is useful for predicting likely toxicity, persistence, and other factors.

EPA has exempted some categories of chemicals from premanufacture review because they pose little, if any, risk to human health or the environment. For example, certain polymers are exempt, as are a number of low-volume chemicals where exposures are expected to be minimal. Such exemptions have allowed manufacturers to introduce such chemicals expeditiously and have allowed EPA to focus its resources on substances with greater potential risks.

EPA has encouraged industry to replace hazardous chemicals with less hazardous ones. For example, industry is moving toward the use of less toxic industrial solvents in the coatings industry (see highlight on "Replacing Toxic Solvents in Paints and Coatings"). Industry is also using industrial dyes in pelletized or liquid form rather than their powdered form. Both of these new practices have substantially reduced toxic exposures, especially for employees.

FIGURE T-8

New Chemical Actions Mid-1979 - September 30, 1987

Actions	Aggregated Total To Date
Total New Chemical Substance Submissions Received (PMNs; Applications for Exemptions)	10,842
Valid Pre-Manufacture Notifications (PMNs) Received	9,132
PMNs Requiring No Further Action	7,166
Voluntary Testing in Response to EPA Concerns	149
Voluntary Control Actions by Submitters	45
PMNs Withdrawn in face of regulatory action	183
PMNs Subject to control pending data	349
PMNs Resulting in prohibition or restrictions	4
PMN Exemption Applications Received	1,710
Granted	1,473
Withdrawn	147
Denied	12

TODAY'S CHALLENGES

Estimating Risk

Risk is a product of both toxicity and exposure. For example, some of the most potent carcinogens may present little risk if they are used in totally enclosed chemical reactions. When toxicity information is not available for a proposed chemical, we have usually relied on the use of structure activity analysis to predict health and environmental hazards of the chemical, rather than requiring toxicity testing. The accuracy of such predictions is especially important for chemicals that will be produced in substantial volume and result in significant human or environmental exposure. EPA's challenge is to determine whether the toxicity predictions that it is using are accurate enough to protect against unreasonable risks.

New Uses of Chemicals

EPA has traditionally based its review of a chemical on the uses that a manufacturer intends for the chemical. Once a chemical goes into commercial production, it may be put to additional uses without review unless we intervene. In order to cover all possible uses, EPA must specify for a given chemical that any restrictions, such as the use of respirators by workers, apply to all potential manufacturers as well as the original manufacturer. We may also designate the uses that are permitted and require premanufacture notification if any other use is proposed. However, this chemical-by-chemical mechanism for controlling new uses is cumbersome. Our challenge is to develop a process for efficiently controlling those new uses that may lead to health or environmental problems.

Replacing Toxic Solvents in Paints and Coatings

Coatings, such as the prime coatings on automobiles and clear films on floors and magazine covers, contain solvents to help ensure that the product flows smoothly and forms a film properly. In response to concern that certain organic solvents in some coatings could present health hazards or contribute to air pollution when they evaporate, industry began developing water-based coatings. Water-based coatings, however, have not been developed sufficiently for many uses. More energy is required to dry water-based coatings than organic-based ones and, in many cases, such "water-based" coatings still contain organic solvents. Thus, many industries continue to use coatings containing organic solvents.

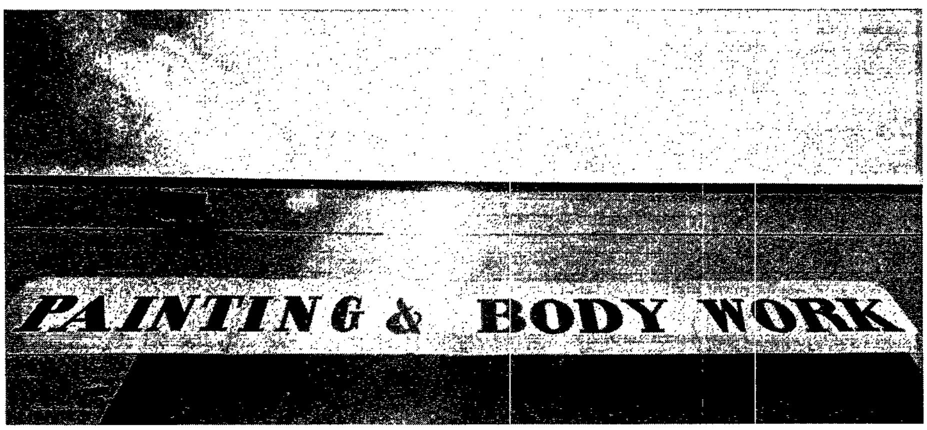
EPA has promoted the replacement of toxic organic solvents with less toxic or non-toxic solvents. For example, ethylene glycol ethers are used as solvents in applications such as resin systems and semiconductors. In 1982, EPA received data indicating that four ethylene glycol ethers produced birth defects, reduced sperm production, and liver and kidney effects in laboratory animals. The effects were at concentrations that raised concern for workers exposed to these chemicals during coating applications.

The Agency began a formal investigation of these four ethylene glycol ethers. During the investigation, EPA contacted coating companies about the uses of ethylene glycol ethers and the potential for substitution. EPA determined that the most likely substitutes were the propylene *glycol ethers, another category of glycol ethers structurally similar but much less toxic than the* ethylene *glycol ethers.*

In 1984, EPA announced that it was considering proposed regulatory action on the four ethylene glycol ethers, representing over 300 million pounds of production. Producers of these ethers recommended voluntarily that workplace exposure levels be reduced well below the current legal standards. At the same time, producers of the potential substitutes began to cite EPA's proposed action in their advertising. Companies eventually began to reduce use of ethylene glycol ethers in coatings.

Because most of the exposure to these chemicals was in the workplace, EPA later referred the four ethylene glycol ethers to the Occupational Safety and Health Administration (OSHA) for further consideration. In 1988, OSHA proposed to lower the levels to which workers may be exposed to these four chemicals. By that time, their use had already declined by about 50 percent. Many suppliers of coatings to the automobile and pigments industries had replaced the ethylene glycol ethers with propylene glycol ethers. In addition, the number of manufacturers of ethylene glycol ethers had dropped from eight companies to two.

