THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Legal Compilation

Statutes and Legislative History
Executive Orders
Regulations
Guidelines and Reports

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WILLIAM D. RUCKELSHAUS
Administrator

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FOREWORD

It has been said that America is like a gigantic boiler in that once the fire is lighted, there are no limits to the power it can generate. Environmentally, the fire has been lit.

With a mandate from the President and an aroused public concern over the environment, we are experiencing a new American Revolution, a revolution in our way of life. The era which began with the industrial revolution is over and things will never be quite the same again. We are moving slowly, perhaps even grudgingly at times, but inexorably into an age when social, spiritual and aesthetic values will be prized more than production and consumption. We have reached a point where we must balance civilization and nature through our technology.

The U.S. Environmental Protection Agency, formed by Reorganization Plan No. 3 of 1970, was a major commitment to this new ethic. It exists and acts in the public's name to ensure that due regard is given to the environmental consequences of actions by public and private institutions.

In a large measure, this is a regulatory role, one that encompasses basic, applied, and effects research; setting and enforcing standards; monitoring; and making delicate risk-benefit decisions aimed at creating the kind of world the public desires.

The Agency was not created to harass industry or to act as a shield behind which man could wreak havoc on nature. The greatest disservice the Environmental Protection Agency could do to American industry is to be a poor regulator. The environment would suffer, public trust would diminish, and instead of free enterprise, environmental anarchy would result.

It was once sufficient that the regulatory process produce wise and well-founded courses of action. The public, largely indifferent to regulatory activities, accepted agency actions as being for the "public convenience and necessity." Credibility gaps and cynicism make it essential not only that today's decisions be wise and well-founded but that the public know this to be true. Certitude, not faith, is de rigueur.

In order to participate intelligently in regulatory proceedings, the citizen should have access to the information available to the

agency. EPA's policy is to make the fullest possible disclosure of information, without unjustifiable expense or delay, to any interested party. With this in mind, the EPA Compilation of Legal Authority was produced not only for internal operations of EPA, but as a service to the public, as we strive together to lead the way, through the law, to preserving the earth as a place both habitable by and hospitable to man.

WILLIAM D. RUCKELSHAUS
Administrator
U.S. Environmental Protection Agency

PREFACE

Reorganization Plan No. 3 of 1970 transferred 15 governmental units with their functions and legal authority to create the U.S. Environmental Protection Agency. Since only the major laws were cited in the Plan, the Administrator, William D. Ruckelshaus, requested that a compilation of EPA legal authority be researched and published.

The publication has the primary function of providing a working document for the Agency itself. Secondarily, it will serve as a research tool for the public.

A permanent office in the Office of Legislation has been established to keep the publication updated by supplements.

It is the hope of EPA that this set will assist in the awesome task of developing a better environment.

LANE WARD GENTRY, J.D.
Assistant Director for Field Operations
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ACKNOWLEDGMENT

The idea of producing a compilation of the legal authority of EPA was conceived and commissioned by William D. Ruckelshaus, Administrator of EPA. The production of this compilation involved the cooperation and effort of numerous sources, both within and outside the Agency. The departmental libraries at Justice and Interior were used extensively; therefore we express our appreciation to Marvin P. Hogan, Librarian, Department of Justice; Arley E. Long, Land & Natural Resources Division Librarian, Department of Justice; Frederic E. Murray, Assistant Director, Library Services, Department of the Interior.

For exceptional assistance and cooperation, my gratitude to: Gary Baise, formerly Assistant to the Administrator, currently Director, Office of Legislation, who first began with me on this project; A. James Barnes, Assistant to the Administrator; K. Kirke Harper, Jr., Special Assistant for Executive Communications; John Dezzutti, Administrative Assistant, Office of Executive Communications; Roland O. Sorensen, Chief, Printing Management Branch, and Jacqueline Gouge and Thomas Green, Printing Management Staff; Ruth Simpkins, Janis Collier, Wm. Lee Rawls, Peter J. McKenna, James G. Chandler, Jeffrey D. Light, Randy Mott, Thomas H. Rawls, John D. Whittaker, John M. Himmelberg, and Richard A. Yarmey, a beautiful staff who gave unlimited effort; and to many others behind the scenes who rendered varied assistance.

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INSTRUCTIONS

The goal of this text is to create a useful compilation of the legal authority under which the U.S. Environmental Protection Agency operates. These documents are for the general use of personnel of the EPA in assisting them in attaining the purposes set out by the President in creating the Agency. This work is not intended and should not be used for legal citations or any use other than as reference of a general nature. The author disclaims all responsibility for liabilities growing out of the use of these materials contrary to their intended purpose. Moreover, it should be noted that portions of the Congressional Record from the 92nd Congress were extracted from the "unofficial" daily version and are subject to subsequent modification.

EPA Legal Compilation consists of the Statutes with their legislative history, Executive Orders, Regulations, Guidelines and Reports. To facilitate the usefulness of this composite, the Legal Compilation is divided into the eight following chapters:

A. General
B. Air
C. Water
D. Solid Waste
E. Pesticides
F. Radiation
G. Noise
H. International

GENERAL

The chapter labeled "General" and color coded red contains the legal authority of the Agency that applies to more than one area of pollution, such as the Reorganization Plan No. 3 of 1970, E.O. 11514, Protection and Enhancement of Environmental Quality, Regulation on Certification of Facilities, Interim Guidelines by CEQ, and Selected Reports. Acts that appear in General are found in full text with their legislative history. When the same Act appears under a particular area of pollution, a cross reference is made back to General for the text.

SUBCHAPTERS

Statutes and Legislative History

For convenience, the Statutes are listed throughout the Compilation by a one-point system, i.e., 1.1, 1.2, 1.3, etc., and Legislative

History begins wherever a letter follows the one-point system. Thusly, any 1.1a, 1.1b, 1.2a, etc., denotes the public laws comprising the 1.1, 1.2 statute. Each public law is followed by its legislative history. The legislative history in each case consists of the House Report, Senate Report, Conference Report (where applicable), the Congressional Record beginning with the time the bill was reported from committee.

Example:

1.4 Amortization of Pollution Control Facilities, as amended, 26 U.S.C. §169 (1969).

1.4a Amortization of Pollution Control Facilities, December 30, 1969, P.L. 91–172, §704, 83 Stat. 667.

(1) House Committee on Ways and Means, H.R. REP. No. 91–413 (Part I), 91st Cong., 1st Sess. (1969).

(2) House Committee on Ways and Means, H.R. REP. No. 91–413 (Part II), 91st Cong., 1st Sess. (1969).

(3) Senate Committee on Finance, S. REP. No. 91–552, 91st Cong., 1st Sess. (1969).

(4) Committee of Conference, H.R. REP. No. 91–782, 91st Cong., 1st Sess. (1969).

(5) Congressional Record, Vol. 115 (1969):

(a) Aug. 7: Debated and passed House, pp. 22746, 22774–22775;

(b) Nov. 24, Dec. 5, 8, 9: Debated and passed Senate, pp. 35486, 38321–37322, 37631–37633, 37884–37888;

(c) Dec. 22: Senate agrees to conference report, p. 40718;*

(d) Dec. 22: House debates and agrees to conference report, pp. 40820, 40900.

This example not only demonstrates the pattern followed for legislative history, but indicates the procedure where only one section of a P.L. appears. You will note that the Congressional Record cited pages are only those pages dealing with the discussion and/or action taken pertinent to the section of law applicable to EPA. In the event there is no discussion of the pertinent section, only action or passage, then the asterisk (*) is used to so indicate, and no text is reprinted in the Compilation. In regard to the

situation where only one section of a public law is applicable, then only the parts of the report dealing with same are printed in the Compilation.

Secondary Statutes

Many statutes make reference to other laws and rather than have this manual serve only for major statutes, these secondary statutes have been included where practical. These secondary statutes are indicated in the table of contents to each chapter by a bracketed cite to the particular section of the major Act which made the reference.

Citations

The United States Code, being the official citation, is used throughout the Statute section of the compilation. In four Statutes, a parallel table to the Statutes at Large is provided for your convenience.

TABLE OF STATUTORY SOURCE

	Statutes	Source
1.1	Reorganization Plan No. 3 of 1970, 35 Fed. Reg. 15263.	EPA's originating act.
1.2	The National Environmental Policy Act of 1969, 42 U.S.C. §§4332(2)(c), 4344(5).	In §4332(2)(c) a mandate was made to all Federal agencies as to environmental impact statements. EPA functioning as appropriate agency, and §4344 cited in Reorganization Plan No. 3 of 1970 as a direct transfer to EPA.
1.3	Environmental Quality Improvement Act of 1970, 42 U.S.C. §4371 *et seq.* (1970).	CEQ's originating act.
1.4	Amortization of Pollution Control Facilities, as amended, 26 U.S.C. §169(d). (1969).	Direct reference in sections cited to Clean Air Act, Fed. Water Pollution Control Act which were transferred to EPA by Reorg. Plan No. 3 of 1970. Also the certifying authority was transferred to EPA through the Reorg. Plan No. 3 of 1970.
1.5	Department of Transportation Act, as amended, 49 U.S.C. §1653(f) (1968).	Reorg. Plan No. 3 of 1970 transferred Clean Air Act and the functions of the Secty of Interior pertaining to same to EPA and its Administrator. The Clean Air Act at §1857f—10(b) references 1.5 and requires consultation from the Administrator.

	Statutes	Source
1.6	Federal Aid Highway Act, as amended, 23 U.S.C. §109(h), (i), (j) (1970).	Direct reference made to EPA in sections cited.
1.7	Airport and Airway Development Act, 49 U.S.C. §§1712(f), 1716(c)(4), (e) (1970).	Direct references made to appropriate agency for air, water and noise pollution which is EPA under Reorg. Plan No. 3 of 1970.
1.8	Disaster Relief Act of 1970, 42 U.S.C. §4401 *et seq.* (1970).	The Water Quality Administration was transferred to EPA by Reorg. Plan No. 3 of 1970 and together with E.O. 11490, §§703(3), 11102(1), 11103(2) EPA assumes responsibility.
1.9	Interest on Certain Government Obligations, as amended, 26 U.S.C. §103 (1969).	§103(c)(4)(E) & (F) of the Act provides tax relief on industrial development bonds for sewage or solid waste disposal facilities and air or water pollution control facilities.
1.10	Uniform Relocation Assistance and Real Property Acquisition Polices Act of 1970, 42 U.S.C. §4601 *et seq.* (1970).	Act requires Federal and federally assisted projects and programs to deal uniformly and equitably with persons whose property was taken. EPA promulgated regulation at 40 C.F.R. §§4.1—4.263.
1.11	Departmental Regulations, as revised, 5 U.S.C. §301 (1966).	Bases of EPA regulation 40 C.F.R. §§3.735—101 —3.735—107.
1.12	Public Health Service Act, as amended, 42 U.S.C. §§203, 215, 242, 242b, c, d, f, i, j, 243, 244, 244a, 245, 246, 247, 264 (1970).	Referred to in Clean Air Act., basis for authority in Water, Pesticides, and Radiation functions transferred in Reorg. Plan No. 3 of 1970.
1.13	Davis-Bacon Act, as amended, 40 U.S. C. §276a–276a–5 (1964).	Referenced from Clean Air Act, Fed. Water Pollution Control Act, Solid Waste Disposal Act—all of which were transferred to EPA in Reorg. Plan No. 3 of 1970.
1.14	Public Contracts, Advertisements for Proposals for Purchases and Contracts for Supplies or Services for Government Departments; Application to Government Sales and Contracts to sell and to Government Corporations, as amended, 41 U.S.C. §5 (1958).	Referred to in Clean Air Act, Federal Water Pollution Control Act, and Public Health Service Act—all of which transferred to EPA in Reorg. Plan No. 3 of 1970.
1.15	Per Diem, Travel and Transportation Expenses; Experts and Consultants; Individuals Serving Without Pay, as amended, 5 U.S.C. §5703 (1969).	Referred to in Clean Air Act, Federal Water Pollution Control Act—all of which were transferred to EPA in Reorg. Plan No. 3 of 1970.

Statutes		Source
1.16	Disclosure of Confidential Information Generally, as amended, 18 U.S.C. §1905.	Referred to in Clean Air Act, and FWPCA which were transferred to EPA both being transferred by the Reorg. Plan No. 3 of 1970.
1.17	Appropriation Bills	Beginning with the Agricultural-Environmental and Consumer Protection Appropriation Act of 1971 each appropriation bill for EPA will appear.

EXECUTIVE ORDERS

The Executive Orders are listed by a two-point system (2.1, 2.2, etc.). Executive Orders found in General are ones applying to more than one area of the pollution chapters.

REGULATIONS

The Regulations are noted by a three-point system (3.1, 3.2, etc.). Included in the Regulations are those not only promulgated by the Environmental Protection Agency, but those under which the Agency has direct contact.

GUIDELINES AND REPORTS

This subchapter is noted by a four-point system (4.1, 4.2, etc.). In this subchapter is found the statutorily required reports of EPA, published guidelines of EPA, selected reports other than EPA's and inter-departmental agreements of note.

UPDATING

Periodically, a supplement will be sent to the interagency distribution and made available through the U.S. Government Printing Office in order to provide an accurate working set of EPA Legal Compilation.

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Preface

WHEN President Nixon, as his first official act of the new decade, signed the National Environmental Policy Act, he declared that improving the quality of the environment is a major goal for the Nation and that, "unless we move on it now, we will not have an opportunity to do it later."

The new Act, which established the Council on Environmental Quality in the Executive Office of the President, included the provision that the President shall transmit to the Congress annually an Environmental Quality Report setting forth the status and condition of the Nation's environment. According to section 201 of the act (Public Law 91–190), the report shall trace current environmental trends and the adequacy of natural resources to fulfill human and economic needs. It shall review programs and activities of Federal, State, and local governments and of nongovernment entities or individuals, detailing the effects on the environment. And it shall suggest ways of remedying the deficiencies of existing programs and activities.

With less than one-quarter of the year available in which to prepare this first annual report, and with insufficient environmental quality indicators or systems by which to monitor the environment with any degree of accuracy, the Council has undertaken to bring together a description of environmental problems and issues facing the Nation.

While this report is wide ranging, the Council realizes that it is incomplete and uneven in some respects. Most important, the lack of

measurement tools prevents an assessment at this time of the status and trends of the major environmental classes of the Nation. The Council has been able to give little or no detailed attention to subject areas such as the activities of State and local governments and of industry and has had an inadequate opportunity to analyze and report on areas such as the supply of natural resources. The Council expects to correct such major deficiencies in subsequent reports.

In preparing this report, the Council has also kept in mind the findings of Congress in the Environmental Quality Improvement Act of 1970 (Public Law 91–224): "that man has caused changes in the environment; that many of these changes may affect the relationship between man and his environment; and that population increases and urban concentration contribute directly to pollution and the degradation of our environment." That act authorized the establishment of an Office of Environmental Quality which provides additional professional and administrative staff for and is meshed with the Council on Environmental Quality, so that the President has one advisory voice on environmental policy. The added personnel assist in preparing the annual report, assessing all other Federal programs that affect the environment, and implementing other requirements of Public Laws 91–190 and 91–224.

Much can be done now to enhance environmental quality, and this first annual report includes a number of specific suggestions for action. For the more distant future, however, environmental improvement will depend increasingly on knowledge yet to be obtained through research and measurement. Also needed will be refinements in predictions, setting of priorities, development of comprehensive policies and strategies, and strengthening of institutions at all levels of government. Responsibility for enhancing the environment cannot be thrust on any one level of government or even on government alone. Every citizen shares in it. Federal leadership, however, will necessarily be a major influence on the effectiveness of the overall national environmental effort.

The opening chapter of the report deals with the growing awareness and understanding by the American people of the nature of the threat to the environment and the interrelationship of environmental problems. Pollution is one of the most obvious dangers. But the problems are much broader. They encompass control of land use, the expansion of population, and waste of resources. The causes of many of our environmental problems rest with the failure of our price

structure to take full account of environmental degradation, our values and our urge for greater mobility.

The effects, sources, and costs of various forms of pollution, and Federal, State, and local antipollution programs are then described. These chapters deal with pollution of air and water and pollution from solid wastes, pesticides, radiation, and noise. The pressures on the environment are then discussed in a chapter on population, economic growth, and resources. In the next chapter, the problem of land use is approached through analysis of its components—urban, suburban, rural, coastal, and natural regions, and the Federal programs that affect them. The chapter on international cooperation discusses environmental problems which do not stop at national frontiers, and the tools for international action. The growing involvement of citizens in environmental affairs, as individuals and through organizations, is followed by a review of the progress in environmental education. The concluding chapter discusses the need for better, stronger institutions, improved measurement of the environment, and the need for comprehensive policies and strategies. Like any first step, this first annual report is only a beginning.

I

Understanding Environmental Problems

HISTORIANS MAY one day call 1970 the year of the environment. They may not be able to say that 1970 actually marked a significant change for the better in the quality of life; in the polluting and the fouling of the land, the water, and the air; or in health, working conditions, and recreational opportunity. Indeed, they are almost certain to see evidence of worsening environmental conditions in many parts of the country.

Yet 1970 marks the beginning of a new emphasis on the environment—a turning point, a year when the quality of life has become more than a phrase; environment and pollution have become everyday words; and ecology has become almost a religion to some of the young. Environmental problems, standing for many years on the threshold of national prominence, are now at the center of nationwide concern. Action to improve the environment has been launched by government at all levels. And private groups, industry, and individuals have joined the attack.

No one can say for sure just how or why the environment burst into national prominence in 1970. Certainly national concern had been mounting for a long time, and the tempo has increased greatly in the last decade.

Early environmentalists—Henry David Thoreau, George Perkins Marsh, John Muir, Gifford Pinchot, Theodore Roosevelt, Aldo Leopold—and a legion of dedicated citizens contributed to the rise in awareness. In its early days, the conservation movement aimed primarily at stemming the exploitation of natural resources and preserving wildlife and important natural areas. By the 1950's, Federal air and water pollution laws had been enacted, and the pace of environmental legislation quickened dramatically in the decade of the 1960's. Now the conservation movement has broadened to embrace concern for the totality of man's environment, focusing on pollution, population, ecology, and the urban environment.

The public has begun to realize the interrelationship of all living things—including man—with the environment. The Santa Barbara oil spill in early 1969 showed an entire nation how one accident could temporarily blight a large area. Since then, each environmental issue—the jetport project near Everglades National Park, the proposed pipeline across the Alaskan wilderness, the worsening blight of Lake Erie, the polluted beaches off New York and other cities, smog in mile-high Denver, lead in gasoline, phosphates in detergents, and DDT—flashed the sign to Americans that the problems are everywhere and affect everyone. Millions of citizens have come to realize that the interdependent web of life—man, animals, plants, earth, air, water, and sunlight—touches everyone.