In summary, the ethylene glycol story demonstrates a shift away from use of a toxic chemical in response to both industry's own concern and potential regulatory action. In this case, fortunately, there was a readily available substitute. In other cases, it may take years before there is a safer and cost effective substitute available. However, wherever possible, EPA will continue to promote the substitution of other existing but less hazardous chemicals.



EPA'S AGENDA

In the future, EPA plans to require toxicity testing of proposed new chemicals if there is potential for substantial exposure to the chemicals. These are chemicals which will be produced in high volumes and to which many may be exposed. For such chemicals, the Agency will also conduct structure activity analyses but will no longer rely solely on this method to predict toxicity. The results of the toxicity tests can then be compared to predictions based on chemical structure and provide a better basis for determining whether restrictions on production and use are appropriate.

EPA has proposed a generic approach for the review of new uses of chemicals that have already been approved for commercial production. Under such an approach, we would define "new uses" for a category of chemicals. No person would be allowed to manufacture or process a chemical in the *category* for a given "new use" without first submitting a notice similar to a premanufacture notice. A major advantage of this approach is that all chemicals in the same category, whether they are new or not, would be reviewed before being allowed for potentially risky uses.

Pesticides: Human Health Concerns

THE PROBLEM

The average consumer is exposed to pesticides through food, drinking water, and personal use of pesticides, such as pet and lawncare products (Figure T-9). Farm workers, forestry and greenhouse workers, and professional pesticide applicators may be exposed to even greater levels of pesticides on a routine basis. Health care workers and consumers are also exposed to antimicrobial pesticides that are used to control disease-causing microorganisms.

While EPA has a pesticide registration process designed to manage the risks from pesticides, some can cause serious health problems if spilled on the skin, inhaled, or otherwise used improperly. Health effects may include cancer, birth defects, neurological effects, and death.

Pesticides may also cause problems following uses that traditionally have been approved. For example, pesticides may enter ground water through rain, runoff, and snowmelt after normal uses. Storage and disposal of pesticides that have been taken off the market may also pose risks unless neutralized or safely destroyed.

EFFORTS TO DATE

A number of chemicals have been taken off the market because of human health concerns. In the 1970s, virtually all uses of DDT, aldrin, dieldrin, and toxaphene and the agricultural uses of chlordane and heptachlor were cancelled (i.e., permanently banned). Since the cancellation, levels of DDT and related chemicals have declined in humans (Figure T-10). More recently, all uses of aldrin, dieldrin, chlordane, and heptachlor against termites have been either cancelled or suspended pending the results of cancellation hearings.

All pesticides must be registered or approved by EPA. Through the registration process, manufacturers are required to provide data on the potential human health effects of pesticides. Previously, the primary health concern was whether a chemical could cause cancer. Now, both new pesticides and those already in use must be tested for a variety of potential problems, including reproductive, immunological, and neurological effects.

All new and previously registered pesticides also are screened for their potential to contaminate ground water. Ground-water concerns were one of the major reasons that ethylene dibromide (EDB) and dibromochloropropane (DBCP) were taken off the market (see highlight on "Ethylene Dibromide: The Problem of Pesticide Disposal"). In 1984, the Agency issued a request for ground-water data on another 140 registered pesticides. We have conducted special reviews of certain pesticides such as aldicarb, alachlor, and cyanazine. EPA has required a national ground-water survey for the pesticide alachlor and issued a ground-water advisory for cyanazine. We have also denied registrations of new pesticides as a result of ground-water problems.

The Agency has established a process for determining tolerances, the allowable levels of pesticides in food. We have developed a new computer system, called the Tolerance Assessment System, which improves our ability to determine tolerances. Previously, EPA was able to determine tolerances only for the general population. The new system takes into account differences in susceptibilities within the general population, such as differences in age and geographic location.

Finally, programs to protect farm workers and other pesticide applicators have continued. Farm worker

FIGURE T-9

Pesticides are Widely Used

The following are categories of pesticides from the list "EPA Site Categories for Preparing and Coding Pesticide Labeling." The list illustrates that not all pesticides are used in agriculture, as is commonly thought.

- Fiber crops — cotton and hemp, for example.
- Specialized field crops, such as tobacco.
- Crops grown for oil, such as castor bean and safflower.
- Ornamental shrubs and vines, like mistletoe.
- General soil treatments, such as manure and mulch.
- Household and domestic dwellings.
- Processed non-food products — textiles and paper, for example.
- Fur and wool-bearing animals, such as mink and fox; laboratory and zoo animals; pet sprays, dips, collars, litter and bedding treatments.
- Dairy farm milk-handling equipment.
- Wood production treatments on railroad ties, lumber, boats and bridges.
- Aquatic sites, including swimming pools, diving boards, fountains, and hot tubs.
- Uncultivated non-agricultural areas, such as airport landing fields, tennis courts, highway rights-of-way, oil tank farms, ammunition storage depots, petroleum tank farms, saw mills, and drive-in theaters.
- General indoor/outdoor treatments, in bird roosting areas, or mosquito control.
- Hospitals, including syringes, surgical instruments, pacemakers, rubber gloves, bandages, and bedpans.
- Barber shops and beauty shops.
- Mortuaries and funeral homes.
- Preservatives in paints, vinyl shower curtains, and disposable diapers.
- Articles used on the human body, such as human hair wigs, contact lenses, dentures, and insect repellents.
- Refuse and solid waste sites, home trash compactors and garbage disposals.
- Specialty uses, such as mothproofing and preserving specimens in museums.

TODAY'S CHALLENGES

safety standards were issued in 1974. The standards prohibit spraying while workers are in the fields and include provisions for protective clothing, warnings about treated areas, and waiting periods after spraying. EPA also has developed educational materials that show farm workers how to handle pesticides safely and has implemented programs for the training and certification of applicators who use restricted pesticides (see highlight on "Pesticide Applicators Require Special Training").

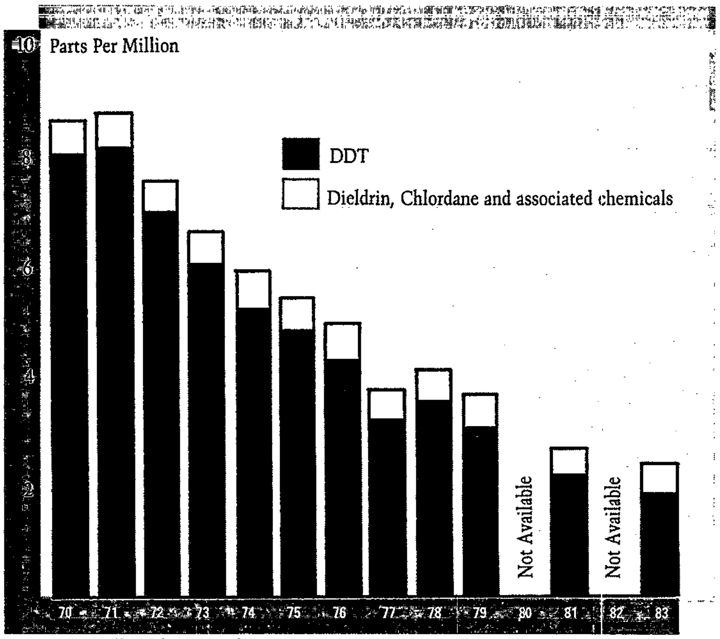
A great deal of progress has been made in addressing the health risks of pesticides. However, the Agency still has much to do to make sure that human health is protected. The following are some of the most significant of these challenges.

Ground-Water Contamination

Contamination of ground water and drinking water by agricultural chemicals is a concern in some areas of the country (see section titled "Drinking Water" in the Water Chapter). For example, EPA estimated from a 1986 survey that 30 states had found wells contaminated with one or more of 60 different pesticides. While the Agency and many states have already taken some steps to address the problem, a national approach to prevent future contamination must be designed. This is especially challenging because ground water may be more vulnerable to contamination in some areas than in other areas because of geological or other factors. The Agency must develop pesticide management approaches that take such variation into account and can be tailored to local ground-water protection needs.

To protect consumers, EPA limits levels of pesticides in food.

FIGURE T-10
Levels of Persistent Pesticides Have Declined In Humans



Source: Office of Toxic Substances, USEPA

Pesticides in Food

Although there is a process for determining allowable levels of pesticides in food, certain pesticides in food have been shown to cause cancer in laboratory animals. These are primarily pesticides registered before more stringent health data were required. We are evaluating these pesticides through the reregistration process, but the task is complicated by a conflict between the standards governing pesticide levels in different types of foods. Raw foods are evaluated by weighing the risks of pesticide exposure against the benefits of pesticide use. Processed foods are subject to a more stringent standard, which states that food additives must pose zero risk of cancer regardless of their benefit. Because of these competing standards, some existing chemicals in raw foods would be prohibited in processed foods. The Agency must resolve the conflict between the standards while continuing to ensure that consumers are protected against unreasonable risks.

Home and Garden Pesticides

A variety of pesticides used on lawns and pets are available off the shelf. No special training is required to use them, and no one monitors how closely the consumer follows the instructions on the label. However, many products are hazardous if improperly stored, handled, or applied.

Pesticides may also increase indoor air pollution and may expose consumers to higher levels of pesticides than previously thought (see section titled "Indoor Air Pollution" in the Air Chapter). Determining the hazards of home-use pesticides and informing consumers about the importance of proper use are major challenges facing EPA today.

Certain inert ingredients must now be identified on pesticide labels.

Ethylene Dibromide: The Problem of Pesticide Disposal

Introduced to commercial use in 1948, ethylene dibromide (EDB) was used widely on soils to protect crops from root worm. It was also used on fruits and vegetables and on stored grain. In 1984, after EDB was shown to cause cancer in laboratory animals and to contaminate food and ground water, EPA halted most uses of EDB. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA must indemnify or reimburse pesticide holders (manufacturers and users) for the costs of the cancelled or suspended products, and then dispose of all stocks of the pesticide if requested. In this case, EPA became responsible for disposing of substantial stocks of EDB.

The discovery of leaking drums of EDB in a Missouri warehouse in 1986 alerted the public that the EDB disposal process was not going smoothly. EPA was faced with the challenge of disposing of the EDB stock even though appropriate methods of disposal were not yet available. In an attempt to neutralize the EDB, EPA decided to use a chemical method that had been used only in a laboratory setting. Unfortunately, mechanical problems delayed the process. When the Agency attempted to remove the EDB from the drums, toxic vapor emissions were released to the air. The process was further complicated because the drums of EDB were corroding. After spending $1.5 million, the Agency realized that this chemical method would not work on certain EDB formulations. EPA currently is considering the use of a type of incineration that can withstand the corrosiveness of EDB. The total cost to dispose of the remaining EDB is expected to be between $6 million and $8 million.

The EDB story illustrates the difficulties EPA faces in dealing with cancelled pesticides. Although stocks of cancelled pesticides must be disposed of safely, the proper disposal method often is not known when the cancellation decision is made. In addition, EPA must identify all the stocks of a pesticide and ensure its safe storage while awaiting disposal. Storage often arouses opposition in a community.

To compound matters, FIFRA does not provide a specific mechanism for financing disposal or storage of the cancelled pesticide, or for reimbursing anyone possessing cancelled pesticides. However, disposal costs are expected to dwarf the costs of other pesticide programs. For example, the disposal cost for dinoseb, which is currently in cancellation hearings, is expected to exceed $100 million. These estimates do not include the costs of other cancellations that may occur in the future.

EPA is examining ways to address the problem of pesticide disposal, particularly the high costs of disposal and reimbursement. Alternatives include amendments to FIFRA and the implementation of fees based on the sale of pesticide products. EPA's responsibility for reimbursing pesticide manufacturers and users also is being reevaluated. In the meantime, EPA is exploring disposal methods for other cancelled pesticides, such as 2,4,5-T and silvex, and plans to complete the incineration of EDB in 1988.