A deteriorating environment has awakened a lively curiosity in Americans about exactly what is meant by an ecosystem, a biome, or the biosphere. Citizens who are now aware of environmental problems want to know the full extent of the environmental crisis and the nature of the factors that have contributed to it. They are anxious to learn what can be done to correct the mistakes that have led to the current condition of the environment. This report attempts to answer some of these questions.

ECOLOGY AND CHANGE

Ecology is the science of the intricate web of relationships between living organisms and their living and nonliving surroundings. These interdependent living and nonliving parts make up *ecosystems.* Forests, lakes, and estuaries are examples. Larger ecosystems or combinations of ecosystems, which occur in similar climates and share a similar character and arrangement of vegetation, are *biomes.* The

Arctic tundra, prairie grasslands, and the desert are examples. The earth, its surrounding envelope of life-giving water and air, and all its living things comprise the *biosphere.* Finally, man's total *environmental system* includes not only the biosphere but also his interactions with his natural and manmade surroundings.

Changes in ecosystems occur continuously. Myriad interactions take place at every moment of the day as plants and animals respond to variations in their surroundings and to each other. Evolution has produced for each species, including man, a genetic composition that limits how far that species can go in adjusting to sudden changes in its surroundings. But within these limits the several thousand species in an ecosystem, or for that matter, the millions in the biosphere, continuously adjust to outside stimuli. Since interactions are so numerous, they form long chains of reactions. Thus small changes in one part of an ecosystem are likely to be felt and compensated for eventually throughout the system.

Dramatic examples of change can be seen where man has altered the course of nature. It is vividly evident in his well-intentioned but poorly thought out tampering with river and lake ecosystems. The Aswan Dam was primarily built to generate electric power. It produced power, but it also reduced the fish population in the Mediterranean, increased the numbers of disease-bearing aquatic snails, and markedly lowered the fertility of the Nile Valley.

In the United States, the St. Lawrence Seaway has contributed significantly to the economic growth of the Great Lakes region. Yet it has done so at a high and largely unforeseen cost to the environment. The completion of the Welland Canal let the predatory sea lamprey into the Great Lakes. Trout, which had been the backbone of the lakes' fishing industry, suffered greatly from the lamprey invasion. By the mid-1950's the trout and some other large, commercial predatory fish were nearly extinct. And with their near extinction, smaller fish, especially the alewife, normally kept under control by these predators, proliferated. The aggressive alewife dominated the food supply and greatly reduced the numbers of small remaining native fish, such as the lake herring. The alewife became so numerous, in fact, that on occasion great numbers died and the dead fish along the shore caused a major public nuisance.

Man attempted to restore the ecological balance by instituting sea lamprey control in the 1950's and 1960's and by stocking the lakes with coho salmon beginning in 1965—to replace the lost native predatory fish. Feeding on the abundant alewife, the salmon multiplied

rapidly and by 1969 had become important both as a commercial and sport resource. Some of the salmon, however, were contaminated by excessive concentrations of DDT and were taken off the commercial market.

The lesson is not that such activities as the St. Lawrence Seaway must be halted, but that the consequences of construction must be carefully studied in advance of construction. Planners and managers must begin to appreciate the enormous interrelated complexity of environmental systems, weigh the tradeoffs of potential environmental harm against the benefits of construction, look at alternatives, and incorporate environmental safeguards into the basic design of new developments.

The stability of a particular ecosystem depends on its diversity The more interdependencies in an ecosystem, the greater the chances that it will be able to compensate for changes imposed upon it. A complex tropical forest with a rich mosaic of interdependencies possesses much more stability than the limited plant and animal life found on the Arctic tundra, where instability triggers frequent, violent fluctuations in some animal populations, such as lemmings and foxes. The least stable systems are the single crops—called monocultures—created by man. A cornfield or lawn has little natural stability. If they are not constantly and carefully cultivated, they will not remain cornfields or lawns but will soon be overgrown with a wide variety of hardier plants constituting a more stable ecosystem.

The chemical elements that make up living systems also depend on complex, diverse sources to prevent cyclic shortages or oversupply. The oxygen cycle, which is crucial to survival, depends upon a vast variety of green plants, notably plankton in the ocean. Similar diversity is essential for the continued functioning of the cycle by which atmospheric nitrogen is made available to allow life to exist. This cycle depends on a wide variety of organisms, including soil bacteria and fungi, which are often destroyed by persistent pesticides in the soil.

TYPES OF PROBLEMS

Pollution

Although pollution may be the most prominent and immediately pressing environmental concern, it is only one facet of the many-sided environmental problem. It is a highly visible, sometimes danger-

ous sign of environmental deterioration. Pollution occurs when materials accumulate where they are not wanted. Overburdened natural processes cannot quickly adjust to the heavy load of materials which man, or sometimes nature, adds to them. Pollution threatens natural systems, human health, and esthetic sensibilities; it often represents valuable resources out of place. DDT, for instance, is a valuable weapon in combating malaria. But DDT, when out of place—for example in lakes and streams—concentrates in fish, other wildlife, and the smaller living things on which they depend.

Historically, man has assumed that the land, water, and air around him would absorb his waste products. The ocean, the atmosphere, and even the earth were viewed as receptacles of infinite capacity. It is clear now that man may be exceeding nature's capacity to assimilate his wastes.

Most pollutants eventually decompose and diffuse throughout the environment. When organic substances are discarded, they are attacked by bacteria and decompose through oxidation. They simply rot. However, some synthetic products of our advanced technology resist natural decomposition. Plastics, some cans and bottles, and various persistent pesticides fall into this category. Many of these materials are toxic, posing a serious health danger.

Some pollutants, which may be thinly spread throughout the environment, tend to reconcentrate in natural food chains. Pesticides tend to diffuse in ocean water. The physical effects of 1 pound of a well-mixed pesticide in 10 billion pounds of water may seem negligible. But many sea animals filter out particular kinds of chemical compounds, including pesticides, and collect them in certain parts of their bodies at concentrations far higher than in the water in which they live. Algae may concentrate some component of a pesticide which is then concentrated further in the fish that eat the algae. In turn, still further concentrations may occur in the birds that eat the fish. When the accumulation of the toxic substances reaches a high enough level, it may kill the organism directly or interfere with its reproduction. A well-known example of such accumulation occurred in 1957 at Clear Lake, Calif. DDD (similar to DDT) was diffused through the water in a concentration of only 0.02 parts per million. The lake's plant and animal organisms, however, had stored residues of DDD at 5 parts per million—250 times greater than the concentration in the water itself. Fish, which consumed large quantities of these small organisms, accumulated DDD concentrations in their body tissues of over 2,000 parts

per million. And there was heavy mortality among grebes which fed on the fish.

Radioactive fallout from the air also concentrates through food chains. Arctic lichens do not take in food through their roots but instead absorb their mineral nutrition from dust in the air. Radioactive fallout tends therefore to collect in the lichens and is further concentrated by grazing caribou, which eat huge quantities of lichen. Caribou meat is a major part of the Eskimo's diet. Although reconcentration of radioactive fallout at low levels has not been proved damaging to health, the effects of long-term, low-level exposure to radioactive pollutants are still not well known.

Water pollution is a problem throughout the country, but is most acute in densely settled or industrial sections. Organic wastes from municipalities and industries enter rivers, where they are attacked and broken down by organisms in the water. But in the process, oxygen in the river is used up. Nutrients from cities, industries, and farms nourish algae, which also use up oxygen when they die and decompose. And when oxygen is taken from the water, the river "dies." The oxygen is gone, the game fish disappear, plant growth rots, and the stench of decay reaches for miles.

Air pollution is now a problem in all parts of the United States and in all industrialized nations. It has been well known for some time to Los Angeles residents and visitors who have long felt the effect of highly visible and irritating smog from automobile exhaust. Now Los Angeles's local problem is becoming a regional problem, because noxious air pollution generated in the Los Angeles Basin has spread beyond the metropolitan area. This same problem, which seemed unique to Los Angeles in the 1950's is today common to major cities in the United States and abroad. Smog is but one of the many types of air pollution that plague the United States, especially its cities.

Land Use

Urban land misuse is one of today's most severe environmental problems. The character of our urban areas changes rapidly. Old buildings and neighborhoods are razed and replaced by structures designed with little or no eye for their fitness to the community's needs. A jumble of suburban developments sprawls over the landscape. Furthermore, lives and property are endangered when real estate developments are built on flood plains or carved out along unstable slopes.

Unlimited access to wilderness areas may transform such areas into simply another extension of our urban, industrialized civilization. The unending summer flow of automobiles into Yosemite National Park has changed one of nature's great wilderness areas into a crowded gathering place of lessened value to its visitors. The worldwide boom in tourism, teamed with rapid and cheap transportation, threatens the very values upon which tourist attraction is based.

The proposed jetport west of Miami and north of the Everglades National Park raised a dramatic land use problem. The jetport, together with associated transportation corridors, imperiled a unique ecological preserve. Planners for the jetport had considered density of population, regional transportation needs, and a host of other related variables. But they gave slight consideration to the wildlife and recreational resources of the Everglades. The jetport could have spawned a booming residential, commercial, and industrial complex which would have diminished water quality and without question drastically altered the natural water cycle of Southern Florida. This in turn would have endangered all aquatic species and wildlife within the park and beyond.

Natural Resources

Natural resource depletion is a particular environmental concern to a highly technological society which depends upon resources for energy, building materials, and recreation. And the methods of exploiting resources often create problems that are greater than the value of the resources themselves.

A classic case was the Federal Government's decision to permit oil drilling in California's Santa Barbara Channel. There, primary value was placed on development of the oil resources. The commercial, recreational, esthetic, and ecological values, which also are important to the residents of Santa Barbara and to the Nation, were largely ignored. The President recently proposed to the Congress that the Federal Government cancel the 20 Federal leases seaward from the State sanctuary extending 16 miles along the Santa Barbara Channel. This is where the blowout erupted in January 1969, spreading a coat of oil across hundreds of square miles including the sanctuary. This action illustrates a commitment to use offshore lands in a balanced and responsible way.

CAUSES OF PROBLEMS

Environmental problems seldom stem from simple causes. Rather they usually rise out of the interplay of many contributing circumstances.

Misplaced Economic Incentives

Many individuals cite selfish profit seekers for environmental degradation, rather than laying much of the blame—where it belongs—to misplaced incentives in the economic system. Progress in environmental problems is impossible without a clearer understanding of how the economic system works in the environment and what alternatives are available to take away the many roadblocks to environmental quality.

Our price system fails to take into account the environmental damage that the polluter inflicts on others. Economists call these damages—which are very real—"external social costs." They reflect the ability of one entity, e.g., a company, to use water or air as a free resource for waste disposal, while others pay the cost in contaminated air or water. If there were a way to make the price structure shoulder these external costs—taxing the firm for the amount of discharge, for instance—then the price for the goods and services produced would reflect these costs. Failing this, goods whose production spawns pollution are greatly underpriced because the purchaser does not pay for pollution abatement that would prevent environmental damage. Not only does this failure encourage pollution but it warps the price structure. A price structure that took environmental degradation into account would cause a shift in prices, hence a shift in consumer preferences and, to some extent, would discourage buying pollution-producing products.

Another type of misplaced incentive lies imbedded in the tax structure. The property tax, for example, encourages architectural design that leans more to rapid amortization than to quality. It may also encourage poor land use because of the need for communities to favor industrial development and discourage property uses, such as high-density housing, which cost more in public services than they produce in property taxes. Other taxes encourage land speculation and the leapfrog development that has become the trademark of the urban-rural fringe.

Values

American have placed a high priority on convenience and consumer goods. In recent times they have learned to value the convenience and comfort of modern housing, transportation, communication, and recreation above clean earth, sky, and water. A majority, like a prodigal son, have been willing to consume vast amounts of resources and energy, failing to understand how their way of life may choke off open space, forests, clean air, and clear water. It is only recently that the public has become conscious of some of the conflicts between convenience and a deteriorating environment.

In the early days of westward expansion, a period in which many national values were shaped, choices did not seem necessary. The forests, minerals, rivers, lakes, fish, and wildlife of the continent seemed inexhaustible. Today choices based on values must be made at every turn. Values can be gauged to some degree by the costs that the Nation is collectively willing to incur to protect them. Some of the costs of environmental improvements can be paid with local, State, and Federal tax money. But paying taxes and falling back on government programs is not enough. People may ultimately have to forgo some conveniences and pay higher prices for some goods and services.

Population

Americans are just beginning to measure the magnitude of the impact of population and its distribution on their environment. The concept that population pressures are a threat to the Nation's well-being and to its environment is difficult to grasp in a country which, during its formative decades, had an ever receding western frontier. That frontier ended at the Pacific many years ago. And it is at the western end of the frontier that some of the most serious problems of population growth emerge most clearly.

California continues to lure large numbers of Americans from all over the country, in large part because of its climate and its beauty. But as the people come, the pressures of population mount. Smog, sprawl, erosion, loss of beaches, the scarring of beautiful areas, and the congestion of endless miles of freeways have caused thoughtful Californians to consider stemming the continued uncontrolled development of their State. When the Governor's Conference on California's Changing Environment met last fall, it agreed that there was

now a need "to deemphasize growth as a social goal and, rather, to encourage development within an ideal and quality environment."

The magnitude of the press of population, although significant, must be put in perspective. This is a vast country, and its potential for assimilating population is impressive, although there is disagreement over what level of population would be optimum. Some authorities believe that the optimum level has already been passed, others that it has not yet been reached. More troublesome, population control strikes at deeply held religious values and at the preference of some Americans for large families.

Population density outside metropolitan areas is not high. There is a desire—indeed an almost inevitable compulsion—to concentrate population in urban areas—primarily in the coastal and Great Lakes regions. If the trend continues, 70 to 80 percent of all Americans will be concentrated in five large urban complexes by the year 2000. The pressures that cause environmental problems that the Nation now confronts—water and air pollution and inefficient land use—will only increase.

Population growth threatens the Nation's store of natural resources. Currently the United States, with about 6 percent of the world's population, uses more than 40 percent of the world's scarce or nonreplaceable resources and a like ratio of its energy output. Assuming a fixed or nearly fixed resource base, continued population growth embodies profound implications for the United States and for the world.

Technology

The major environmental problems of today began with the Industrial Revolution. Belching smoke from factory stacks and the dumping of raw industrial wastes into rivers became the readily identified, but generally ignored hallmarks of "progress" and production. They are no longer ignored, but the extraordinary growth of the American economy continues to outpace the efforts to deal with its unwanted byproducts.

The growth of the economy has been marked not just by greater production but also by an accelerating pace of technological innovation. This innovation, although it has provided new solutions to environmental problems, has also created a vast range of new problems. New chemicals, new uses for metals, new means of transportation, novel consumer goods, new medical techniques, and new industrial

processes all represent potential hazards to man and his surroundings. The pace of technological innovation has exceeded our scientific and regulatory ability to control its injurious side effects. The environmental problems of the future will increasingly spring from the wonders of 20th-century technology. In the future, technology assessment must be used to understand the direct and secondary impacts of technological innovation.

Mobility

The extraordinary, growing mobility of the American people constitutes another profound threat to the environment—in at least three major ways. The physical movement of people crowds in on metropolitan centers and into recreation areas, parks, and wild areas. Mobility permits people to live long distances from their places of employment, stimulating ever greater urban and suburban sprawl. The machines of this mobility—particularly automobiles and aircraft—themselves generate noise, air pollution, highways, and airports—all in their way affecting the environment.

The automobile freed Americans from the central city and launched the flight to the suburbs. As a consequence, thousands of acres of undeveloped land fall prey each year to the bulldozer. More single-family, detached homes shoulder out the open spaces. Many of these developments are drab in design and wasteful of land. They denude the metropolitan area of trees and thus affect climate; they cause erosion, muddy rivers, and increase the cost of public services.

Limitations of Government Units

Most government agencies charged with solving environmental problems were not originally designed to deal with the severe tasks they now face. And their focus is often too narrow to cope with the broad environmental problems that cut across many jurisdictions. Agencies dealing with water pollution, for example, typically do not have jurisdiction over the geographic problem area—the watersheds. Control is split instead among sewerage districts, municipalities, and a multitude of other local institutions. To attack water pollution effectively may require establishing new river basin authorities or statewide basin agencies with the power to construct, operate, and assess for treatment facilities.

Public decisions, like private decisions, suffer from the inadequate balancing of short-run economic choices against long-term environmental protection. There is a nearly irresistible pressure on local governments to develop land in order to increase jobs and extend the tax base—even if the land is valuable open space or an irreplaceable marsh. The problem is amplified by the proliferation of agencies, all competing narrowly, without consideration of broader and often common goals. The development that generates economic benefits in a town upstream may create pollution and loss of recreation in a town downstream.

Information Gap

Sometimes people persist in actions which cause environmental damage because they do not know that they are causing it. Construction of dams, extensive paving of land surfaces, and filling of estuaries for industrial development have in many cases been carried out with incomplete or wrong information about the extent of the impact on the environment. Furthermore, change in the environment has often been slow and exceedingly difficult to detect, even though piecemeal changes may eventually cause irreversible harm. Widespread use of certain types of pesticides, mercury pollution, and the use of dangerous substances such as asbestos occurred without advance recognition of their potential for harm.

EFFECTS OF PROBLEMS

Health

The impact of environmental deterioration on health is subtle, often becoming apparent only after the lapse of many years. The speed of change in a rapidly altering technological society and the complex causes of many environmental health problems produce major uncertainty about what environmental changes do to human well-being. Nevertheless, it is clear that today's environment has a large and adverse impact on the physical and emotional health of an increasing number of Americans.

Air pollution has been studied closely over the past 10 years, and its tie to emphysema and chronic bronchitis is becoming more evident.

These two diseases are major causes of chronic disability, lost workdays, and mortality in industrial nations. Estimates of deaths attributable to bronchitis and emphysema are beset with doubts about cause; nevertheless, physicians have traced 18,000 more deaths in the United States to these two causes in 1966 than 10 years earlier—an increase of two and one-half times. The increase of sulfur oxides, photochemical oxidants, and carbon monoxide in the air is related to hospital admission rates and length of stay for respiratory and circulatory cases.

Whether the accumulation of radioactive fallout in body tissues will eventually produce casualties cannot be predicted now, but close surveillance is needed. Nor has a direct correlation between factors in the urban environment and major malignancies of the digestive, respiratory, and urinary tracts been established. But the frequency of these diseases is much higher in cities than in nonurban environments.

Esthetics

The impact of the destruction of the environment on man's perceptions and aspirations cannot be measured. Yet today citizens are seeking better environments, not only to escape pollution and deterioration but to find their place in the larger community of life. It is clear that few prefer crowding, noise, fumes, and foul water to esthetically pleasing surroundings. Objections today to offensive sights, odors, and sounds are more widespread than ever. And these mounting objections are an important indicator of what Americans are unwilling to let happen to the world about them.