Professional Pesticide Applicators Require Special Training

The pesticides commonly used at home do not require any special training. More hazardous pesticides, however, generally are restricted to use by certified applicators, who must meet minimum federal requirements for certification. They also must be trained to use these pesticides safely and in accordance with the restrictions. The states are responsible for running federally-approved certification and training programs.

In general, these programs have improved the competency of applicators and have heightened awareness of safe pesticide use. Over two million private and commercial pesticide applicators have been trained since 1976, and over one million applicators have been certified by the states. Many states have more stringent standards than the minimum standards established by EPA. Some states provide training for the "registered technician," who is often the person actually applying a pesticide under supervision of a certified applicator. A number of states also have implemented a process for ensuring that applicators are recertified periodically.

Despite improvements in applicator competency, most state programs have not been updated since they were first approved by EPA. Since that time, a number of new concerns about pesticides have arisen, including concerns about ground-water contamination, endangered species, wood preservatives, and pesticide disposal. There also are differences among state programs, some of which are needed to reflect differences in vulnerability of ground water and wildlife. Other differences should be addressed to ensure that all state programs meet basic standards.

EPA is taking a number of steps to improve the training of pesticide applicators. All state plans are being reviewed to identify areas that need updating and to make them consistent across states where appropriate. Training materials are being revised, especially with respect to evaluating the risks to ground water and methods of pesticide disposal. In addition, it is our goal that anyone who deals with pesticides will be trained. We currently are considering three levels of training: the "master," a level above the present federal certification; the "operator," the present level of certification; and the registered technician. We are taking the additional step of training the trainers, and EPA currently is compiling a national repository of training materials.

Finally, EPA is working with other federal agencies and industry to improve training programs. For example, we are working with the National Institute of Occupational Safety and Health to obtain the latest information on worker safety equipment. We also have worked with the Department of Agriculture to develop training materials. Such efforts to ensure that professional applicators and technicians use pesticides safely is an important component of the pesticides program.

Inert Ingredients

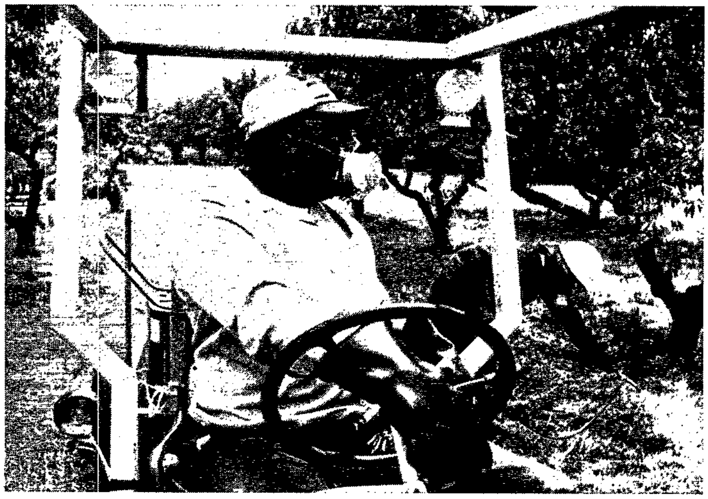
Regulations traditionally have focused on the active ingredients in pesticide products. In addition, there are also about 1200 inert ingredients added to pesticide products for a variety of purposes. While not "active" in attacking a particular pest, some inert ingredients are chemically or biologically active and may cause health and environmental problems. These inert ingredients have received relatively little scientific scrutiny and, in the case of food-use products, have been exempt from tolerance requirements. EPA must evaluate and regulate the hazards of inert as well as active ingredients to ensure that pesticide products are safe.

Antimicrobial Pesticides

Although antimicrobials have been regulated since 1910, the public health community has stated that further safeguards are necessary to ensure proper labeling and product effectiveness. Antimicrobials include disinfectants, sterilizing agents, and fungicides, and are used both by consumers and the health care community. When an antimicrobial fails to work, it may be impossible for the user to tell, and diseases can be spread while thought to be under control. Unsupported advertising claims may also create a false sense of security among users. In addition, since our evaluations have focused on whether a product works against microorganisms, relatively little is known about how such products affect humans. The Agency must ensure not only that antimicrobial pesticides are effective but also that they pose no unreasonable dangers to human health.

Farm Workers and Pesticide Applicators

In 1974, EPA issued worker protection standards designed to protect farm workers against the hazards of pesticides sprayed in fields. However, the standards did not go far enough to protect other pesticide handlers, such as mixers and applicators, or workers in greenhouses, nurseries, and forests. Requirements for protective clothing are also thought to be inadequate by today's standards. EPA's challenge is to ensure the protection of all pesticide handlers, as well as to promote the dissemination of information regarding the safe use of pesticides. In addition, we must make sure that EPA standards are updated as new methods of pesticide application are developed or new hazards are discovered.



Farm workers and other pesticide handlers may require protective clothing when contacting pesticides.

EPA'S AGENDA

Implement an Agricultural Chemicals and Ground-Water Strategy

EPA has proposed a strategy designed to prevent contamination of ground water. Since the location and condition of ground water can vary widely, the strategy relies on the development of state plans as well as collaboration among the states, EPA, and other agencies. The strategy is intended to help identify the areas most vulnerable to contamination because of geological or other factors. It will also help identify areas where contamination would pose the greatest risk to human health and the environment. The Agency also is developing a program to help states establish buffer zones around community water wells.

Steps to deal with existing ground-water contamination are being taken. For example, EPA is conducting a nationwide survey of pesticides in drinking water to determine the extent of contamination. We also are publishing health advisories regarding chemicals in ground water and setting maximum allowable levels of pesticides in drinking water.

Finally, although the Agency has already requested ground-water monitoring studies for some pesticides, it is determining when and what kind of ground-water monitoring data will be needed for pesticide registration. EPA is also determining how to classify pesticides for restricted use because of ground-water concerns.