Economic Costs

The economic costs of pollution are massive—billions of dollars annually. Paint deteriorates faster, cleaning bills are higher, and air filtering systems become necessary. Direct costs to city dwellers can be measured in additional household maintenance, cleaning, and medical bills. Air pollution causes the housewife to do her laundry more often. The farmer's crop yield is reduced or destroyed. Water pollution prevents swimming, boating, fishing, and other recreational and commercial activities highly valued in today's world.

Natural Systems

Vast natural systems may be severely damaged by the improvident intervention of man. The great Dust Bowl of the 1930's was born in the overuse of land resources. Many estuarine areas have been altered and their ecology permanently changed. On a global scale, air pollution could trigger large-scale climatic changes. Man may also be changing the forces in the atmosphere through deforestation, urban construction, and the spilling of oil on ocean waters.

SOLVING PROBLEMS

In the short run, much can be done to reverse the deadly downward spiral in environmental quality. Citizens, industries, and all levels of government have already begun to act in ways which will improve environmental quality. The President's February 10 Message on the Environment spelled out some specific steps which can be taken now.

It is clear, however, that long-range environmental improvement must take into account the complex interactions of environmental processes. In the future, the effects of man's actions on complete ecosystems must be considered if environmental problems are to be solved.

Efforts to solve the problems in the past have merely tried—not very successfully—to hold the line against pollution and exploitation. Each environmental problem was treated in an ad hoc fashion, while the strong, lasting interactions between various parts of the problem were neglected. Even today most environmental problems are dealt with temporarily, incompletely, and often only after they have become critical.

The isolated response is symptomatic of the environmental crisis. Americans in the past have not adequately used existing institutions to organize knowledge about the environment and to translate it into policy and action. The environment cuts across established institutions and disciplines. Men are beginning to recognize this and to contemplate new institutions. And that is a hopeful sign.

II

Federal Organization for Environmental Quality

THE FEDERAL GOVERNMENT'S pace in tackling environmental deterioration has greatly accelerated. The problems of pollution, waste, and degradation, haphazardly handled, have pressed in on daily living and forced Washington to become more deeply involved and better organized. This year President Nixon has proposed legislation on a wide range of environmental concerns. The Government has to reorganize for a comprehensive attack.

How the Federal Government is organized can strongly influence its strategies, programs, and effectiveness in coping with the environment.

In recent years, Federal institutions responsible for environmental quality have been handicapped by a managerial organization poorly suited to the task. The Federal Government has needed improvement in three environmental areas.

First, it has needed to sharpen both the development of environmental policy and the analysis of environmental trends and programs. Many problems of the environment cut across several Federal agencies, but no one agency—and until recently no special staff in the Executive Office of the President—has had an overview function.

Second, environmental concerns are often slighted when agencies pursue their primary missions with inadequate attention to side effects. For example, the agencies which construct or fund the construction of highways, dams, and airports are chiefly concerned with costs and engineering feasibility. Such quantitative factors usually overshadow adequate consideration of a project's environmental impact.

Finally, as environmental control programs grow in scope and authority, effective management grows more difficult. Different agencies carrying out like functions, such as standard setting, research, monitoring, and regulation, have operated independently of one another.

FEDERAL POLICYMAKING

Establishment of the Council on Environmental Quality

In May 1969, President Nixon established the first organizational entity charged with taking a broad overview of environmental problems—the Cabinet-level Environmental Quality Council, chaired by the President. It was still felt, however, that the Executive Office needed an independent organization concerned exclusively with environmental problems and yet not made up of the many existing agencies. Such an organization would be free to look at environmental problems in new ways and to propose new approaches for dealing with them. With broad bipartisan backing, the Congress enacted two related measures: the National Environmental Policy Act of 1969 and the Environmental Quality Improvement Act of 1970. The Cabinet-level Environmental Quality Council was abolished by Reorganization Plan No. 2 of 1970, which established a Domestic Council in the Executive Office of the President.

On January 1, 1970, President Nixon signed the National Environmental Policy Act (Public Law 91–190). That act established a national policy on the environment, placed new responsibilities on Federal agencies to take environmental factors into account in their decisionmaking, and created a Council on Environmental Quality in the Executive Office of the President. The President appointed Russell E. Train as chairman of the newly created Council and Robert Cahn and Gordon J. F. MacDonald members. They were confirmed by the Senate on February 6.

The act charges the Council with assisting the President in preparing an annual environmental quality report and making recommen-

dations to him on national policies for improving environmental quality. It empowers the Council to analyze conditions and trends in the quality of the environment and to conduct investigations relating to the environment. It gives the Council responsibility for appraising the effect of Federal programs and activities on environmental quality, and authorizes funds for 1970–1973.

The Council's ability to perform its functions was significantly strengthened this year by the Environmental Quality Improvement Act of 1970 (Public Law 91–224) (see app. F), which was passed as title II of the Water Quality Improvement Act of 1970. This act created a new Office of Environmental Quality, which provides staff support to the Council. The Chairman of the Council on Environmental Quality serves as its Director and the activities of the Council and Office are meshed into one entity. The Act authorized funds for the Office, bringing the total authorization for the Council and the Office to $800,000 for fiscal year 1970; $1,450,000 for 1971; $2,250,000 for 1972; and $2,500,000 for 1973. The Environmental Quality Improvement Act also added to the responsibilities of the Council and the Office. It specified that they should review monitoring, evaluate the effects of technology, and assist Federal agencies in the development of environmental standards.

On March 5, 1970, the President issued Executive Order 11514. Together with the two public laws, it empowers the Council to recommend to the President and to Federal agencies priorities in environmental programs. Under the order and the acts, the Council will also promote the development and use of indices and monitoring systems and advise and assist the President and the agencies in achieving international environmental cooperation—under the foreign policy guidance of the Department of State. Taken together, the legislation and the Executive order provide a broad charter for the Council. They also provide a mandate for reform in the way Federal agencies make environmental decisions—from initial planning to implementation.

A New Step in Decisionmaking

The National Environmental Policy Act requires Federal agencies to take several significant steps. One is to include in every recommendation or report on legislation and on other major Federal actions significantly affecting the quality of the environment a detailed statement concerning the environmental impact of the action, adverse

impacts that cannot be avoided, alternatives to the proposed action, the relationship between short- and long-term uses, and any irreversible commitment of resources involved. The detailed statements will include the comments of State and local environmental agencies as well as appropriate Federal agencies with environmental expertise. The statements will then be made available to the Council on Environmental Quality, the President, and the public.

Executive Order 11514 further requires that Federal agencies continually monitor their own activities to enhance environmental quality. The order also requires that the agencies provide for timely public information and hearings, where appropriate, on Federal plans and programs with potential environmental impact.

On April 30, the Council on Environmental Quality issued Interim Guidelines for the preparation of environmental statements, requiring each Federal agency to establish internal procedures for implementing this provision of the act by June 1, 1970. The Council's Interim Guidelines, published in the Federal Register (see app. G), will be reviewed and revised as necessary.

In addition to its immediate impact within the Federal establishment, the provision of the law requiring detailed environmental statements has been the subject of litigation in several lawsuits and administrative proceedings. In one instance a Federal court blocked a Federal loan to develop a wildlife habitat into a golf course pending submission of the required environmental analysis. In another, the Corps of Engineers was enjoined from removing the ground cover along a river in Arizona.

The environmental statements required of the agencies add a vital step to the decisionmaking process. Federal agencies are now required to consider explicitly the environmental implications of their actions. Such consideration will permit Federal, State, and local agencies and other Federal agencies having an interest in the environment to review the environmental implications of a Federal project before the project is undertaken. The Federal Government need no longer be in the position of trying to repair damage to the environment after the damage has been done because the relevant factors were not considered at the time of decision.

Council Activities

Since it was organized the Council has been involved in a wide variety of projects, many at the direction of the President. In his

February 10, 1970, Message on the Environment, the President directed the Council to provide leadership in the areas of agricultural pollution, in the development of nonpolluting power sources for the automobile, and in the recycling and reuse of solid wastes. In the area of solid wastes, the Council has been evaluating the feasibility of recycling junked automobiles, beverage containers, paper, and waste oil. In his April 15 Message to Congress on Waste Disposal, the President directed the Council, in consultation with other Federal agencies and State and local governments, to develop a Federal policy and programs for controlling disposal of wastes in the ocean.

The Council is involved in a number of other activities. It participated with other agencies in developing the President's proposals to control and prevent oil spills from ships and boats. It is now working with a number of Federal agencies on proposals to control air and water pollution, solid wastes, pesticides, noise, and mercury pollution; to reduce the phosphate content of detergents; and to control pollution in the Great Lakes.

The President, in Executive Order 11507, directed Federal agencies to undertake an extensive program to bring Federal facilities in line with air and water quality standards. That order envisions a 3-year program to demonstrate Federal leadership in the Nation's antipollution drive. The Council was made responsible for maintaining a continuing review of this program.

The Council has established three advisory committees. One, formed on April 6, 1970, advises the Council on the impact of current Federal, State, and local tax structures on the environment. A Legal Advisory Committee announced on April 30, advises the Council on a broad range of environmental legal questions. A task force on the development of a virtually nonpolluting automobile had its first meeting on July 9.

The Council is at work identifying improved indicators of environmental quality and determining requirements for comprehensive environmental monitoring systems. Current monitoring systems are often spotty in coverage and do not provide the total information necessary to assess environmental conditions and trends, or to predict the impact of proposed actions, or to determine the effectiveness of programs for protecting and enhancing environmental quality.

A number of additional broad environmental policy issues are also under consideration by the Council. It is evaluating a wide range of Federal programs for their impact on the development and growth of specific areas. It is measuring the sufficiency of land use planning and control at State and local levels, and it is seeking alternative in-

stitutional and control mechanisms for better land use management. It is also analyzing the growing levels of toxic substances injected into the environment by new and complex manufacturing processes and is searching for alternative ways to pretest and control them.

In all of these activities, the Council works closely with Executive Office agencies such as the Office of Science and Technology, Council of Economic Advisers, and Office of Management and Budget. It also works with the program agencies such as the Departments of the Interior; Health, Education, and Welfare; Agriculture; Transportation; Commerce, and others. Only by working through these agencies is it possible to deal with the broad range of environmental problems.

REORGANIZING THE FEDERAL STRUCTURE

The current fragmentation of programs for environmental protection makes it difficult for the Federal Government to pursue a coordinated anti-pollution strategy. Although many of the same pollutants may be disposed of either in the air or on water or land, major pollution control programs treat them separately according to the medium where they occur. Imbalance, overlap, and neglect come from confusion about the extent to which air and water pollution control agencies are responsible for radioactive materials and pesticides when these substances appear in air or water. Some agencies which administer environmental control programs also have developmental responsibilities which tend to be inconsistent with their environmental programs.

These problems have become increasingly apparent in recent years. In 1969, President Nixon directed his Advisory Council on Executive Organization, headed by Roy L. Ash, to make a thorough study of Federal environmental programs. The President stated in his 1970 Message on the Environment that he would recommend needed organizational reforms based on the Ash Council report.

On July 9, 1970, the President transmitted to the Congress two reorganization plans to improve administration of environmental and oceanographic programs. One plan would consolidate pollution control programs in a new, independent Environmental Protection Agency. The other would consolidate a number of marine and atmospheric programs in a new National Oceanic and Atmospheric Administration in the Department of Commerce. In his message on the two

reorganization plans, the President said that "only by reorganizing our Federal efforts can we . . . effectively ensure the protection, development and enhancement of the total environment."

The Environmental Protection Agency

The Environmental Protection Agency (EPA) would combine programs now housed in five separate Federal agencies. It would be independent of any Cabinet agency—similar to NASA or the AEC. Its main role would be to establish and enforce standards, monitor and analyze the environment, conduct research and demonstrations, and assist State and local government pollution control programs.

The Federal Water Quality Administration, now in the Department of the Interior, and the National Air Pollution Control Administration, now in the Department of Health, Education, and Welfare (HEW), would be transferred to EPA. These would give EPA broad authority and ability to control air and water pollution. The new agency would carry out all the functions and responsibilities contained in the Clean Air and Federal Water Pollution Control Acts.

EPA would also take over the solid waste management program from HEW. It would take from the Federal Radiation Council the power to establish guidelines and recommend standards for radiation exposure. It would assume the authority of the Atomic Energy Commission to set standards for radiation hazards in the general environment.

The new Agency would pull together the widely scattered programs dealing with the environmental impact of pesticides. It would assume authority, now in the Department of Agriculture, to register pesticides. It would acquire the pesticide research and standard-setting programs of the Food and Drug Administration of HEW.

EPA's total budget would approach $1.4 billion, and it would employ almost 6,000 Federal personnel. It would be able to deal with significant problems that the current, fragmented organization of environmental protection programs is not capable of handling.

Many pollutants are not limited to one medium—air, land, or water—and are difficult to combat by media, which is the primary organizational basis of current programs. Pesticides, for example, which are applied to crops or land, degrade and disperse. Anywhere along the way, they may intrude on land, water, or air. EPA will be able to establish standards for the control of pollutants, taking into account the "total body burden"—that is, how much of a given sub-

stance an individual is exposed to whether it comes from air, water, or land. By bringing together research and monitoring activities from several agencies, EPA will be able to provide an "early warning system" against the accumulation of hazards.

Some pollution problems remain unrecognized because of gaps in agency jurisdiction or because no one agency has clear lead responsibility. With its broad responsibility for environmental protection, EPA would greatly improve the ability to recognize and to take action against such "new" pollution problems as noise. Pollution problems of the future will cut more and more across the jurisdictions of existing agencies, making the need for a unified agency even greater.

Also, the same source may contribute to several different kinds of pollution. Many industrial firms are able to choose the particular medium in which they will dump their wastes. The current organization deals separately with each medium. A case in New Jersey illustrates this problem. A manufacturing firm was required by court order to control air pollution pouring from the stacks of one of its large factories. The firm installed control devices which converted the gaseous wastes into a liquid. But then the wastes were dumped into a nearby river, and the firm is now back in court for violating water quality standards. Creation of EPA cannot guarantee that such problems will no longer arise. But it can provide more rational standards and more coordinated enforcement, which will permit industry and State and local governments to work toward total environmental improvement.

Current environmental protection programs compete for funds with health, resource, and development programs—with no clear framework for establishing priorities among them. EPA will provide an opportunity to weigh priorities carefully and develop an optimum mix of manpower and funds. It will be able to marshall improved overall strategies for attacking pollution problems.

The new EPA and the Council on Environmental Quality will reinforce each other's mission. The Council is essentially a staff organization. It is not intended to have operating responsibilities. Its function is to advise the President on environmental policies, to coordinate all activities of the Federal agencies related to environmental quality and to work with the agencies to insure that environmental consideration be a key element of decisionmaking. EPA, on the other hand, will be responsible for executing antipollution policies and for carrying out the many functions involved in controlling pollution. It will assist the

Council in developing and recommending to the President new policies for the protection of the environment.

There is also a difference in the scope of concern of the two agencies. The Council is responsible for the environment, broadly defined. This includes such subjects as population, land use, and conservation. The new agency will focus specifically on pollution control, which is only one part of the Council's responsibilities. But, creation of EPA will be a key building block in achieving the comprehensive view of environmental matters which the Council seeks.

The National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) would be composed of selected marine programs transferred from the Department of the Interior, the National Science Foundation (NSF), the Coast Guard, the Navy, and the Army Corps of Engineers. Its budget would total about $270 million, and it would have a personnel strength of over 12,000. These programs would be transferred to NOAA: Environmental Science Services Administration (Commerce); most elements of the Bureau of Commercial Fisheries, the marine sport fish program from the Bureau of Sport Fisheries and Wildlife, the major part of the anadromous fish program, and the marine mining program (Interior); the Office of Sea Grant Programs (NSF); the national data buoy development program (Coast Guard); and the Great Lakes Survey (Corps of Engineers). NOAA would be located in the Department of Commerce.

The NOAA proposal in large part reflects the recommendations of the Commission on Marine Science, Engineering and Resources as published in its report, "Our Nation and the Sea," in January 1969. The President, in transmitting the proposal to Congress, stated that he expected NOAA to "exercise leadership in developing a national oceanic and atmospheric program of research and development."

A Coordinated Attack

In his message to the Congress of July 9, the President called his reorganization proposals "an opportunity to re-evaluate the adequacy of existing program authorities. . . . As these two new organizations come into being, we may well find that supplementary legislation to perfect their authorities will be necessary. I look forward to working with the Congress in this task."

NOAA provides new opportunities to improve understanding of oceanic and atmospheric resources. The creation of the Council on Environmental Quality and the reorganization plan for an Environmental Protection Agency represent a bold move in Federal organization for environmental quality. For the first time, the Nation will have the type of policy and organizational focus to mount an effective, coordinated attack on pollutants and other forms of environmental decay.

III

Water Pollution

THROUGHOUT history man has been ravaged by plague and epidemics visited on him by poor sanitation and polluted water. In more modern times, the great typhoid epidemics that swept London in the mid-19th century underscored the peril of water pollution and launched the first organized steps to combat it. And until very recent times this stress on preventing waterborne disease was the major thrust of efforts to stem the decline of the environment.

Americans have acted, until recently, as though their rivers and lakes had an infinite capacity to absorb wastes. Pollution was considered the price of progress. Not until 1948 was comprehensive Federal water pollution control legislation enacted, and the first permanent legislation was not passed until 1956. The original overriding concern was with human health, and almost all State water pollution programs were carried on by State health departments.

Water pollution control legislation and programs have now been broadened to embrace a host of environmental concerns, including recreation and esthetics. Epidemics due to waterborne causes are largely of the past, and our health efforts have moved to a more sophisticated concern for the effects of small amounts of toxic chemicals on humans and other forms of life.

Three reasons, besides the changed nature of the health problem, help explain the broader environmental concern of today: First, the

growth of industries and cities has multiplied pollution in most waterways; second, demand for outdoor recreation has grown in a society increasingly affluent and leisure oriented; and third—a thread running through all the others—is man's inexplicable affinity to water. Whether it is the pleasure he derives from a fountain, the mood of a walk along the lake shore, the relaxation of fishing, or his identification with majestic water bodies—the Danube, the Great Lakes, or San Francisco Bay—man has found tranquility and inspiration in his appreciation of water. But, the current condition of many of our lakes and rivers makes appreciation impossible.

Pollution problems exist in all parts of the United States, particularly in the Northeast and in the Great Lakes region. In these areas, which have experienced tremendous urban and industrial growth over the past century, there was, at least until recently, inadequate investment in the construction of treatment plants. Now a big backlog of needed construction has accumulated. Specific sources of pollution, besides the ordinary municipal and industrial wastes, affect certain areas. Acid mine pollution is common in the coal mining States of Appalachia, and saline pollution occurs in the irrigation areas of Western States.

In some areas of the country, remedial programs have succeeded in raising the levels of water quality. However, population and industrial growth, higher water quality demanded by the public, and the increasing severity of certain types of pollution—for example, oil spills and increased algal blooms in lakes—all mean that we have only begun to tackle the problem.

NATURAL PROCESSES AND WATER POLLUTION

Several basic biological, chemical, and physical processes affect the quality of water.

Organic wastes decompose by bacterial action. Bacteria attack wastes dumped into rivers and lakes, using up oxygen in the process. Organic wastes are measured in units of biochemical oxygen demand (BOD), or chemical oxygen demand (COD), both measures of the amount of oxygen needed to decompose them. The COD measure is more inclusive than BOD, but BOD is much more commonly used. Fish and other aquatic life need oxygen. If the waste loads are so great that large amounts of oxygen are spent in their decomposition, certain types of fish can no longer live in that body of water. A pollution-

resistant, lower order of fish, such as carp, replace the original fish population. The amount of oxygen in a water body is therefore one of the best measures of its ecological health.

If all the oxygen is used, an anaerobic (without air) decomposition process is set in motion with a different mixture of bacteria. Rather than releasing carbon dioxide in the decomposition process, anaerobic decomposition releases methane or hydrogen sulfide. In these highly polluted situations, the river turns dark, and odors—often overwhelming—penetrate the environment.

Heated water discharged into lakes and rivers often harms aquatic life. Heat accelerates biological and chemical processes, which reduce the ability of a body of water to retain dissolved oxygen and other dissolved gases. Increases in temperature often disrupt the reproduction cycles of fish. By hastening biological processes, heat accelerates the growth of aquatic plants—often algae. Finally, the temperature level determines the types of fish and other aquatic life that can live in any particular body of water. Taken together, these effects of excess heat operate to change the ecology of an area—sometimes drastically and rapidly.

One of the most serious water pollution problems is eutrophication—the "dying of lakes." All lakes go through a natural cycle of eutrophication, but normally it takes thousands of years. In the first stage—the oligotrophic—lakes are deep and have little biological life. Lake Superior is a good example. Over time, nutrients and sediments are added; the lake becomes more biologically productive and shallower. This stage—the mesotrophic—has been reached by Lake Ontario. As nutrients continue to be added, large algal blooms grow, fish populations change, and the lake begins to take on undesirable characteristics. Lake Erie is now in this eutrophic stage. Over time, the lake becomes a swamp and finally a land area.

Man greatly accelerates this process of eutrophication when he adds nutrients to the water—detergents, fertilizers, and human wastes. He has done this in Lake Erie and countless other lakes. Man's action can, in decades, cause changes that would have taken nature thousands of years.

WHERE WATER POLLUTION COMES FROM

Although water pollution comes from many sources, the major ones are industrial, municipal, and agricultural.

Industrial Wastes

The more than 300,000 water-using factories in the United States discharge three to four times as much oxygen-demanding wastes as all the sewered population of the United States. Moreover, many of the wastes discharged by industry are toxic. Table 1 shows the amount of water consumed by various industries and the pollution loads, before treatment, that they produce. The output of industrial wastes is growing several times faster than the volume of sanitary sewage.

TABLE 1.—*Estimated Volume of Industrial Wastes Before Treatment, 1964* [1]

Industry	Wastewater volume (billion gallons)	Process water intake (billion gallons)	BOD (million pounds)	Suspended solids (million pounds)
Food and kindred products	690	260	4,300	6,600
Meat products	99	52	640	640
Dairy products	58	13	400	250
Canned and frozen food	87	51	1,200	600
Sugar refining	220	110	1,400	5,000
All other	220	43	670	110
Textile mill products	140	110	890	N.E.
Paper and allied products	1,900	1,300	5,900	3,000
Chemical and allied products	3,700	560	9,700	1,900
Petroleum and coal	1,300	88	500	460
Rubber and plastics	160	19	40	50
Primary metals	4,300	1,000	480	4,700
Blast furnaces and steel mills	3,600	870	160	4,300
All other	740	130	320	430
Machinery	150	23	60	50
Electrical machinery	91	28	70	20
Transportation equipment	240	58	120	N.E.
All other manufacturing	450	190	390	930
All manufacturing	13,100	3,700	22,000	18,000
For comparison: Sewered population of United States	[2] 5,300	----------	[3] 7,300	[4] 8,800

[1] Columns may not add, due to rounding.
[2] 120,000,000 persons times 120 gallons times 365 days.
[3] 120,000,000 persons times 1/6 pound times 365 days.
[4] 120,000,000 persons times 0.2 pound times 365 days.
Source: Data derived from T. J. Powers, National Industrial Waste Assessment, 1967.

Although there is as yet no detailed inventory of industrial wastes, indications are that over half the volume discharged to water comes from four major industry groups—paper, organic chemicals, petroleum, and steel.

The greatest volume of industrial wastes is discharged in the Northeast, the Ohio River Basin, the Great Lakes States, and the Gulf Coast States. Lesser, but significant volumes are discharged in some areas of the Southeast and the Pacific Coast States.

Most industrial water waste can be curbed—and much has been—by treatment and by designing production processes that minimize waste. For example, the average waste from modern sulfate pulp and paper plants is only 7 percent of what it was in the older sulfite process. Treatment processes are now available for most industrial wastes. Their total estimated costs, as a percentage of gross sales by all industry are well under 1 percent, although costs are much higher for some industries. Also, many industrial wastes—those from food processing, for example—can be treated efficiently (after pretreatment in some cases) in municipal waste treatment systems.

Some industrial pollution, however, presents difficult abatement problems. The trend toward using and shipping complex chemical products has greatly increased the possibility of releasing wastes in the environment. Many of these new chemicals are very difficult to detect and to control, and there is fear that too little caution and study preceded the processing and marketing of some of these materials.

Small amounts of heavy metals can be a problem. For example, until early this spring, little attention was given to mercury, although separate incidents of mercury poisoning had occurred in Japan and Sweden. Currently, levels of mercury above Food and Drug Administration standards have been discovered in more than 20 States with the result that in many of them, sport and commercial fishing has been curtailed. The Federal Government has collected data on the sources of mercury discharge—mainly chemical plants—and has sought court action against eight firms. The Council on Environmental Quality is coordinating long-term Federal agency efforts to spell out the danger and develop remedial programs.

Many authorities believe that waste heat looms as one of the most serious types of future water pollution. The chief source of thermal pollution today is the electric power industry, which requires tremendous amounts of water for cooling. Other sources include petroleum, chemical, steel, and pulp and paper processing. The heaviest users are listed in table 2.

The best single indicator of future potential for thermal pollution is the predicted increase in the generation of electricity. The electric power industry is growing at a rate of 7.2 percent annually, virtually doubling every 10 years. This trend is expected to continue, as table 3 shows.

TABLE 2.—*Use of Cooling Water by U.S. Industry*

Industry	Cooling water intake (billions of gallons)	Percent of total
Electric power	40,680	81.3
Primary metals	3,387	6.8
Chemical and allied products	3,120	6.2
Petroleum and coal products	1,212	2.4
Paper and allied products	607	1.2
Food and kindred products	392	0.8
Machinery	164	.3
Rubber and plastics	128	.3
Transportation equipment	102	.2
All others	273	.5
Total	50,065	100.0

Source: Federal Water Pollution Control Administration, "Industrial Waste Guide on Thermal Pollution," September 1968.

TABLE 3.—*U.S. Electric Power—Past Use, Future Estimates*

Year:	*In billion kilowatt-hours*
1912	12
1960	753
1965	1,060
1970	1,503
1975	2,022
1980	2,754
1985	3,639

Source: Federal Water Pollution Control Administration, "Industrial Waste Guide on Thermal Pollution," September 1968.

The principal use of water in steam-electric generating plants is for condenser cooling. The amount of water necessary depends on plant efficiency and the designed temperature rise within the condensers. The temperature rise of cooling water condensers is usually in the range of 10° to 20° F., with the average rise about 13° F. Large nuclear steam electric plants require about 50 percent more condenser water for a given temperature rise than late model fossil-fueled, steam-electric plants of equal size. However, the development of advanced reactors, such as the fast breeder, will essentially eliminate the difference between nuclear and fossil-fueled plants. It is estimated that by 1980, cooling operations by the electric power industry will require the equivalent of one-fifth of the total fresh water runoff of the United States.

Municipal Wastes

Municipal waste treatment plants handle more than just domestic wastes from homes and apartments. On a nationwide average, about 55 percent of the wastes processed by municipal treatment plants comes from homes and commercial establishments and about 45 percent from industries. Less than one-third of the Nation's population is served by a system of sewers and an adequate treatment plant. About one-third is not served by a sewer system at all. About 5 percent is served by sewers which discharge their wastes without any treatment. And the remaining 32 percent have sewers but inadequate treatment plants. Of the total sewered population, about 60 percent have adequate treatment systems. The greatest municipal waste problems exist in the areas with the heaviest concentrations of population, particularly the Northeast.

Three levels of treatment are employed in municipal treatment plants. Primary treatment is a simple gravity process that separates and settles solids in a big tank. Such primary plants provide BOD removal levels of 25 to 30 percent. Secondary treatment is a biological process that speeds up what nature does in natural water bodies. In the activated sludge process used by many large cities, bacteria and air are mixed with sewage to accelerate decomposition of wastes. The other secondary treatment process—the trickling filter—involves spraying wastes uniformly over a rock bed. Bacteria formed on the rocks, in the presence of air, accelerates decomposition of wastes. Good secondary treatment plants remove 90 percent of measured BOD. That does not mean that 90 percent of total oxygen-demanding wastes are removed, but only the part that is measured by certain laboratory tests.

Advanced waste treatment, often called tertiary treatment, involves a wide variety of processes tailored for specific treatment needs. For example, one advanced waste treatment process is lime-alum precipitation, which removes 80 percent of phosphates from waste water, compared to an average of 30 percent in normal secondary treatment. Other processes, using carbon adsorption and sand filtering, remove up to 99 percent of measured BOD.

The waste loads from municipal systems are expected to nearly quadruple over the next 50 years. Even if municipal and industrial waste loads are cut substantially through treatment, pollution problems will continue to plague densely populated and highly industrialized areas where the capacity to assimilate waste is exceeded.

Among other municipal waste problems that will grow more apparent as conventional treatment reduces gross pollution loads are those caused by storm or combined sewers and by nutrients. Many

cities have combined sewers, which discharge raw sewage along with street runoff directly to streams when treatment systems become overloaded during storms or thaws. Even where sewers are separated, pollution from storm sewer discharges carrying a variety of wastes from the streets is possible. Although combined sewer problems exist in most regions of the country, the most severe are centered in the Northeast, Midwest, and to some degree, the Far West.

Municipal wastes contribute the major load of usable phosphates and significant amounts of nitrates to water bodies. Already nutrient pollution has led to a strict requirement for very high treatment levels for waste discharges to the Great Lakes and several other areas. Secondary treatment plants remove an average of 30 percent of the phosphorous and up to 20 percent of the nitrogenous materials, although with modifications higher levels of treatment are possible. In many places treatment levels approaching 100 percent will probably be necessary—especially if the phosphate content of detergents is not reduced.

Agricultural Wastes

Wastes from feedlots are a key source of agricultural pollution. The increasing number of animals and modern methods of raising them contribute to the worsening pollution of waters by animal wastes. Beef cattle, poultry, and swine feeding operations, along with dairy farms, are the major sources of actual or potential water pollution from animal wastes. In the United States today, the number of animals, their waste equivalents to humans, and the total waste equivalent are as follows:

	Animal population (in millions) (1)	Ratio of waste output of single animal to output of a human (2)	Total animal wastes expressed as equivalent number of humans (in millions of humans) (3)
Cattle	107	16.40	1,754.8
Horses	3	11.30	33.9
Hogs	53	1.90	100.7
Sheep	26	2.45	63.7
Chickens	375	0.14	52.5
Total [1]	564		2,005.6

[1] Col. 1 times col. 2 equals total in col. 3.

Source: Data derived from Federal Water Pollution Control Administration, "Cost of Clean Water," vol. 2, 1968.

Hence, animal wastes are estimated to be the equivalent of the wastes of 2 billion people. These figures should not be interpreted as an estimate of the potential pollution from feedlots, however, since most of these wastes never reach the water. But they are a measure of the total amount of animal wastes, part of which causes water pollution and solid waste problems.

Agricultural waste sources are scattered throughout the Nation. Large cattle herds are fed in the Midwest, West, and Southeast; poultry in the South and in the Middle Atlantic States; and hogs in the Midwest and South. If current consumption rates continue, animal wastes will increase significantly. The trend toward confined feeding and concentrated rations is bound to add to the pollution potential of feedlot wastes although better control methods are being developed.

Fertilizers contain nitrogen and phosphorus, two primary nutrients that nourish algae in water. Nitrates are the bigger problem since, unlike phosphates, which stick to soil, nitrates are very susceptible to runoff from rain. Also, nitrates leach into ground water. High nitrate concentrations in water cause infant methemoglobinemia or "blue baby." The use of chemical fertilizers has increased rapidly in the United States over the last decade and is expected to continue to rise, although at somewhat slower rates. In some areas, particularly in the West, water leached from irrigated lands has caused serious water pollution. In the Western United States, salt content in many rivers exceeds the levels considered acceptable for most types of crops. The problems resulting from use of pesticides, which pollute the air, the land, and the water, are covered in chapter VII.

Other Sources

Sediment and erosion—Sediments carried by erosion represent the greatest volume of wastes entering surface waters. The volume of suspended solids reaching U.S. waters is at least 700 times greater than the total sewage discharge loadings. Sediments are washed in from croplands, unprotected forest soils, overgrazed pastures, strip mines, roads, or bulldozed urban areas. Agricultural development increases land erosion rates four to nine times over what they are for natural cover. Construction may increase the rate a hundredfold. A 1969 report of the Federal Water Quality Administration estimated the average sediment yield during a rainstorm at highway

construction sites at about 10 times that for cultivated land, 200 times that for grass areas, and 2,000 times that for forest areas—depending on the rainfall, land slope, and the exposure of the bank. Similar rates of sediment production occur from commercial and industrial construction in urban areas.

Oil and other hazardous substances—With the grounding of the *Torrey Canyon* in 1967, the breakup of the *Ocean Eagle* in Puerto Rican waters in 1968, and the Santa Barbara offshore oil leak in 1969, oil pollution has become recognized as a serious national and worldwide problem. An estimated 10,000 spills of oil and other hazardous materials annually pollute navigable waters of the United States. Although damages from other hazardous substances can be just as significant and diverse as those caused by oil pollution, the volume of oil transported and used makes it the most important single pollutant of this type.

Most oil spills exceeding 100 barrels come from vessels, although about one-third of the incidents involve pipelines, oil terminals, and bulk storage facilities. Vessel casualties are a prime source of oil pollution. Damage from several million gallons of oil entering the water at one time and place can be extensive.

TABLE 4.—*Number of Reported Oil Spills in U.S. Waters (Over 100 Barrels)*

	1968	1969
Vessels	347	532
Shore facilities	295	331
Unidentified	72	144
Total	714	1,007

Source: Federal Water Quality Administration, "Clean Water for the 1970's," June 1970.

Oil pollution may spring from several other sources. Gasoline service stations dispose of 350 million gallons of used oil per year, much of which was previously re-refined. Two hundred thousand miles of pipelines, carrying more than a billion tons of oil and hazardous substances, cross waterways and reservoirs and are subject to leakage. The blowout of offshore oil and gas wells, the dumping of drilling muds and oil-soaked wastes, the destruction of offshore drilling rigs by storms, and ship collisions—all are significant potential sources of pollution.

With more and more oil and hazardous materials being transported, the number of spills could grow. On the other hand, tightened regulations developed for oil exploration and production and sounder ship and pipeline construction could reduce this number.

Mine drainage—Mine drainage is one of the most significant sources of water pollution in Appalachia, in the Ohio Basin States, and in certain other areas of the country.

In Appalachia alone, where an estimated 75 percent of the coal mine pollution occurs, about 10,500 miles of stream are dropped below desirable quality levels by acid mine drainage. Similar drainage from other types of mining—such as phosphate, sand and gravel, clay, iron, gold, copper, and aluminum—pollutes other regions of the country. Acid formation occurs when water and air react with the sulfur-bearing minerals in the mines or in refuse piles to form sulfuric acid and iron compounds. Coal mines idle for 30 to 50 years may still discharge large quantities of acid waters. Mine drainage also contains copper, lead, zinc, and other metals toxic to aquatic life.

Watercraft wastes—About 46,000 federally registered commercial vessels, 65,000 unregistered commercial fishing vessels, 1,600 federally owned vesels, and 8 million recreational watercraft ply the navigable waters of the United States according to FWQA. The potential sewage pollution from these vessels is estimated to equal that from over 500,000 persons—comparable to the population of a city the size of San Diego. As a total source of pollution, it is insignificant, but it can be a major impediment to achieving clean water in some harbors and recreational areas. Further vessel pollution occurs when ships discharge bilge and ballast water heavy with oils and other substances.

WHAT WATER POLLUTION DOES

Water pollution stems from many sources and exists in many forms to assail man's senses and hamper his activities. It may appear as oil slicks, as public health notices against swimming, or as masses of aquatic weeds making drinking water undrinkable. More subtle are long-term changes in the aquatic life of a river—the decline of sport fish and the ascendance of carp, sludge worms, and other life forms tolerant of pollution.

. . . to Health

Epidemics of typhoid, dysentery, and salmonellosis borne by polluted water are no longer serious public health threats in the United States. To protect the public from these and other pollution dangers, however, water must often be treated to high levels before it is drinkable. Beaches often must be closed and shellfish left unharvested and unmarketed. Inadequately disinfected municipal wastes, overflows from combined sewer systems, and runoff from animal feedlots often create high bacteria densities in local water supplies.

A survey prepared by the Department of Health, Education, and Welfare points to disquieting quality deficiencies in some community water systems, particularly in small communities. Also, there is mounting public health concern over chemical constituents in water. The effects on humans of small amounts of toxic chemicals in water supplies are not known, but health authorities show increased concern over their potential effects. Accelerated research is needed for better understanding of these dangers. The technology to maintain safe bacteriological quality and to remove many of the potentially dangerous chemicals from drinking water exists but is not as widely employed as necessary.

. . . to Recreation

Reduction of recreational opportunities represents the most widespread consequence of water pollution. Three major types of recreational activities may be hampered by water pollution:

- ***Boating and water skiing***—Such water pollution as floating solids, gas bubbles and odors, and algal blooms make boating and water skiing unpleasant. And if bacterial levels are sufficiently high, water pollution can be a health hazard to water sportsmen.
- ***Swimming***—When bacterial counts reach certain levels, public health authorities close beaches. Inadequately disinfected wastes from municipalities and overflows from combined sewers are principal bacterial polluters in populated areas.
- ***Sport fishing***—The highest water quality is needed to maintain populations of certain types of game fish. When water quality declines, the fish die. For example, the most popular fresh water

sport fish, the trout, requires cold water and dissolved oxygen levels in excess of 5 parts per million to live and reproduce. On the other hand, carp, a "trash" fish, can live with dissolved oxygen levels below 4 parts per million, and even below 2 parts per million for a limited time.