Improve Methods for Ensuring Food Safety

EPA commissioned the National Academy of Sciences to study the methods for setting tolerances of pesticide residues in food. The study found that food is still safe for consumption but that the process for setting tolerances could be improved. For example, the study recommended dropping the distinction between raw and processed foods and setting a uniform goal of "negligible risk." Since many pesticides pose little risk, this would allow us to focus on the most worrisome pesticides and replace them with less hazardous chemicals. The study also identified the pesticides requiring the most regulatory attention. We are developing a plan to implement these and other recommendations.

Determine Exposure to Home and Garden Pesticides

The Agency is examining the extent of consumer exposure to unsafe levels of pesticides from home and garden products. For example, a survey of pesticide levels in homes is underway. Steps are also being taken to eliminate indoor use of certain termiticides and to investigate the use of Blockade-brand flea and tick repellents for pets. For lawncare products, we are identifying available health and environmental data so that their hazards can be evaluated. At the same time, state and local governments are proposing that lawn care services be required to post notices on pesticide-treated lawns. Finally, through publications and improved labeling of products, we plan to educate consumers about safe pesticide use.

Ground water being sampled for pesticide contamination.

Implement Special Strategy on Inerts

EPA has developed a strategy that groups or ranks inert ingredients according to their toxicity or need for additional toxicity testing. For example, we have identified about 50 substances that present the greatest toxicological concern and are encouraging substitution of safer chemicals. In the interim, manufacturers must relabel products to identify the presence of these toxic inerts. If manufacturers cannot or do not eventually replace these chemicals, the Agency plans to request additional health information and, if necessary, to hold hearings to evaluate the need for cancellation.

Improve the Testing and Marketing of Antimicrobials

EPA has developed a special strategy for improving the regulation of antimicrobial pesticides. As part of this strategy, we are examining the design and performance of laboratory testing procedures to ensure that they give consistent results and indicate the effectiveness of a product in both the real world and the lab. To address the concern over toxic effects, the Agency is reviewing additional toxicological data on antimicrobials. We have prohibited manufacturers from making claims about the effectiveness of products that have not been approved by the Agency and sent warning letters to registrants making false claims. We are even addressing the safety of home use products such as pine oils and sanitizers through improved labeling requirements.

Ensure the Safety of All Pesticide Handlers

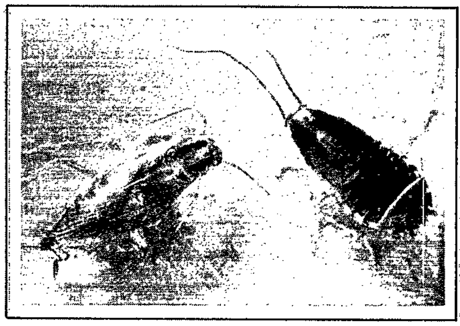
We are in the process of expanding the 1974 worker protection standards so that they apply to all pesticide handlers, including greenhouse, nursery, and forestry workers as well as farm workers. The revised regulations will enhance the enforceability of the provisions and improve requirements for training, protective clothing, and warnings about pesticide-treated areas. In addition, we have established a Farm Safety Center to advise EPA on the health and training of farm workers. Finally, through integrated pest management, we will continue to encourage more efficient use of pesticides in order to minimize overall exposure (see the highlight on "Cockroaches - A Case Study in Integrated Pest Management").

Cockroaches — A Case Study in Integrated Pest Management

Cockroaches carry viruses and bacteria that can cause hepatitis, polio, typhoid fever, plague, and salmonella. Attempts to control the cockroach consume one third of the pest control budget for urban sites and represent the largest expenditure for a single pest in U.S. homes and other establishments. Because of its growing resistance to many pesticides, however, the cockroach is not likely to be eliminated from homes and other buildings in the near future.

Both the professional pesticide applicator and the average consumer can control cockroaches by using the principles of Integrated Pest Management (IPM). A blend of old-fashioned practices and new technology, IPM is an ecological approach to pest management that takes into account the biology of the pest and its interaction with the environment. Although IPM may include the use of chemical pesticides, it considers all available options to achieve the greatest control with the least possible hazard.

Controlling cockroaches with IPM involves estimating the extent of the cockroach population, and then using a range of techniques to achieve tolerable levels. The basic control measure is to modify cockroach habitats by lowering the temperature, removing food, eliminating moisture, reducing clutter, and filling hiding spaces such as cracks and crevices. If these actions do not provide enough control, the appropriate pesticides may be used. Recent studies have shown that the most effective, least toxic, and least expensive method to control cockroaches is to apply 99 percent boric acid dust in cracks and crevices. The cockroaches ingest the powder while grooming themselves and die three to ten days later. (Because boric acid may be harmful if ingested by children, it should be used cautiously if children may be exposed.)



The IPM approach is being demonstrated for use in managing a variety of other pests, such as termites, grasshoppers, and aquatic weeds. Much of this work is done cooperatively with other federal and state agencies, pesticide user groups, universities, and the agricultural chemical industry. IPM is also viewed as a primary tool for managing pest populations that have become resistant to pesticides. Toward this end, we are working with the states to promote the use of innovative methods for dealing with pest resistance.

Pesticides: Fish and Wildlife Concerns

THE PROBLEM

Wildlife come into contact with pesticides by feeding on contaminated fields and water, or by preying on other contaminated organisms. In the 1960s, drastic declines in some species of birds due to widespread use of DDT demonstrated the problems that pesticides can pose to fish and wildlife. DDT and other organochlorine pesticides were found to persist in the environment and accumulate in the tissues of wildlife and humans. DDT caused the thinning of eggshells, which in turn prevented the successful hatching of chicks.

While pesticides that have replaced DDT may not be as persistent, some are known to kill or cause other harm to fish and wildlife, including effects on growth and reproduction. In addition, organisms that are already threatened with extinction by other factors may be particularly at risk from exposure to pesticides (see the highlight on "Endangered Species Return but Still Require Protection From Pesticides").