Fish can die from all types of pollution, but the majority of fish kills are caused by lack of dissolved oxygen, pesticides, and by toxic wastes from industrial operations. In 1969, over 70 percent of the kills were caused by industrial waste and 20 percent by agricultural waste. Most of the fish killed were "trash" or "rough" fish—those already tolerant of water pollution.

. . . *to Esthetics*

The esthetic qualities of water also represent a use by man. That use may take the form of picnicking, hiking, or just driving near a body of water. Besides ruining the visual enjoyment, pollution can cause unpleasant odors, especially when algae clog the water or when anaerobic conditions exist. Also, sediment, which can turn waters murky brown, reduces their esthetic appeal.

. . . *to Commercial Fishing*

Commercial fishing is an important industry in some areas of the country. In 1969, domestic landings totaled about 4.9 billion pounds of fish and shellfish valued at $354 million. Although total landings fell to 4.3 billion pounds in 1969, the value to the fisherman had increased to $518 million. The extent to which water pollution, compared to other factors, contributed to the lower level of landings is unknown.

. . . *to Agriculture*

Saline pollution is the water quality problem which primarily affects agriculture. As water is used by plants and evaporates, the concentration of salt rises. As salt levels in water increase, the farmer may have to shift to lower yielding, salt-resistant crops.

. . . to Industrial Water Supplies

Studies indicate that industry generally treats water to its desired level to assure constant quality, rather than depending on water withdrawn directly from rivers and lakes. It would be cheaper for industrial concerns to treat nonpolluted or less polluted water, but the extra treatment costs for industry are usually not significant.

. . . to Municipal Water Supplies

Small amounts of potentially toxic materials, the effects of which are not well known, are not removed by many drinking water treatment plants. Water pollution also increases the costs of treating water at intake for domestic uses. However, studies indicate that the extra costs of treating polluted water to meet current standards are not significant. Several forms of water pollution, however, such as algae or small amounts of phenols, a byproduct of a number of manufacturing processes, adversely affect the taste and odor of water. For reasons of taste and custom, people are often reluctant to draw water from polluted sources. For example, the quality of water that Philadelphia takes from the Delaware River is about the same as that of the Hudson River near New York City, but New Yorkers have been most reluctant to use the Hudson River as a source of drinking water.

WHAT WATER POLLUTION CONTROL COSTS

The amount of money needed to clean up polluted water is great. The direct costs are immense, but a substantial part of the costs are indirect. For example, any lasting solution is bound to involve modification of construction, agricultural, and water management practices.

The cost over the next 5 years for municipal waste treatment plants to meet water quality standards is estimated at $10 billion—about $2 billion a year. Operating charges are estimated to rise from $410 million a year in 1969 to $710 million in 1974. The costs of dealing with problems of combined sewer overflows have been put by the American Public Works Association at between $15 and $48 billion—depending on the alternatives chosen.

TABLE 5.—*Annual Outlays for Water Pollution Control*

[In millions of current dollars]

Year	Industrial outlays		Municipal outlays			Total annual outlays
	Investment	Operating charges	Investment		Operating charges	
			Treatment works	Collection		
1965	640	200	476	355	270	1,940
1966	780	270	520	400	295	2,215
1967	565	365	550	505	320	2,306
1968	530	430	655	500	350	2,465
1969	740	515	880	450	410	2,995
1970[1]	655	555	2,000	(2)	[3] 470	>3,680
1971	655	595	2,000	(2)	530	>3,780
1972	655	635	2,000	(2)	590	>3,880
1973	655	675	2,000	(2)	650	>3,980
1974	655	715	2,000	(2)	710	>4,080

[1] 1970–74 expenditures represent those associated with an investment level that will achieve controls required by water quality standards within the period.

[2] No estimates available.

[3] No estimate of incremental collection operating and maintenance costs.

Source: Federal Water Quality Administration.

Industrial abatement costs, excluding those for waste heat from power production, are estimated at $3.3 billion over the next 5 years. Annual industrial operating costs will increase from $515 million in 1969 to $715 million in 1974. Up to another $2 billion would be necessary in the next 5 years to provide recirculation of water to prevent thermal pollution.

Costs for controlling other pollution sources are grounded on widely varying assumptions as to what is necessary, desirable, or possible. As analysis improves, these costs can be calculated as part of the total costs necessary to meet water quality objectives.

GOVERNMENT ACTION

Federal Efforts

The first temporary water pollution control legislation was passed in 1948. Permanent legislation was enacted in 1956. The Federal Water Pollution Control Act of 1956 authorized planning, technical assistance, grants for State programs, and construction grants for municipal waste treatment facilities. Amendments followed in 1961,

which among other things, extended Federal enforcement authority and increased construction grant authorizations.

In 1965, more amendments established the Federal Water Pollution Control Administration as successor to a program previously in the Public Health Service of the Department of Health, Education, and Welfare. The Administration was transferred to the Department of the Interior in May 1966. The most important provisions in the 1965 act called for the establishment of water quality standards and implementation plans for clean-up of all interstate and coastal waters.

The Clean Water Restoration Act of 1966 provided more Federal money for building treatment facilities. The Water Quality Improvement Act of 1970 gives a new name to the responsible agency, the Federal Water Quality Administration; provides tighter controls over oil pollution, vessel pollution, and pollution from Federal activities; and broadens the earlier laws in other respects.

Setting water quality standards—The water quality standards authorized by the 1965 legislation set the stage for the current strategy for water quality management. The act called on the States to establish standards for their interstate waters, which can then be approved as Federal standards by the Secretary of the Interior. To set these standards, the States had to make crucial decisions about desired uses of their water resources, the quality of water that they need to support uses, and specific plans for achieving quality levels. Most water quality standards carry antidegradation clauses seeking to insure that high-quality waters are maintained at existing levels of purity.

The States are the primary enforcers of water quality standards. If they fail to act, the Secretary of the Interior may then set standards and enforce them. The standards of all the States have now been approved. The goal—to provide nationwide, comprehensive water quality standards—however, is far from reached. Over half the States established standards that were not stringent enough in all aspects to assure adequate water quality protection. So the Secretary excepted parts of them from initial approval. For example, the temperature criteria of a number of States have been excepted because they did not set adequate safeguards against thermal pollution. In some cases implementation plans have not been approved because the abatement measures or the schedules were inadequate. The Secretary of the Interior is negotiating with the States concerned, and a number of them have agreed to raise their standards. In one case, where no agreement was reached, the Secretary has taken initial action to impose Federal standards.

Even when standards have been approved, there is a need to improve knowledge of water quality characteristics so that the standards can be upgraded. For example, general criteria on toxic materials are written into all of the approved water quality standards. But in many of the standards, specific limits on such products as pesticides have not been spelled out. Nor have definitive measures for implementing standards been detailed. The standards generally require secondary treatment—or its equivalent—for industrial wastes, even though this is a crude measure for industrial wastes, and may not be adequate to forestall pollution in particular areas. In his February 10 Message on the Environment, the President said that he was requesting authority to require the States, with Federal approval, to set specific effluent discharge requirements as part of water quality standards. These would arm the States and the Federal Government with a tool to assure that water quality goals would be met. It would provide a standard against which the States and the Federal Government can enforce compliance.

Enforcing standards—Vigorous State and Federal enforcement is critical if the Nation hopes to attain water quality standards. Several States are moving aggressively against polluters. Illinois has not hesitated to open proceedings against major industrial firms. Pennsylvania successfully carried through on the first test of its clean stream law. And with the passage of its Water Quality Act in 1969, California has vastly buttressed and stepped up its regulatory activity.

Last year, the Federal Government launched its first action to curb violations of water quality standards under the Water Quality Act of 1965. On August 30, 1969, the Secretary of the Interior ordered six alleged violators to clean up their pollution within 180 days or face court action. Each took remedial steps and court action was forestalled. On May 19, 1970, the Secretary took action against five other alleged violators under this procedure.

Joint Federal-State enforcement conferences have been stepped up. The Biscayne Bay conference in February 1970 was the 50th conference enforcement action taken since 1956. Five of these actions—Lake Superior, Escambia River Basin, Perdido Bay, Mobile Bay, and Biscayne Bay—have been started since January 1, 1969. Eight other conferences were reconvened, and three progress meetings were held to review progress in compliance. The Refuse Act of 1899 provides fines and criminal sanctions for dumping wastes into navigable waters without a permit. This authority, assigned to the Army Corps of

Engineers, has been invoked in several recent actions, notably in the Lake Michigan area. The Federal Government is initiating new efforts to control pollution through the exercise of the Refuse Act's permit functions. Section 21(b) of the new Water Quality Improvement Act of 1970 requires applicants for Federal permits to file with permit requests certification from the appropriate State or interstate pollution control agency that its activity will not violate water quality standards. The Federal Government will invoke new procedures for requiring permits to discharge materials into navigable waters.

Assisting communities to treat wastes.—The Federal Government gives grants to municipalities to build waste treatment works. The legislation permits the Government to make basic grants of 30 percent of the costs of construction. In States in which the State government provides financial help and has enforceable water quality standards plus a comprehensive plan, the Federal share can go up to 55 percent.

Since 1957, the Federal Government has paid out $1.5 billion to help build and expand over 10,000 municipally owned and operated sewage treatment plants. With this money States and cities have constructed $6.4 billion in treatment works. In 13 years of such grants, the population served by some degree of waste treatment has jumped by more than 51 million people.

Despite this progress, many cities still lag in modern waste treatment. Many facilities were designed to provide levels of treatment which have since proved inadequate. Other plants have become outgrown and overloaded. Others, crippled by improper operation and maintenance, have been beset by polluted discharges and have lapsed into early obsolescence.

Sheer population growth has speeded the overloading of many treatment plants. During the years in which the Federal Government has financed sewage treatment, that part of the population using sewers and thus discharging wastes that must be treated has grown by 35.7 million persons. Higher standards of living and the universal use of household chemicals and appliances which add to the waste load—garbage grinders, for instance—have also overloaded sewage treatment plants. And in many river basins, success in treating wastes from municipalities has often been offset by failure to deal simultaneously with other waste sources.

Despite Federal assistance in the past, waste treatment plant construction needs have far outpaced all available financing. Not until 1970 did Federal funding take any major leap upward—from $214 million in 1969 to $800 million. To meet treatment needs after 1970, the

President has requested $4 billion—$1 billion a year for 4 years—to be matched by $6 billion in State and local funds, for a total $10 billion program. That level of funding was arrived at from a study of requirements by the Federal Water Quality Administration and an independent canvass of the States' estimated needs. The Administration's legislation would require a reassessment in 1973 to estimate future need.

The Administration also seeks authority to set up an Environmental Financing Authority (EFA) to help remove barriers for local communities that want to participate in the grant program. EFA would buy the obligations of State and local governments to help finance treatment plant construction when they cannot get credit elsewhere on reasonable terms. EFA would obtain funds to make these purchases by issuing its own taxable obligations in large enough blocks to win favorable reaction in the market. The differential between the interest that EFA must pay on its obligations and the rates that State and local governments pay back to EFA would be made up by regular Federal payments. By providing an assured commitment on grant funds and credit assistance, the Administration's proposals would overcome the obstacles that have prevented needed investment growth in the past.

Controlling oil—The Santa Barbara blowout and subsequent incidents show conclusively that no fully effective techniques are available to control oil spills in the ocean or large lakes. And common straw, which soaks up oil so that it can be removed, is still the standard material for cleaning up after oil spills. The Water Quality Improvement Act of 1970 tightens the law and strengthens the Federal hand to prevent and control oil pollution. It requires notification of spills and establishes financial liability for cleanup costs. It also authorizes a $35 million revolving fund for emergency oil cleanup by the Federal Government. Regulations issued by Secretary Hickel on August 22, 1969, tighten Federal control and make industry liable for spills occurring from oil and gas exploration and production on the Outer Continental Shelf.

On May 20, the President announced a comprehensive list of proposals to deal with oil pollution. He advocated Senate ratification of three international treaties, asked Congress for legislation to give the Federal Government authority to regulate handling and transfer of oil cargoes, and recommended more research in detecting and removing

oil spills. Ten days later, the Chairman of the Council on Environmental Quality released a new National Contingency Plan which details responsibilities for oil spill cleanup.

Vessel wastes—In recent years, many States have enacted new laws and regulations or have strengthened old ones for controlling vessel wastes. Unfortunately, nonuniformity of State requirements poses significant compliance problems for vessels that travel between States. Also, in many cases the State regulations do not cover, or inadequately cover, interstate and international carriers.

The Water Quality Improvement Act of 1970 embodied comprehensive Federal legislation covering the control of vessel wastes. It provides for the establishment of effluent standards for sanitary waste discharges from all classes of watercraft—new and old. It penalizes vessel owners and manufacturers for failing to provide adequate shipboard treatment or sanitary waste control.

Controlling Federal activities—The Federal Government itself carries on many activities that affect water quality. It maintains Federal facilities—such as military bases, lighthouses, and post offices. It manages Federal lands. It dredges, develops nuclear energy, and controls pests. Today, in the United States, the Federal Government owns approximately 20,000 pieces of property and one-third of the country's land area.

On February 4, 1970, the President issued Executive Order 11507, which launched an aggressive approach to clean up water and air pollution from Federal facilities. The order demands that all projects or installations owned or leased by the Federal Government be designed, operated, and maintained to meet air and water quality standards. Under it, pollution control projects must be finished or underway by December 31, 1972. To ensure that funds, once appropriated, are channeled to the intended purpose, the order stops them from being used for anything but pollution control.

Control of water pollution from other Federal activities is covered by a number of laws and administrative arrangements. The Water Quality Improvement Act requires that States certify projects before Federal agencies can give them licenses or permits. The Fish and Wildlife Coordination Act requires that the Department of the Interior comment before the Corps of Engineers issues a dredging permit. The National Environmental Policy Act requires agencies carrying

out projects to issue a detailed statement on what the project will do to the environment.

Research and development—Much is already known about the technology of water pollution control. But there are still major gaps in knowledge. New technology is being developed and tested, largely through a program of grants, contracts, and demonstrations with municipalities and industries. Municipal and industrial treatment technology, oil spill control, and agricultural pollution claim highest priority. The 1971 Federal budget sets aside $61 million for research, development, and demonstration by all agencies.

Monitoring and surveillance—Adequate enforcement of water quality standards demands accurate factfinding and ready data. The Federal Water Quality Administration (FWQA), the U.S. Geological Survey, and State pollution control agencies have been jointly developing a nationwide water quality surveillance system for several years. Part of the network is already in operation. Some 400 FWQA-funded and operated stations, 260 FWQA-funded and U.S. Geological Survey-operated stations, 200 stations jointly funded by the State and Federal agencies, and 500 State-funded and operated stations make up the surveillance web. It now covers about 20 percent of the Nation's streams. Ultimately it will grow into a complex of thousands of State and Federal stations. Network data will be supplemented by many short-term intensive FWQA field studies of specific water quality problems.

A number of other Federal agencies run monitoring and surveillance programs. The Environmental Science Services Administration of the Department of Commerce, the Coast Guard, the Corps of Engineers, the Bureau of Commercial Fisheries, and others have programs. They do not generate data for enforcement, but they do add to the Nation's knowledge of the pollutant load in the water, how it is dispersed, and how it reacts.

Helping States—State agencies have major responsibility in the national water pollution control effort. But often they are underequipped for the task. Federal grants spur State and interstate agencies to expand and improve their programs. The grant program started in 1957 with $2 million and has grown to $10 million today. State and interstate agency expenditures to match Federal funds have increased sixfold in that time. The President has asked for legislation to triple the Federal share over 5 years—from $10 million to $30 million—and to provide bonus funds for control, inspection, and manpower programs.

State Efforts

The years since 1965 have seen significant strides in State water pollution control programs. The amount and significance of legislation introduced and enacted in State legislatures in recent sessions and the rise in appropriations for support of State water pollution control programs point to progress. A rapidly rising number of States now financially assist the construction and operation of local waste treatment plants. Thirty-one States have authorized assistance programs, and all but 10 of these States have funded their programs. Some States provide other forms of assistance. For example, Nebraska, New Hampshire, and New York underwrite local bond issues; and at least 23 States award to industry tax incentives in one form or another.

States have tightened supervision over local waste disposal operations. They have expanded monitoring and inspection of treatment plants and have upgraded operators' qualifications and skills by mandatory certification requirements and training programs. Forty-six States require permits for municipal and industrial discharges; six States inspect treatment plants monthly, five quarterly, and 13 annually; 43 States require monthly operating reports; 16 States require mandatory certification of waste treatment plant operators. Unfortunately, in many States, these mechanisms do not work as well as they could.

State legislatures themselves are looking hard at the organizational structure for administering State water pollution control programs. At least 16 States have acted in this area. Most of those States have taken part or all of the water quality responsibility from health departments and created either water quality boards, made up of representatives of a number of State agencies, or combined water quality responsibilities with natural resources activities. Some States—for example, New Jersey and New York—have combined their air and water pollution activities in an even more comprehensive approach to environmental management. Perhaps the most exciting organizational innovation has been the statewide treatment authority. Ohio has authorized an Ohio Water Development Authority, with power to construct, operate, and assess charges for treatment plants in that State. Maryland has recently created a Waste Acceptance Service with similar functions. Overall, State spending for pollution control programs in fiscal year 1970 will more than triple spending in 1965, increasing from about $11.2 million to an estimated $36 million.

WHERE WE STAND

Problems and Their Control

As discussed earlier, the two major sources of organic pollution are industrial and municipal wastes, with industrial discharges contributing three to four times the waste loads of municipal systems. Reduction of pollution from industrial sources—where abatement technology is generally available—is largely a matter of attaining necessary investment levels.

According to extremely tentative figures, industrial investments for water pollution control facilities increased in 1969 over 1968. The actual spending for industrial pollution control facilities in 1968, however, was less than the amounts previously projected.

Although the level of industrial investment appears to be close to the level necessary to meet water quality standards, there is room for concern that the industries putting money in now are the most public spirited firms, and in the years ahead the main burden of investment will have to be carried by the less highly motivated firms. If this is true, the investment level is likely to fall unless Federal and State enforcement is greatly strengthened.

The cost of solving pollution from municipal discharges will be high over the next 5 years. According to FWQA estimates, about $10 billion of capital investment will be needed to meet water quality standards, compared to about $3.3 billion for industry. (Industry's capital costs are much lower than are municipalities' because the wastes do not have to be collected from a wide area and because firms generally choose less capital intensive abatement measures.) Since 1965, the level of investment in municipal facilities has nearly doubled—from $476 million to $880 million—but it must reach an annual level of $2 billion to cut backlogs and keep pace with future population and expansion. The President's program will help achieve this level.