EFFORTS TO DATE

Since the 1960s, the use of a number of chemicals that were harmful to fish and wildlife have been cancelled. In 1972, EPA banned the manufacture of DDT and subsequently banned the use of other organochlorines. A number of species threatened with extinction have since shown signs of recovery. These include the California brown pelican, the bald eagle, and the peregrine falcon. In addition, the levels of DDT and other organochlorines in the tissues of fish, birds, and humans have declined significantly since the early 1970s (Figure T-11).

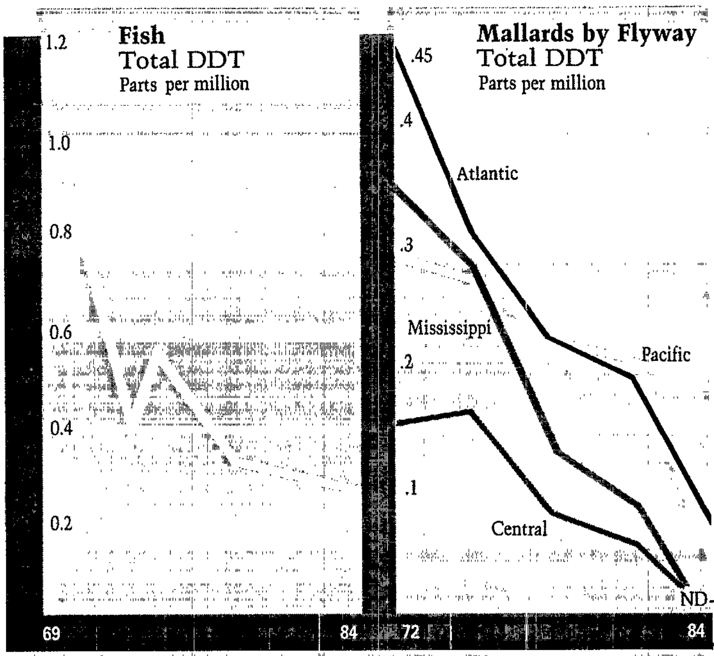
Despite the overall decline of organochlorines, DDT was found at unexpectedly high levels in wildlife in the southwestern U.S. in the early 1980s. One possible source was thought to be the pesticide dicofol, which contained DDT and related chemicals formed as by-products during manufacturing. After completing a special review of dicofol in 1986, EPA required the manufacturer to change the previous method of manufacturing and sharply reduce the level of DDT. The manufacturer also was required to make a substantial payment to a fund supporting the breeding of the still-endangered peregrine falcon.

Pesticides such as DDT have been replaced with chemicals designed to be less persistent, to require much lower rates of application, and to be more precise in attacking a given target. Certain pesticides also are produced in different forms to reduce exposure to wildlife. For example, after changing the form of a pesticide that resembled food for birds, the incidence of bird kills dropped dramatically.

EPA has lowered the allowable doses of certain existing pesticides instead of cancelling their use. For example, we have been examining the use of two pesticides that kill rodents, strychnine and 1080, because of concern that they kill other wildlife such as bald eagles. We currently are examining whether lower doses of these chemicals against rodents can reduce the risks to wildlife and still be effective.

Finally, the Agency has been evaluating some chemicals because of concerns about effects on fish and wildlife. Previously, our primary concern was whether a chemical could cause harm to humans. For example, while the organochlorines caused significant effects on wildlife, they were ultimately banned when found to accumulate in human tissue. Special reviews of the pesticides strychnine, 1080, diazinon, tributyltins, and carbofuran are being conducted because of concern for their effects on fish and wildlife (see the highlight on "Status of Some Chemicals in Special Review").

FIGURE T-11
Levels of Persistent Pesticides Have Declined In Fish and Wildlife



Nondetectable. (More than 50% of pools had levels less than analytical detection limits (.01))

Source: U.S. Fish and Wildlife Service, National Contaminant Biomonitoring Program, unpublished data for 1984

Status of Some Chemicals in Special Review

If there is evidence that a pesticide may be presenting unreasonable risks, EPA may conduct a special review of a pesticide. The Agency first identifies and quantifies the human health and environmental problems as well as the benefits to agriculture and other users. EPA may then decide to continue current uses, restrict some or all uses, or permanently cancel uses of the pesticide.

Following are some pesticides that have undergone special review because of concern over their effects on fish and wildlife.

• ***Diazinon:*** *Diazinon is among the first chemicals to have undergone special review solely on the basis of potential hazards to fish and wildlife. EPA issued the final notice of intent to cancel diazinon for use on golf courses and sod farms because it was found to kill birds. After hearings on the cancellation, EPA halted these uses of diazinon after March 31, 1988.*

• ***Tributyltin:*** *TBT (tributyltin)-based paint is used to prevent the growth of barnacles and other marine organisms on boat hulls. In the 1970s, scientists in England and France noticed that TBT, which leaches from the paint into surrounding water, caused effects in oysters, including physical deformities, reduced size and fewer offspring. TBT also affected the reproduction of snails. EPA began a special review of TBT when levels of TBT known to produce these effects were discovered in U.S. waters. EPA is considering several options, including the prohibition of TBT use on recreational boats and limitations on the rate TBT may be released into the water. Several states already have restricted the use of TBT.*

• ***Carbofuran:*** *Carbofuran is a pesticide usually applied when seeds are planted to control pest problems that may occur later in the growing season. Based on carbofuran's toxicity to birds, EPA began a special review of the granular form of the pesticide. This review was followed by a complete evaluation of the hazards of carbofuran, including an evaluation of its acute toxicity, the degree of exposure to the pesticide, direct and indirect poisoning of birds, and the toxicity of substitute pest control products. EPA estimated that, in nine states studied, about two million birds would be killed per year from direct exposure to carbofuran. A decision regarding whether to limit or ban the use of granular carbofuran is still pending.*

TODAY'S CHALLENGES

Manufacturers are required to submit information regarding the real-world effects of pesticides on wildlife. In addition to laboratory studies of toxicity, EPA requires field studies that demonstrate the actual impacts of a pesticide in the environment. However, obtaining this kind of information is not straightforward. Since we rely on data from manufacturers, EPA must be able to ensure that field studies are scientifically and statistically valid. The Agency must also be able to compare studies done by different manufacturers, so each applicant must follow similar procedures.