Current monitoring systems are not adequate to determine the extent of improvement or deterioration of water quality. In some isolated cases, such as Lake Washington in Seattle and San Diego Bay, improvement has been dramatic. In other areas water quality has deteriorated. Given the Administration's proposed level of funding, more uniform improvement is likely in the next few years.

Nutrient Enrichment

Eutrophication is emerging as perhaps the single most difficult water pollution control problem. It is especially vexing because even as gross organic waste loads are reduced by injections of money into treatment plants, eutrophication does not stop. It will continue to prevent achievement of high quality water. The causes of eutrophication have recently been under debate. Some claim that carbon stimulates algal growth and is the chief cause, rather than phosphates, which had long been the suspected controlling factor. To learn more about this, the Council on Environmental Quality and the Office of Science and Technology (OST) met with a number of outside scientific experts and Federal agency personnel. The staff of the Council, the OST, and the Department of the Interior concluded that phosphates are still the most important nutrient to control if eutrophication is to be successfully attacked. They held that carbon is only likely to be limiting where algal blooms are already at unacceptable levels.

The largest amount of useable phosphates reaches water from municipal sources. Phosphates in detergents account for approximately 50 percent of the total. A second source, less amenable to control, is runoff of phosphate fertilizers from land. Nitrogen, another contributor to eutrophication, especially in the western part of the United States, also originates from municipal discharges and land runoff.

Toxicity Levels

Increasingly complex manufacturing processes, coupled with rising industrialization, create greater amounts of exotic wastes potentially toxic to humans and aquatic life. Current levels of cadmium, lead, and other substances whose effects on humans and fish and wildlife are not fully understood constitute a mounting concern. And mercury pollution has become a serious national problem.

Waste Heat

Waste heat is one of the most serious emerging sources of water pollution. The electric power industry, which currently discharges over 80 percent of all the thermal heat into the Nation's waters, doubles its capacity every decade. The trend toward larger, nuclear plants, which create 50 percent more thermal pollution in water per unit of power than fossil-fuel plants, could result in damage to aquatic systems—if it is not controlled. With the tremendous thermal pollution potential of

projected power production, it is fortunate that waste heat from electric generating plants can be adequately controlled. Waste heat and thermal pollution can be reduced by improving the efficiency of the plants; by making productive use of heat; and by the use of cooling towers, cooling ponds, or spray ponds.

Enforcement—Enforcement has not reached its full potential for two reasons. First, the Federal Government's authority over standards—under the Federal Water Pollution Control Act—generally extends only to interstate waters. It does not adequately cover intrastate and ground waters. Second, the implementation plans of the States do not specifically spell out the maximum amounts of effluent that can be discharged within the standards. Enforcement provisions are also inadequate. Under the Federal Water Pollution Control Act, the Federal Government has jurisdiction only if the pollution from one State endangers the health and welfare of another State; or if the Governor of the State in which the pollution occurs requests it (except for shellfish damage or for oil and vessel pollution). The conference-hearing procedure is cumbersome and time-consuming. Finally, the only force that the Government can wield against a polluter is a cease-and-desist order, and the court's only option in the case of noncompliance is a contempt-of-court action. The act does not provide for fines to enforce compliance. The use of the Corps of Engineers' permit authority as a basis for enforcement will add some Federal muscle.

The President recommended in his February 10 Environmental Message a broad range of tough new enforcement provisions. These include: extending jurisdiction to intrastate pollution and groundwaters, streamlining the enforcement procedures, establishing specific effluent requirements, and setting fines up to $10,000 a day for noncompliance. The procedures under which enforcement has been carried out have been less than satisfactory. There has been no clear rationale for convening enforcement conferences; rather, they have tended to be reactions to critical local problems. Even when held, the results have been mixed. In many cases, abatement schedules agreed to by the Federal Government and the States have slipped seriously. The purpose of any enforcement program is voluntary compliance. What has been lacking is a systematic process that makes clear to municipalities and industries the timing and type of enforcement and penalties if they fail to comply on schedule. Nevertheless, enforcement conferences have spurred State and local governments and industry to make investments that they otherwise would not have made. The pace of

recent actions indicates that the Federal Government intends to enforce existing water pollution laws vigorously. But significant changes in the system of enforcement will be necessary to meet current and future requirements.

State Programs

Although States are better able to cope with water pollution than with air pollution, they are still generally unable to meet the massive requirements to implement water quality standards. Lack of funds and personnel is the major reason. Low salary scales and poor merit systems discourage many talented persons from seeking jobs in State and local water pollution control agencies.

Local Programs

Construction and operation of waste treatment facilities have traditionally been left to individual municipalities. In too many cases, a collection of small, uncoordinated treatment plants ring a city, when a more efficient and effective solution would have been a regional treatment system. Local jealousies and, in the past, the Federal grant system have encouraged this fragmentation. The current proliferation of small plants independent of each other in a number of communities is poor economics and poor pollution control.

It is poor economics because small plants cannot operate as cheaply as big plants. (However, economies of scale are not infinite. An optimum system may include a mix of large and small plants to permit both economies of scale and optimum use of the assimilative capacity of the receiving waters.) It is poor pollution control because of the almost impossible task of getting a large number of communities and industries in a single metropolitan area to plan and construct plants on a coordinated basis. Not only is coordination difficult, but with many diverse authorities, some will fail to take adequate steps to halt pollution. Also, a large single plant can obtain the skilled personnel necessary for sound operation.

As in the State agencies, lack of manpower and funds are a problem. Surprisingly large numbers of treatment plants are operated poorly because of inexperienced personnel. This reduces the plants' contribution to pollution control and shortens their useful life. But the most pressing problem is raising funds for the construction of waste treatment facilities—even when the Federal Government bears a large part

of the cost. Not only is it becoming difficult to find sources of revenue in the face of rising demands for public services, high costs, and high interest rates, but legal and constitutional restrictions can be barriers to issuing bonds.

Monitoring and Information

Water quality monitoring and information systems are not adequate. The systems tend to be spotty in geographic coverage and in the parameters that they cover. Data often are not quickly available. There is no method of combining data to develop indices to help policy makers and the public determine the types of control programs necessary. Finally, there is a shortage of data on the amounts and types of pollutants discharged.

WHAT NEEDS TO BE DONE

The Council on Environmental Quality recommends the following:

1. *Investment in waste treatment facilities must be significantly raised and kept at a sustained high level by enactment of the President's $4 billion program of Federal grants.*

Coupled with State and local matching funds, that program would embrace a $10 billion effort. The President's proposal for an Environmental Financing Authority should also be promptly enacted.

2. *Management reforms must be vigorouly implemented to meet water quality goals effectively and efficiently.* In his February 10 message, the President listed the following reforms in the FWQA waste treatment grant program:

- Federally assisted treatment plants will be required to meet prescribed design, operation, and maintenance standards and be operated only by State-certified operators.
- Municipalities receiving Federal assistance in constructing plants will be required to impose charges on industrial users sufficient to meet the cost of treating industrial wastes.
- Comprehensive river basin plans will be required at an early date to insure that Federally assisted treatment plants will, in fact, contribute to effective cleanup of entire river basin systems.
- Wherever feasible, communities will be encouraged to cooperate in the construction of large regional treatment facilities

providing economies of scale and more efficient and more thorough waste treatment.

Better management of waste treatment programs is absolutely essential—to meet higher water quality standards and to insure that public funds are not wasted. Continued evaluation of the ongoing progress of implementation will be necessary to determine whether additional and more effective measures are necessary.

3. *The FWQA and other Federal waste treatment assistance programs should give priority to encouraging the development of regional treatment systems in metropolitan areas based on comprehensive sewer, water, and land use planning.*

4. *These Federal programs must also encourage localities to impose user charges on the amount and strength of wastes to increase equity and to work toward self-financing systems.* These charges would cover not only industrial wastes, for which policy already exists, but home and commercial wastes as well.

5. *Vigorous and effective enforcement of water quality standards must be implemented.* The President's proposals to extend Federal jurisdiction to intrastate and groundwaters, streamline the conference-hearing procedures, establish effluent requirements, and set fines up to $10,000 a day for violations should be enacted promptly. The basic process of enforcement should be improved. Information systems must be developed to include specific data on implementation schedules. Expansion of Federal and State sampling stations, coupled with an industrial waste inventory, are high priority. States, municipalities, and industries should systematically be warned of violation of standards. If action does not follow and if extenuating circumstances do not exist, the Federal Government should automatically seek court action.

6. *Increased attention must be given to encouraging changes in State and local institutions dealing with water pollution control.* The Council recommends that:

- Efforts be made to provide a demonstration in one river basin of the most advanced concepts of water quality management. Such a demonstration might use regional treatment facilities; nontreatment alternatives such as in-stream aeration and low flow augmentation; and new financial incentives, such as effluent charges. The proposal would demonstrate the techniques to meet water quality management needs in the future, when the problems from increasing population and industrialization grow even more acute. The FWQA should consider how exist-

ing assistance programs could be channeled to such a demonstration.

- Consideration be given to incentives for improving water quality institutions generally. To provide incentives, there must be more knowledge of the merits and faults of various institutional alternatives. One alternative that should be explored for more widespread application is Statewide sewage treatment authorities similar to those authorized by Maryland and Ohio. Other alternatives that should be explored include river basin commissions or authorities and regional government entities to provide sewerage facilities. Besides identifying the best types of institutions for managing water quality, careful attention should be given to the types of incentives, financial or otherwise, necessary to encourage new types of institutions.

7. *A concerted and comprehensive attack should be made on eutrophication.* Three actions are necessary: One, phase phosphates out of detergents as soon as feasible; two, find better methods to control agricultural runoff; and three, remove more of the nutrients from wastes generated by towns and cities, particularly in urban centers and in critical areas such as the Great Lakes.

8. *A program should be formulated to deal with urban runoff and pollution from combined sewer overflows.* Research on alternative methods of separation has uncovered some interesting approaches. In a plan for the District of Columbia, an overflow lake would be created to treat combined sewer overflows, and the treated water would then be channeled into two other lakes for recreation. Promising proposals should be put into operation as demonstrations of what can be done. Clearly the costs and disruption that complete separation entails make it an unattractive approach. In developing solutions to combined sewer overflows, it is necessary to deal with the broader problem of urban runoff which in itself can create high bacterial pollution. As experience mounts and the chances for choosing wrong alternatives diminish, the development of a broader remedial program should be evaluated.

9. *State programs need to be significantly improved.* A major step forward is the tripling of support to State and interstate agencies, as announced by the President. Emphasis must be placed on improving the capabilities of State pollution control agencies to monitor, enforce, and inspect the operations of sewage treatment facilities.

10. *Professional, technical, and operator manpower must be trained.* Manpower needs in water pollution control are great, and training

should be accelerated. The Federal Government, States, municipalities and industries must all share in the costs and responsibilities if a truly effective program is to be launched.

11. *A strong and consistent Federal policy should be developed to control thermal pollution.* Criteria should be upgraded to assure prompt and successful negotiations with the States on water quality limits from thermal pollution, as well as from other sources of water pollution.

12. *A policy and programs should be developed for ocean disposal of wastes.* In his April 15 message to the Congress on Waste Disposal, the President directed the Council on Environmental Quality, working with the Secretaries of the Interior and of the Army, other Federal agencies, and State and local agencies, to determine research needs, legislative changes, and other recommendations to deal with the problem of ocean disposal. The report, due September 1, will focus on new directions and policies in disposal of a wide variety of wastes in ocean waters.

13. *More research, development, and demonstration are needed in several areas.* New methods must be developed to prevent, control, and clean up oil spills. New methods should be developed to deal with waste heat, with more emphasis on its beneficial use. Broader research is required to define and anticipate adverse effects from water pollutants, including the subtle long-term effects from small amounts of toxic chemicals.

14. *Efforts to assure the safety of municipal water supplies should be increased.* This will mean greater research on the potential health hazards which may be contained in drinking water and more thorough surveillance of drinking water supplies. Current knowledge, surveillance, and control of such hazards are inadequate.

15. *More demonstrations on reuse and recycling of waste waters and sludge should be conducted.* Most abatement plans look toward treatment and disposal into water bodies. The materials left over, the so-called sludge, are disposed of as a solid waste. More creative solutions for reuse, such as using the fertile waste water for irrigation systems (providing both water and nutrients), recharging of ground water, and use of recreation lakes as the end of the treatment process are necessary. Tertiary treated waste waters could be used as a source of domestic and industrial water supply. The nutrient-rich sludge might be used productively as a soil conditioner.

16. *Water quality management should be considered in the broader context of overall waste management.* Water pollution, like other

forms of pollution, is a problem of materials balance. If the materials normally considered waste are used for productive purposes, pollution problems are diminished. Recycling of materials—paper, for example—would also reduce pollution from primary production. New chemicals, offshore oil loading facilities, and new methods of generating power will all have an impact on the environment—positive or negative. Attention must be given to "technology assessment" to prevent future pollution and to choose alternative courses that will reduce it. Strategies to deal with water pollution or any other pollution should take into account these broader waste management considerations.

17. *The attack on problems from agricultural pollution should be intensified.* Among these are nutrients from fertilizers; animal wastes, especially from feedlot operations; pesticides; and irrigation return-flows. New techniques must be developed and demonstrated for controlling agricultural pollution as soon as possible. At the same time, more action can and should be taken now to deal with these problems. The Council is currently working with Federal agencies and universities to evaluate the status of control techniques and the best research and action approaches.

18. *Mechanisms may be required to protect water against a wide variety of materials that enter the environment and that are not covered under current regulatory authorities.* The Council is exploring the feasibility of a program to pretest and control products and residuals that can be harmful to human health, to wildlife, and to plant life.

Looking Toward the Future

The Nation is on the threshold of a major attack on water pollution, but the goal is not easily won. The President's proposals for a $10 billion financing program and tighter enforcement will reverse the worst water pollution, but other water pollution problems will become even more apparent. In the short run, there is no easy solution to this highly complex problem. In the long run, control of water pollution will require institutional and management changes, possibly some changes in the products that people consume. It will require large amounts of public funds, and it will lead to higher prices for some products.

The financing and management tools to solve the water quality problems of the future are yet to be developed. The Nation's ability to develop these tools is its most important challenge in attaining high-quality water.

IV

Air Pollution

WE TEND to view air pollution as a recently discovered phenomenon. But since the dawn of the industrial revolution, people in many communities have endured levels of smoke pollution that would be held intolerable today. In the last half of the 19th century, a surprising number of aroused citizen groups protested the smoke-laden air of London. But their protests were lost in the overwhelming clamor for industrial development at any price.

Progress in the United States was no more heartening. Chicago and Cincinnati passed smoke control laws in 1881. By 1912, 23 of the 28 American cities with populations over 200,000 had passed similar laws. But still there was little dent made in air pollution.

In the 1930's, 1940's, and 1950's smoke pollution reached its zenith in the United States, especially in Eastern and Midwestern industrial cities. The public outcry against these conditions resulted in the enactment of improved smoke pollution legislation, its partial enforcement, and a visible improvement in the air of some industrial cities. These local control efforts focused primarily on cutting down smoke from fossil fuels, particularly coal. The fortunate advent of diesel engines in place of steam locomotives and the increased use of gas as a fuel for space heating also helped cut back air pollution in that era.

The Donora disaster in Pennsylvania in 1948 pricked the conscience of the Nation, but the experience of Los Angeles beginning in that same decade was a more certain sign of the complex air pollution problem which now confronts cities throughout the world. When the citizens of Los Angeles began to complain of smog, few people suspected that air pollution was a great deal more than just smoke. Los Angeles used virtually none of the fuels primarily responsible for the smoke problems of cities elsewhere; yet smog appeared and worsened. Dr. Arie J. Haagen-Smit, of the California Institute of Technology, finally pinpointed the principal sources of photochemical smog in Los Angeles—hydrocarbons and nitrogen oxides from automobile exhausts. Smog was at first thought to be a phenomenon amplified by local weather conditions and limited to Los Angeles. Today, however, most major cities are afflicted to some degree by photochemical smog as well as by other forms of air pollution.

Air pollution is for the most part a phenomenon of urban living that occurs when the capacity of the air to dilute the pollutants is overburdened. Population and industrial growth and a high degree of dependence on the motor vehicle cause new gaseous and particulate emissions to complement, interact with, and further complicate the traditional ones.

When the first Federal air pollution control legislation was passed in 1955, there were no viable ongoing State programs at all. There was little interest in the scientific community, and the public, by and large, equated air pollution with coal smoke and considered smog a problem unique to Los Angeles. It is no wonder that air pollution is regarded as a recently discovered phenomenon.

POLLUTANTS AND THEIR SOURCES

Five main classes of pollutants are pumped into the air over the United States, totaling more than 200 million tons per year. These are summarized in table 1 for 1968, the latest year for which data are available for making estimates.

Transportation—particularly the automobile—is the greatest source of air pollution. It accounts for 42 percent of all pollutants by weight. It produces major portions not only of carbon monoxide but of hydrocarbons and nitrogen oxides.

TABLE 1.—*Estimated Nationwide Emissions, 1968*

[In millions of tons per year]

Source	Carbon monoxide	Particulates	Sulfur oxides	Hydrocarbons	Nitrogen oxides	Total
Transportation	63.8	1.2	0.8	16.6	8.1	90.5
Fuel combustion in stationary sources	1.9	8.9	24.4	.7	10.0	45.9
Industrial processes	9.7	7.5	7.3	4.6	.2	29.3
Solid waste disposal	7.8	1.1	.1	1.6	.6	11.2
Miscellaneous [1]	16.9	9.6	.6	8.5	1.7	37.3
Total	100.1	28.3	33.2	32.0	20.6	214.2

[1] Primarily forest fires, agricultural burning, coal waste fires.

Source: NAPCA Inventory of Air Pollutant Emissions, 1970.

Carbon monoxide (CO) is a colorless, odorless, poisonous gas, slightly lighter than air, that is produced by the incomplete burning of the carbon in fuels. Carbon monoxide emissions can be prevented by supplying enough air to insure complete combustion. When this occurs, carbon dioxide, a natural constituent of the atmosphere, is produced instead of carbon monoxide.

Almost two-thirds of the carbon monoxide emitted comes from internal combustion engines, and the overwhelming bulk of that comes from gasoline-powered motor vehicles.

Particulate matter includes particles of solid or liquid substances in a very wide range of sizes, from those that are visible as soot and smoke to particles too small to detect except under an electron microscope. Particulates may be so small that they remain in the air for long periods and can be transported great distances by the winds. They are produced primarily by stationary fuel combustion (31 percent) and industrial processes (27 percent). Forest fires and other miscellaneous sources account for 34 percent.