Determining that a chemical does not harm organisms is especially difficult. Non-lethal effects are difficult to observe, and even wildlife mortality may not be observed in the wild unless there is consistent monitoring. Furthermore, a chemical may be toxic to some organisms and not to others. For example, the pyrethroid pesticides that have replaced DDT apparently are not toxic to birds but very toxic to fish and aquatic invertebrates. Thus the Agency needs to make sure that tests of a pesticide provide comprehensive information on its potential to harm fish and wildlife.

EPA'S AGENDA

The Agency is striving to make sure that environmental data represent the effects of a pesticide on fish and wildlife in their natural habitat. In particular, we are preparing guidance for applicants to improve the way in which field studies are conducted. This guidance describes the use of aquatic mesocosms for examining the effects of pesticides on aquatic organisms. Mesocosms are a series of ponds designed for studying the effects of a pesticide without harming the entire environment. This guidance is also intended to ensure that field data are valid and consistent from applicant to applicant. EPA expects to release such guidance in 1988.

EPA likewise is developing better methods for determining the effects of pesticides on entire ecosystems as well as on individual organisms. For example, we have developed a stream mesocosm that mimics stream conditions and can test the effects of pesticides on a large suite of organisms. We also are beginning a major five-year research program to improve computer models of ecosystems in different environments across the country. With such models, the Agency hopes to be able to predict the future effects of pesticides as well as to deal with existing problems.

Endangered Species Return but Still Require Protection from Pesticides

By the early 1970s, the bald eagle had all but vanished from many areas of its natural range. At that time, only about 1,000 nesting pairs of eagle were found in the entire United States. Too few offspring were hatching successfully, and evidence pointed to the use of DDT and other persistent pesticides as the likely factor responsible for this condition. These pesticides and their by-products had affected calcium metabolism, making eggshells so thin that they broke under the weight of the nesting birds. Our national symbol, the bald eagle, became an endangered species.

Although still endangered, the bald eagle has shown remarkable signs of recovery since the ban on DDT in 1972. Today, there are almost 2,000 nesting pairs of bald eagles in the United States. The majority of birds seem to be producing normal eggs, even though problems with eggshells have been reported for some nests. The California brown pelican and peregrine falcon, also threatened with extinction by the persistent pesticides, have been recovering slowly as well.

Although the bald eagle and other birds have been recovering since the ban on DDT, there are still many thousands of species listed as endangered. These species usually have become endangered for a variety of reasons other than pesticides contamination; they nonetheless are particularly vulnerable to added stresses such as pesticides. Pesticides may kill wildlife directly, or may contaminate the food, water, and habitat of the wildlife.

Under the Endangered Species Act, EPA is required to consult with the Fish and Wildlife Service to ensure that pesticides do not jeopardize endangered species and their habitat. If the Fish and Wildlife Service determines that a pesticide is likely to be harmful to endangered species, it suggests alternatives to EPA for preventing damage to the species. It usually recommends not using the pesticide where endangered species would be exposed.

EPA is developing an approach to implementing these restrictions through the pesticide label. As proposed in the Federal Register, pesticide labels would list the counties that have limitations on use in endangered species habitats. Labels would refer users to county bulletins that contain maps indicating the portions of the county where pesticide use is limited. At first these limitations would apply to the four groups of pesticides that already have been evaluated: certain crop pesticides, pasture and rangeland pesticides, forestry pesticides, and mosquito larvicides. Information currently is being gathered for maps that would identify the location of potentially affected endangered species.

Because the presence of endangered species may vary within a state and even within a single county, states will have a particularly important role in determining where limitations are needed. Several states already have proceeded to develop recommendations for implementing the program. By working with agriculture and wildlife experts and government officials, we hope to ensure that pesticides pose minimal threats to endangered species.

THE PROBLEM

Bacteria in petri dishes. Using gene splicing techniques, scientists can genetically alter bacteria.

With the advent of "gene splicing" techniques, it has now become possible to develop microorganisms with new combinations of characteristics. Pieces of the genetic material carrying the blueprint for desired traits from one microorganism now can be inserted into another microorganism. In one step, the results of generations of breeding can be achieved and the range of characteristics possible in a given microorganism expanded.

These new techniques are already being used with great effect to develop microorganisms that metabolize (i.e., "eat") certain pollutants, such as oil (see the highlight on "Some Developments in Biotechnology"; also see the highlight on "Using Biological Organisms to Clean Up Hazardous Waste" in the Land Chapter). They have also been used to produce needed biological materials like enzymes more efficiently and at a much lower cost. For example, the insulin-producing human gene has been inserted into a common bacterium which then produces insulin in large quantities.

Despite the benefits of biotechnological advances, the development of "new microorganisms" has raised questions about the possible risks to human health and the environment. One concern is that the microorganism, though not disease-causing, may be so successful that it could seriously disrupt the balance among existing species and even eliminate some species. For example, the vine called "kudzu" was intentionally introduced in the southeastern U.S. to control erosion but then spread to cover many areas of the countryside. Although kudzu is not the result of biotechnology, the kudzu story demonstrates what can occur when a plant or animal is introduced either intentionally or inadvertently into a new habitat.


Dr. John Attaway & Dr. Larry Parsons

In winter, citrus trees must be sprayed with water to form a protective ice coating. Geneticists are now developing naturally frost-resistant plants.

EFFORTS TO DATE

In response to public concerns about biotechnology, various federal agencies met to ensure that approaches throughout the federal government were consistent. Their respective responsibilities were described in policy statements issued by the White House science office in 1984 and 1986. The Food and Drug Administration oversees the production of new pharmaceutical products, and the Department of Agriculture regulates the development of new strains of food crops and livestock. EPA is responsible under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) for overseeing the development of microbial pesticides, and under the authority of the Toxic Substances Control Act (TSCA), all other microbial products not regulated by other federal agencies or programs. These include microorganisms used for waste degradation, chemical production, conversion of biomass to energy, and other environmental and industrial uses.