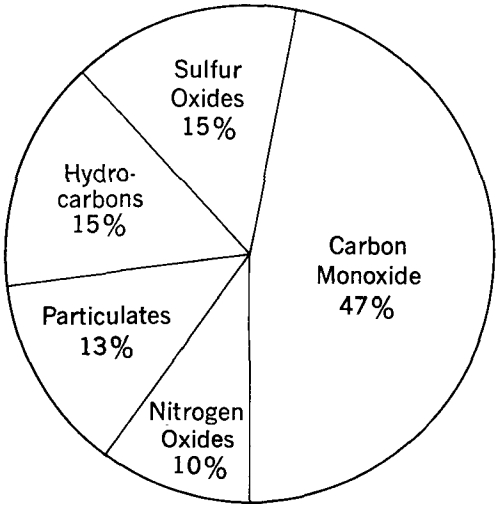
There are established techniques for controlling particulates from a boiler stack or from a waste air stream—among them filtering, washing, centrifugal separation, and electrostatic precipitation. These work well for most of the particles, but complete removal, especially of the very finest particles, is technically and economically difficult.

Sulfur oxides (SO_x) are acrid, corrosive, poisonous gases produced when fuel containing sulfur is burned. Electric utilities and industrial plants are its principal producers since their most abundant fuels are coal and oil, which contain sulfur as an impurity. The burning of coal produces about 60 percent of all sulfur oxides emissions, oil about 14 percent, and industrial processes that use sulfur 22 percent.

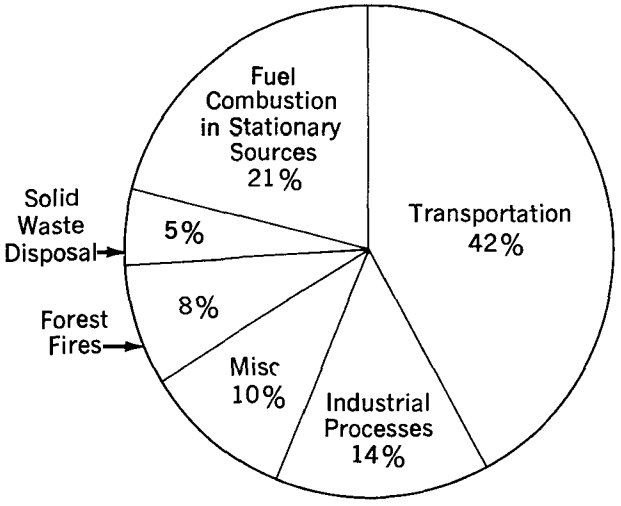
Air Pollution Emissions in the United States, 1968

Percentage by weight

What They Are



Where They Come From



Source: National Air Pollution Control Administration, HEW.

Most of the coal and oil is burned in electric power generation plants. About two-thirds of the Nation's sulfur oxides are emitted in urban areas, where industry and population are concentrated. And seven industrial States in the Northeast account for almost half of the national total of sulfur oxides. In rural areas, however, sulfur oxides sources may be large industrial plants, smelters, or power plants. Any one of these may throw out several hundred thousand tons of sulfur oxides in a year.

Government agencies and industry have sought to reduce sulfur oxide emissions in three ways: switching to low sulfur fuels (those with less than 1 percent sulfur), removing sulfur from fuels entirely, and removing sulfur oxides from the combustion gases.

Hydrocarbons (HC), like carbon monoxide, represent unburned and wasted fuel. Unlike carbon monoxide, gaseous hydrocarbons at concentrations normally found in the atmosphere are not toxic, but they are a major pollutant because of their role in forming photochemical smog. More than half the estimated 32 million tons of hydrocarbons produced each year comes from transportation sources, mainly gasoline-fueled vehicles. Another 27 percent comes from miscellaneous burning and 14 percent from industrial processes. About 60 percent is produced in urban areas, largely because there are more automobiles.

Nitrogen oxides (NO_x) are produced when fuel is burned at very high temperatures. Stationary combustion plants produce 49 percent of the nitrogen oxide emissions; transportation vehicles, 39 percent; and all other sources, 12 percent.

Internal combustion engines operate at very high temperatures, and so do efficient, large electric power and industrial boilers. Nitrogen that is ordinarily inert combines with oxygen in high temperature flames and tends to stay combined if the exhaust gases are cooled too quickly. The control of NO_x from stationary sources requires careful adjustment of flame and stack gas temperatures. Control of nitrogen oxides from automobiles is more difficult because reducing other pollutants can increase the output of NO_x.

Under the influence of sunlight, nitrogen oxides combine with gaseous hydrocarbons to form a complex variety of secondary pollutants called *photochemical oxidants*. These oxidants, together with solid and liquid particles in the air, make up what is commonly known as smog. The photochemical oxidant family of pollutants includes, among others, ozone, an unstable, toxic form of oxygen; nitrogen

dioxide; peroxyacyl nitrates; aldehydes; and acrolein. In air they can cause eye and lung irritation, damage to vegetation, offensive odor, and thick haze.

WHAT AIR POLLUTION DOES

Air pollution adversely affects man and his environment in many ways. It soils his home and interferes with the growth of plants and shrubs. It diminishes the value of his agricultural products. It obscures his view and adds unpleasant smells to his environment. Most important, it endangers his health.

The extent of air pollution depends heavily on how weather disposes of the pollutants. The ability of the atmosphere to dilute and disperse them is limited to two factors—wind speed and the depth in the atmosphere to which air near the surface can be mixed. Although considerable variation occurs from day to day in the extent to which these factors disperse air pollution, the same patterns tend to repeat themselves over months or years. On some few days in a year, strong winds and highly unstable atmospheric conditions may disperse even the heaviest blanket of pollution. On many other days, weak winds and highly stable conditions let small quantities of pollutants accumulate and build up to serious proportions. Between these extremes, variations in weather conditions create varying levels of pollution over a given area.

Many cities lie in natural basins at the confluence of rivers, around bays, or in flat areas backed against mountains. Such basins are natural gathering places for low-lying masses of warm air, which trap pollutants in the familiar phenomenon known as an "inversion." However, even communities more favorably located increasingly find that atmospheric conditions limit the amount of air available as a dumping place for pollutants.

. . . to Human Health

The most important effect of air pollution is its threat to human health. Acute episodes of pollution in London, New York, and other cities have been marked by dramatic increases in death and illness rates, especially among the elderly and those with preexisting respiratory or cardiac conditions.

The incident most familiar to Americans occurred in 1948 in Donora, an industrial town in the mountains of western Pennsylvania. Almost half of the town's 14,000 inhabitants fell ill; 20 died. The worst air pollution disaster of modern times struck in London in 1952 when its famous "killer smog" increased the number of deaths in London to 1,600 more than would have normally occurred. Both of those episodes occurred when, under conditions lasting for several days, unusual weather prevented the dispersal of pollutants.

Such major disasters are cause for concern. However, of much greater significance for the American population are the subtle, long-range effects on human health of exposure to low-level, long-lasting pollution.

The causes of chronic diseases which constitute the major public health problems of our time are difficult to determine. Assessing the contribution of particular pollutants to these conditions is complicated by the seemingly infinite variety of pollutants to which persons, particularly those in urban areas, are exposed from the day of their birth. And it is difficult to separate pollution from the other biological and physical stresses to which people are subjected.

Nonetheless, it is well established that air pollution contributes to the incidence of such chronic diseases as emphysema, bronchitis, and other respiratory ailments. Polluted air is also linked to higher mortality rates from other causes, including cancer and arteriosclerotic heart disease. Smokers living in polluted cities have a much higher rate of lung cancer than smokers in rural areas.

The incidence of chronic diseases has soared sharply during this century, while the infectious diseases which were the primary public health concern in the past have been brought under control. Heart and blood vessel diseases caused more than half the deaths in the United States in 1962. Lung cancer, once a rarity, now kills more persons than all other cancer types combined. Emphysema has doubled every 5 years since World War II. Air pollution has been linked to asthma, acute respiratory infections, allergies, and other ailments in children. Such childhood diseases may well underlie chronic ills developed in later life.

Knowledge of the health effects of specific contaminants present in the air is far from complete. However, the more overt health effects of several major classes of pollutants are beginning to be defined. Those pollutants are found almost everywhere in the United States.

When *carbon monoxide* is inhaled, it displaces the oxygen in the blood and reduces the amount carried to the body tissues. At levels commonly found in city air, it can slow the reactions of even the healthiest persons, making them more prone to accidents. Moreover, it is believed to impose an extra burden on those already suffering from anemia, diseases of the heart and blood vessels, chronic lung disease, overactive thyroid, or even simple fever. Cigarette smokers, who are already inhaling significant amounts of CO in tobacco smoke, take on an additional CO burden from polluted air.

Studies show that exposure to 10 parts per million of CO for approximately 8 hours may dull mental performance. Such levels of carbon monoxide are commonly found in cities throughout the world. In heavy traffic situations, levels of 70, 80, or 100 parts per million are not uncommon for short periods.

Sulfur oxides, produced mainly by burning coal and oil, can cause temporary and permanent injury to the respiratory system. When particulate matter is inhaled with the sulfur oxides, health damage increases significantly. The air pollution disasters of recent years were due primarily to sharply increased levels of sulfur oxides and particulates.

Sulfur dioxide can irritate the upper respiratory tract. Carried into the lungs on particles, it can injure delicate tissue. Sulfuric acid—formed from sulfur trioxide when water is present—can penetrate deep into the lungs and damage tissue.

Health may be imperiled when the annual mean concentration of sulfur dioxide in the air rises above 0.04 parts per million. Deaths from bronchitis and from lung cancer may increase when this level of sulfur dioxide is accompanied by smoke concentrations of about 0.06 parts per million. American cities often exceed this annual mean substantially. The annual mean concentration of SO_2 in the air was 0.12 parts per million in Chicago in 1968; in Philadelphia it was 0.08. When SO_x exceeds 0.11 parts per million for 3 to 4 days, adverse health effects have been observed, and this level is reached in many large cities during inversions.

Photochemical oxidants have emerged relatively recently as a major health problem, and research relating to their effects on human health is still in its infancy. However, studies have shown that eye irritation begins when peak oxidant levels reach 0.10 parts per million. Increased frequency of asthma attacks occurs in some patients on those days when hourly concentrations average 0.05 to 0.06 parts per million. Even the healthiest persons may be affected, however; a study

of cross-country runners in a Los Angeles high school showed that their performances suffered when hourly average oxidant levels ranged from 0.03 to 0.30 parts per million.

Less is known about the effects on health of *nitrogen oxides*, which play such an important part in producing photochemical pollution. They have been little studied until recently. However, evidence so far suggests that they may be harmful to human health. A study in Chattanooga, Tenn., linked very low levels of these oxides in the air to children's susceptibility to Asian flu.

The lowest *particulate levels* at which health effects have been noted in the United States were reported at Buffalo. The Buffalo study suggests that the overall death rate rises in areas with an annual average concentration ranging from 80 to 100 micrograms per cubic meter. The study also reveals a tie between these levels of particulate matter and gastric cancer in men 50 to 69 years old. A similar association was found in a Nashville study. Particulate levels in this range are found in most major urban areas and are common even in smaller industrial cities.

The findings relating to particulate matter, as a class of pollutants, amply justify measures to reduce their level in the air. Included in this class of pollutants are a number of substances which are potential health hazards at much lower concentrations and which will require even more stringent controls.

Beryllium, for example, which may be emitted from industrial sources and from rocket fuel, can cause lesions in the lung, producing serious respiratory damage and even death. Since the sources of this pollutant are limited, however, it may be a problem only in specific localities.

Asbestos, long recognized as an occupational hazard, is increasingly present in the ambient air because of its use in construction materials, brake linings, and other products. Long exposure in industry produces the lung-scarring disease, asbestosis. On the other hand, mesothelioma, a type of lung cancer associated almost exclusively with asbestos exposure, does not appear to be associated only with heavy or continued exposure.

Many other particulate pollutants are a growing public health worry even though they may not constitute such an immediate and direct threat. Current studies suggest that lead levels now found in the blood and urine of urban populations—although well below those associated with classic lead poisoning—may interfere with the ability of

the human body to produce blood. As air pollution becomes more widespread, increased numbers of people are being exposed to airborne lead, chiefly from automotive emissions, at levels formerly found only in congested areas.

. . . *to Vegetation and Materials*

Air pollution inflicts widespread and costly damage on plant life and buildings and materials. Some experiences of the past warned of the effects of air pollution on plant life. Sulfur dioxide fumes from a large copper smelting plant set up after the Civil War in Copper Basin, Tenn., damaged 30,000 acres of timberland. Much of this originally forested mountain land is still barren. Today, the damage to plant life is less dramatic than in the days of unrestricted smelter operations. But the slower, chronic injury inflicted on agricultural, forest, and ornamental vegetation by increasing quantities and varieties of air pollutants has now spread to all parts of the country.

Smog in the Los Angeles basin contributes to the slow decline of citrus groves south of the city and damages trees in the San Bernardino National Forest 50 miles away. Fluoride and sulfur oxides, released into the air by phosphate fertilizer processing in Florida, have blighted large numbers of pines and citrus orchards. Livestock grazing on fluoride-tainted vegetation develop a crippling condition known as fluorosis. In New Jersey, pollution injury to vegetation has been observed in every county and damage reported to at least 36 commercial crops.

At sulfur oxide levels routinely observed in some of our cities, many plants suffer a chronic injury described as "early aging." Nitrogen dioxide produces similar injury symptoms and seems to restrict the growth of plants even when symptoms of injury are not visible. Ozone, a major photochemical oxidant, is a significant threat to leafy vegetables, field and forage crops, shrubs, and fruit and forest trees—particularly conifers. The damage from ozone in minute quantities can be great. Extended ozone exposure to 0.05 parts per million can reduce a radish yield 50 percent. Tobacco is sensitive to ozone at a level of 0.03 parts per million.

Air pollutants also damage a wide variety of materials. Sulfur oxides will destroy even the most durable products. Steel corrodes two to four times faster in urban industrial areas than it does in rural areas where much less sulfur-bearing coal and oil are burned. When par-

ticulate matter is also present in the air, the corrosion rates multiply. One-third of the replacement cost of steel rails in England is estimated to be caused by sulfur pollution. The rise of sulfur oxides levels in the air is accelerating the erosion of statuary and buildings throughout the world, and in some cities, works of art made of stone, bronze, and steel must be moved indoors to preserve them from deterioration. Particulate matter in the air not only speeds the corrosive action of other pollutants but by itself is responsible for costly damage and soiling. Clothes and cars must be washed, houses painted, and buildings cleaned more often because of the particulates in the air. Ozone damages textiles, discolors dyes, and greatly accelerates the cracking of rubber.

. . . *to Visibility*

Air pollution dims visibility, obscures city skylines and scenic beauty, interferes with the safe operation of aircraft and automobiles, and disrupts transportation schedules. In one recent year, low visibility from smoke, haze, and dust was the suspected cause of 15 to 20 plane crashes. In Los Angeles, visibility in the smog frequently lowers to less than 3 miles. During the air pollution alert in the eastern States during July 1970, visibility was almost totally obscured in some areas. The Federal Aviation Administration's visibility safety factor for airplane operation without instruments is 5 miles. Nitrogen dioxide, which reaches peak levels during morning rush-hour traffic, is responsible for the whiskey-brown haze that stains the sky over many cities. Particulates, however, are the major villain in reducing visibility. Particles (ash, carbon, dust, and liquid particles) discharged directly to the air scatter and absorb light, reducing the contrast between objects and their backgrounds. Particles are also formed in the atmosphere by photochemical reactions and by the conversion of sulfur dioxide to sulfuric acid mist. Wherever sulfur pollution is significant—which is wherever large amounts of coal and oil are burned—visibility diminishes as relative humidity rises.

. . . *to Climate*

Air pollution alters climate and may produce global changes in temperature. Chapter V of this report deals with that subject.

WHAT AIR POLLUTION COSTS

. . . *in Damages*

The total costs of air pollution in the United States cannot be precisely calculated, but they amount to many billions of dollars a year. Economic studies are beginning to identify some of the more obvious costs. To paint steel structures damaged by air pollution runs an estimated $100 million a year. Commercial laundering, cleaning, and dyeing of fabrics soiled by air pollution costs about $800 million. Washing cars dirtied by air pollution costs about $240 million. Damage to agricultural crops and livestock is put at $500 million a year or more. Adverse effects of air pollution on air travel cost from $40 to $80 million a year. Even more difficult to tie down are the costs of replacing and protecting precision instruments or maintaining cleanliness in the production of foods, beverages, and other consumables. It is equally difficult to assess damage, soiling, and added maintenance to homes and furnishings or how air pollution acts on property values. The cost of fuels wasted in incomplete combustion and of valuable and potentially recoverable resources such as sulfur wasted into the air is also hard to count. It is still more difficult to determine the dollar value of medical costs and time lost from work because of air pollution—or to calculate the resulting fall in productivity of business and industry.

. . . *in Control*

The total investment necessary through 1975 to control the major industrial and municipal sources of particulate matter, sulfur oxides, hydrocarbons, and carbon monoxide in 100 metropolitan areas of the United States has been estimated at $2.6 billion. This includes costs for controlling both existing and new sources. By 1975, it will cost another $1.9 billion for operation, maintenance, depreciation, and interest.

These estimated costs are based on assumed future control requirements. Still, the yearly cost to control the industrial sources of these four major pollutants is relatively low, less than 1 percent of the value of the annual output of the industries involved, although the costs to some industries is much greater.

According to industry estimates, the costs of control devices to meet Federal motor vehicle emission standards are rising rapidly, both because of general increases in prices and because of the increasing stringency of the standards. The cost for 1968 and 1969 models was $18–19 per car; for 1970, $36 per car; and for 1971 models it is estimated at $49 per car. The application of more stringent standards will increase these costs still further. Thus in 1971 the cost for installing control devices on the 10 million new cars produced will be almost $500 million. However, assuming that the average vehicle life is 10 years, the cost is only $5 per car per year.

PROGRAMS IN AIR POLLUTION CONTROL

Legislative History

The first Federal legislation concerned exclusively with air pollution was enacted in July 1955. It authorized $5 million annually to the Public Health Service of the Department of Health, Education, and Welfare for research, data collection, and technical assistance to State and local governments.

Pressures for action led to the Clean Air Act of 1963. It provided grants to air pollution agencies for control programs (with special bonuses for intermunicipal or interstate areas). And it provided Federal enforcement authority to attack interstate air pollution problems.

In October 1965, the Clean Air Act was amended to permit national regulation of air pollution from new motor vehicles. The first standards were applied to 1968 models. These standards were tightened for 1970 and 1971 model cars. And even more stringent standards have been announced for 1973 and 1975.

In November 1967, the Congress passed the comprehensive Air Quality Act, which undergirds much of the current Federal air pollution control effort. That act set in motion a new regional approach to establishing and enforcing Federal-State air quality standards:

- The Secretary of HEW first must designate air quality control regions within a State or within an interstate region.
- The Secretary must promulgate air quality criteria which, based on scientific studies, describe the harmful effects of an air pollutant on health, vegetation, and materials. He must issue control technology documents showing availability, costs and effectiveness of prevention and control techniques.