Using the authority of TSCA, we defined microorganisms containing genetic material from dissimilar microorganisms as "new microorganisms." Producers of these microorganisms must provide premanufacture notification under the new chemicals program. In addition, since living organisms can multiply, the Agency announced that small quantities of "new" microorganisms used for research and development field trials would not be exempt from premanufacture notification requirements as are other chemicals used for research.

FIFRA gives EPA authority over the distribution and use of all pesticide products, including microbial pesticides. Some of the data needed for registration must be developed through actual field trials. Because of the special concern over genetically engineered microbial pesticides, the Agency has required prior notification regarding the field testing of genetically altered or non-native microbial pesticides.

Under both TSCA and FIFRA, a process has been instituted for carefully evaluating proposals for field tests of genetically altered products. Before permission for such an experiment is granted, EPA evaluates the information about the experiment and shares this information with other agencies. If the experiment is approved, we specify conditions for conducting the experiment and require that the results be submitted to EPA so that we can monitor the effects of the organism and reevaluate our decision on the experiment. The Agency also has established a Biotechnology Science Advisory Committee to provide advice on these and other biotechnology issues.

To date, several tests of genetically engineered microorganisms outside the laboratory have been approved. Under the authority of FIFRA, EPA approved tests on strawberries and potatoes using a microorganism modified to retard frost formation on plants. Under TSCA, the Agency approved field tests of a microorganism designed to enhance nitrogen fixation in alfalfa, as well as a microorganism that when grown on a special substance produces a blue color; this ability permits it to be followed into the environment. Some large-scale enclosed fermentations of genetically engineered microorganisms have also been approved. For example, EPA has approved the manufacture of a microorganism which contains a synthetic gene similar to a human liver-cell gene and which will be used to produce a growth factor for culturing cells. In addition, one company has been fined for conducting a test outdoors without our approval.

TODAY'S CHALLENGES

One of the challenges we face is ensuring public confidence in the safe development of biotechnology products. When recombinant DNA research began about ten years ago, some people who lived in towns where such research was conducted voiced their concern that potentially harmful organisms might accidentally escape from the laboratory. Scientists worked to inform people fully about these experiments and now research proceeds as usual in these communities. Today, as such research moves from the laboratory to the field, there continues to be public concern over the intentional release of genetically engineered organisms into the environment.

Enforcing EPA policies on biotechnology is also a challenge. Already, two incidents have occurred in which genetically engineered products were tested outdoors without our approval. While EPA has issued policy statements, such "policies" are not legally enforceable until given the force of regulation. The Agency must develop and issue the necessary regulations as rapidly as possible.

Finally, EPA must keep pace with advances in biotechnology and modify regulations accordingly. So far, the Agency has been asked to approve only a few applications for the testing of genetically engineered microorganisms in the environment. However, in the same way that fifteen years ago we may not have foreseen the development of bacteria to "eat" pollutants or produce insulin, advances in biotechnology may someday require us to rethink our regulatory approach.

EPA'S AGENDA

Through public education, EPA is working to ensure that the public understands the benefits of biotechnology and the system of checks and balances in place to prevent undesirable effects. Our regional offices will play a particularly important role in providing clear information to the press and public on specific biotechnology projects.

The Agency is also working to clarify information for industries affected by EPA policies. In one case of an unapproved release of a genetically altered product, EPA determined that the company made an error in judgment rather than a conscious disregard for our procedures. Nonetheless, we are making it clear that EPA will impose strict penalties when people fail to comply with regulations and are currently developing the regulations needed to implement our policy.

EPA will propose regulations in 1988 that will take into account comments on the 1986 policy statement as well as the deliberations of our Biotechnology Science Advisory Committee. In addition, to prepare for future developments in biotechnology, we are attempting to determine up front the problems that might occur before the technology is widely applied. Thus, EPA will continually evaluate biotechnology regulations and modify their scope when necessary.

Some Developments in Biotechnology

There are many potential uses of genetically altered microorganisms. Some of the most exciting developments in biotechnology are described below.

- ***Tracking the release of genetically altered bacteria***

A microorganism has been developed that can be tracked in the environment to provide information on its behavior. The microbe is formed by inserting two genes from a common bacterium into another microorganism. When these genes are present, the bacteria form blue colonies when exposed to a certain sugar, thereby allowing scientists to follow the survival of the genetically changed microbes both inside and outside the test area. The marking system can be used to mark other microorganisms and should help allay public concerns about potential consequences of releasing such microorganisms in the environment. EPA approved field tests of the bacteria on wheat and soybeans.

- ***Developing bacteria to protect plants against frost***

EPA approved field tests of a bacteria designed to protect strawberry and potato plants from mild frosts. The new bacteria are the same as those that normally colonize these plants, except that they lack a protein that promotes the formation of ice crystals. Scientists expect that these new bacteria can help plants resist frost if the bacteria are applied before the normal bacteria can establish themselves.

- ***Using bacteria to enhance alfalfa yield***

EPA also is examining the design of an experiment to test the effectiveness of genetically engineered bacteria to enhance the yield of alfalfa. This experiment will be conducted in Pepin County, Wisconsin and will use an altered form of the bacteria that occur naturally in the soil. These altered bacteria work together with the roots of legumes (such as alfalfa, soybeans, and peas) to convert nitrogen gas into a form that can be used by the plants.

- ***Using dead bacteria as a pesticide***

An innovative approach to pesticide development involves the insertion into another microbe of the genes that contain the code for a protein toxin. These altered microbes subsequently are grown in cultures to produce large quantities of the toxic protein. When these bacteria are killed, they can be administered as a pesticide. Small-scale field trials currently are underway to determine the effectiveness of these dead bacteria as pesticides.

- ***Using bacteria for toxic waste disposal***

Researchers currently are working on the development of bacteria that can metabolize specific compounds in toxic wastes, such as PCBs, dioxin, and oil spills. For example, an EPA scientist has developed a strain of bacteria that can metabolize several components of crude oil. This development may enable us to control oil spills using only one bacteria rather than several different types. Bacteria also are being developed to extract toxic metals from landfills, mines, and wastewater.

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