- In the designated regions, the States must show willingness to establish air quality standards.
- The States then set standards limiting the levels of the pollutant described in the criteria and control technology documents. If the States fail to do this, the Secretary is empowered to set the standards.
- After the States have developed air quality standards, they must establish comprehensive plans for implementing them. (These plans should set specific emission levels by source and a timetable for achieving compliance.)

The process of adopting standards and implementation plans can take up to a year and a half, and the approval process requires still more time. The process must be renewed and repeated each time criteria and control techniques are issued for a new pollutant.

On February 10, 1970, the President made a number of legislative proposals to improve the air quality program. Among them were proposals to apply air quality standards throughout the entire Nation, not just within the air quality control regions. Hearings are provided for, and the States have the option of adopting more stringent standards if they choose. The States would have 9 months from the time the national standards are established to submit a plan detailing how they would enforce the national standards, including the associated emission standards. The Federal Government would enforce the standards if the air quality in a State or region fell below the standards and the State plan was not being carried out. The provisions for national standards should markedly quicken the process of establishing enforceable standards and a workable plan for abatement.

The President's proposals also call for national emission standards for new pollutant sources considered harmful to health and welfare and which can be controlled. This authority is necessary to insure that new stationary sources are designed to reduce emissions to the lowest level consistent with available technology. National emission standards would apply to existing as well as to new stationary sources for pollutants extremely hazardous to health, such as asbestos, cadmium, or beryllium. The legislation would authorize the Secretary of HEW to move directly against sources of these pollutants when States do not act.

The President's program would also extend Federal enforcement authority to pollution within one State. And it would levy fines of up to $10,000 a day for noncompliance.

The Department of HEW first issued documents on air quality criteria and control methods for sulfur oxides and particulate matter in February 1969. This triggered the standards-setting process for these two key pollutants. In March 1970, criteria and control documents were issued for carbon monoxide, hydrocarbons, and photochemical oxidants. HEW expects to issue documents on lead, nitrogen oxides, flourides, and polynuclear organic compounds early in 1971.

By July 1, 1970, air quality regions had been designated in 40 major metropolitan areas. By the end of the summer 1970, HEW expects to designate 90 regions, providing at least one region in each State. These regions will embrace 123 million people, almost 60 percent of the U.S. population. As of July 1, 1970, 17 States had submitted standards to the Department, and 10 had been approved. No implementation plans have yet been approved.

Action on each new pollutant requires publication of air quality criteria and control technology, the development and approval of State standards for each region, and the development and approval of State implementation plans for each region. The National Air Pollution Control Administration (NAPCA) is currently studying 30 different pollutants to determine their potential effects on health. When the evaluations are completed, criteria documents will be issued, as necessary.

Federal Abatement Actions

Although the major current emphasis is on developing standards, some action continues under the enforcement provisions of the 1963 Clean Air Act. Since passage of the act, 10 enforcement conferences have been held. Four have dealt with single sources of pollution; six have considered all sources of pollution within major metropolitan areas, including the metropolitan areas of New York-New Jersey, Kansas City, and Washington, D.C.

Those conferences covering whole metropolitan areas have concentrated more on strengthening State and local efforts than on directly curbing polluters. The conference-public hearing procedure has been a cumbersome and time-consuming method of taking action against individual polluters.

The first air pollution enforcement action was instituted in 1965 against a chicken rendering plant in Bishop, Md. A conference was held in 1965 and a public hearing in 1967; a suit was begun in the Federal district court in 1969, and an appeal finally made to the U.S

Supreme Court. The plant was not shut down until the Supreme Court refused to hear the appeal in May 1970—5 years after the action started. No other enforcement action has proceeded beyond the conference stage.

No enforcement has yet taken place under the 1967 act, since the standards, for the most part, have not yet been adopted nor implementation plans approved. The President has submitted comprehensive proposals to the Congress to strengthen enforcement powers. These are discussed later in the chapter.

Curbing Auto Pollution

The first standards set under the 1965 Amendments to the Clean Air Act applied to 1968 model vehicles. These standards required complete control of crankcase hydrocarbons and partial control of exhaust hydrocarbons and carbon monoxide.

In June 1968, HEW tightened exhaust standards for 1970 and later model vehicles and for the first time set evaporative loss standards—to be applied starting with the 1971 model year.

In July 1970, the Secretary proposed sweeping changes in procedures for testing whether new automobiles meet the Federal emission standards—when it was discovered that the existing procedures underestimated the actual amount of pollution being emitted. The new test procedures would take effect when prototypes of 1972 model cars begin their tests at the end of this year. At the same time, the Secretary confirmed the same 1975 standards for hydrocarbons and carbon monoxide and said that the nitrogen oxide and particulate standards proposed in February 1970 would be confirmed as soon as test procedures for these standards had been developed. Table 2 summarizes the effects of all these standards on automobile emissions through 1975.

Under the 1965 Amendments to the Clean Air Act, NAPCA tests only vehicles submitted by a manufacturer. If the test vehicle meets the Federal standards, all other like model vehicles sold by a manufacturer are deemed in conformity with the standards.

The first surveillance data on production line cars subject to the Federal standards were reported in the summer of 1968. The data showed that, on the average, the cars complied with the Federal standards. However, by the winter of 1969, the surveillance data showed that, on the average, hydrocarbon emissions of 1968 cars ran about 20 percent above the standard and carbon monoxide emissions

about 8 percent above. Reports in 1970 show hydrocarbon emissions higher than the standard by 25 percent and carbon monoxide by about 10 percent.

TABLE 2.—*Exhaust Emission Standards and Uncontrolled Vehicle Emission Levels Based on Current and Proposed 1972 Test Procedures*

PRESENT TEST PROCEDURE

	Hydrocarbons		Carbon monoxide		Oxides of nitrogen		Particulates	
	G./mi.[1]	Percent[2]	G./mi.	Percent	G./mi.	Percent	G./mi.	Percent
Baseline (uncontrolled vehicle)	11.2		73.0					
Present standards (intended degree of control)	2.2	80	23.0	69	N.A.[3]	N.A.	N.A.	N.A.
1975 standards (expected control)	.5	96	11.0	86				

PROPOSED TEST PROCEDURE

Baseline (uncontrolled vehicle)	14.6		116.3		6.0		0.3	
Equivalent present standards (achieved degree of control)	4.6	69	47.0	60				
Proposed 1972 Standards (control)	2.9	80	37.0	69				
Proposed 1973 standards (control)					3.0	50		
Proposed 1975 standards (control)	.5	97	11.0	91	.9	85	.1	66.7

[1] Grams per mile emitted.
[2] Percentage reduction from uncontrolled vehicle.
[3] No standards applicable.
Source: NAPCA.

Remedies for the failure of production line cars to perform as well as their prototypes are both administrative and legislative. New tests to be applied for the first time to 1972 models include a revised durability test. It will more accurately reflect actual operating conditions. And the manufacturer will be required to make available to NAPCA test cars to be under the control of the Federal Government in accumulating durability mileage.

Proposed Presidential amendments to the Clean Air Act would authorize HEW to withdraw approval of a particular model of car if vehicles coming off the production lines do not meet the Federal standards. Moreover, the Secretary of HEW would be explicitly authorized to test, or require manufacturers to test, vehicles at the end of production lines. Even with these safeguards, many automobiles will not meet the standards. In addition to systems that break down or are not sufficiently durable, the car owner may not provide proper maintenance.

The data on present levels of pollution in our urban environment,

the projected increase in urban traffic in the years ahead, and the performance of pollution control systems under actual driving conditions make it clear that even applying stricter standards in 1975 will only prolong the downward curve in vehicle emissions until the middle 1980's. After that, carbon monoxide levels will again rise because of the sheer number of automobiles on the roads and highways.

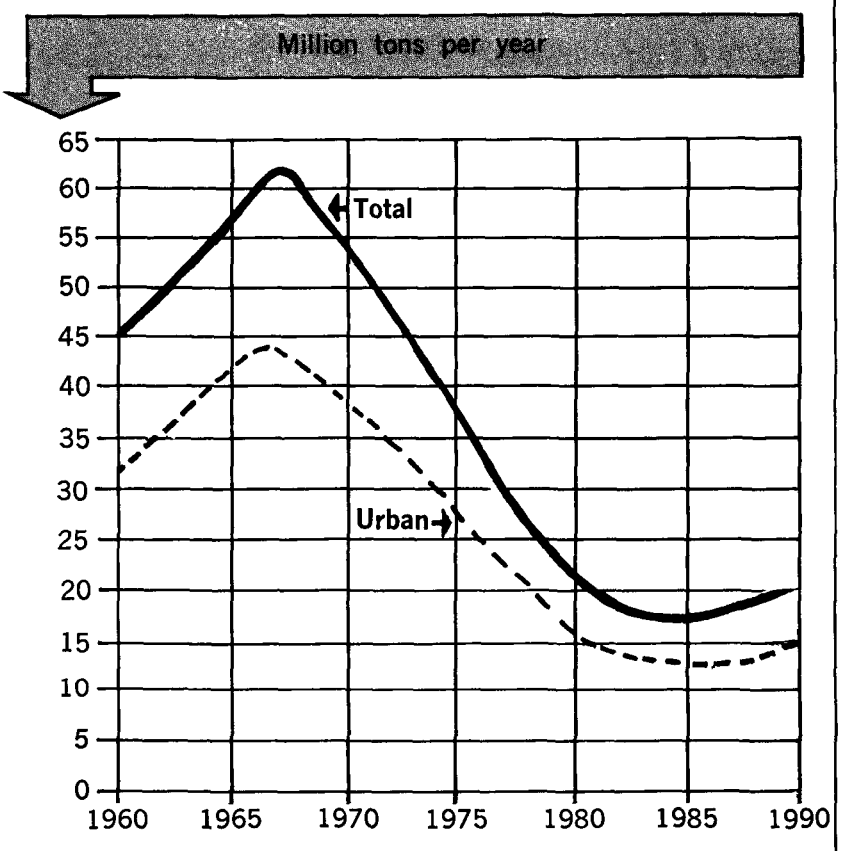
Motor vehicle pollution is the product of a complex combustion system of engines, fuels, and fuel additives. Effective control, then, means dealing not only with engines and control devices but with the fuel itself and with fuel additives. The President's proposed legislation includes authority to establish standards and regulations for both fuel and fuel additives.

The key additive from an air pollution control viewpoint is tetraethyl lead in gasoline. It accounts for a significant portion of the particulate pollution from automobiles. Most experts believe that control systems incorporating chemical catalysts will be required to meet 1975 standards. Experience to date indicates that lead in gasoline poses serious problems to the use of catalytic control devices. Although other control methods are likely to be available, the catalyst appears to be most economical and durable. A panel of the Commerce Technical Advisory Board concluded that lead-free gasoline should be ready within the next few years so that industry will have the chance to road-test these catalytic devices. Automobile manufacturers say that they intend to market vehicles with low-octane requirements in their 1971 models, thus reducing or even eliminating the need for lead in gasoline.

The Secretary of HEW has asked the chief executives of the Nation's petroleum companies to work toward production of a lead-free gasoline. The Secretary suggested a plan to reduce lead levels in regular grades to 0.5 gram per gallon by July 1, 1971, and to zero lead content by July 1, 1974. However, since premium gasoline containing lead will still be needed for a number of years to meet the requirements of high compression engines in older cars, the Secretary's plan provides for leaded premium gasoline as long as it is needed. To make the new gasolines competitive, the administration has requested a $4.25 per pound tax on lead used in gasoline.

An alternative to the internal combustion engine may be necessary if it cannot meet the increasingly stiff standards. The President announced in his February 10, 1970, environmental message a program to develop one or more alternatives within 5 years. He called for:

Carbon Monoxide Emissions by Motor Vehicles in the United States, 1960–90



Projections based on proposed
1973 and 1975 Federal Standards

Source: National Air Pollution Control Administration, HEW.

- An extensive research and development program to be conducted under the general direction of the Council on Environmental Quality;
- An incentive program to private developers, through Government purchase of privately produced unconventional vehicles for testing and evaluation.

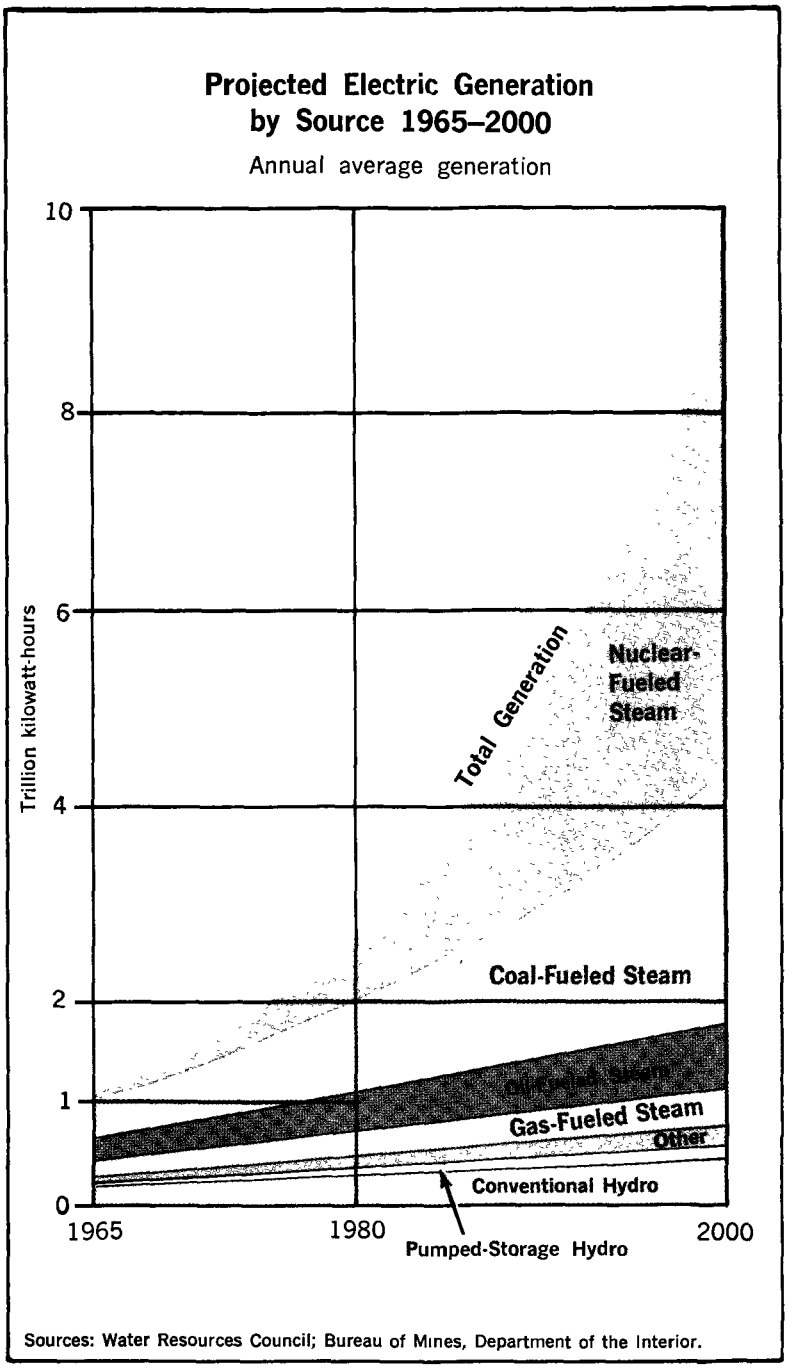
Controlling Sulfur Oxides

Sulfur oxides are one of the most difficult classes of air pollutants to control. Because of their toxicity and pervasiveness, they are among the most dangerous air pollutants to human health and are clearly the most harmful to vegetation, buildings, and materials. Because their source is chiefly the electric power industry, their potential increase is tied to that burgeoning industry, which almost doubles its output every 10 years.

At present about 65 percent of the energy for generating electricity stems from coal; gas, oil, and hydroelectric sources account for about 34 percent; and nuclear energy the remaining 1 percent. By 1980, 22 percent of the total installed electric power capacity is expected to be nuclear. By 1990, it will be 40 percent. However, by far the greatest source of energy is now, and will continue to be for the rest of this century, the burning of coal and oil. The amount of coal used for power by the year 2000 will be four times greater than it is today.

A number of alternatives are available to control sulfur oxide pollution over the next decade. Switching fuels is possible, but only when an alternative, low-sulfur fuel is available. Most coal near the Nation's centers of population and power demand is high in sulfur. Low-sulfur coal not only is far away but also commands a higher price for use as coke by domestic and foreign steelmakers. North Africa and other areas are rich in low sulfur oil but are limited by low production and refinery capabilities. Oil import quotas bar it from certain areas of the Midwest and the West Coast, although the oil may be imported to other areas of the United States. The United States will probably continue to rely primarily on residual oil from the Western Hemisphere. And that oil will have to be desulfurized before it is used. Natural gas carries an insignificant sulfur content, but it is the scarcest of fossil fuels, and most of it is being conserved for nonpower purposes.

Sulfur can be separated from coal and oil, but the processes are costly, and some are not fully developed technically. Methods to remove sulfur from the stack gases after the fuel is burned are under


Projected Electric Generation
by Source 1965–2000
Annual average generation
Trillion kilowatt-hours
10
8
6
4
2
1
0
1965
1980
2000
Total Generation
Nuclear-Fueled Steam
Coal-Fueled Steam
Oil-Fueled Steam
Gas-Fueled Steam
Other
Conventional Hydro
Pumped-Storage Hydro
Sources: Water Resources Council; Bureau of Mines, Department of the Interior.

development. However, none of these processes is yet in large-scale use and the costs are not yet known. Some of the stack control processes recover sulfur or a sulfur byproduct, which can be sold to help offset costs. Some are also being evaluated for their potential in reducing pollution from nitrogen oxides.

Research and Development

A number of technological and research gaps in controlling air pollution still exist. NAPCA carries on an extensive research, development, and demonstration program in its own facilities and through grants and contracts. The fiscal year 1970 budget contains $59.3 million in budgeted funds for research and demonstration. The fiscal year 1971 budget requests call for $63.3 million.

Two principal areas hold high priority. One is the development of technology for the control of stationary sources. Currently, a comprehensive program is underway in NAPCA, working with the Bureau of Mines and TVA, aimed at perfecting techniques for controlling sulfur oxides. A similar program is getting underway for nitrogen oxides. The second prime priority is the development of new low-emission power systems for motor vehicles. This program aims to develop at least two unconventional vehicle prototypes and to demonstrate commercial feasibility by 1975. Initial research will center on gas turbine, steam, and hybrid systems, with continued work on electrical systems. The 1971 Federal Budget sets aside $9 million for this program. The Council on Environmental Quality has worked closely with the Department of Health, Education, and Welfare, which is the lead agency for this program, and with other Federal agencies to assure that the widest range of Federal talents is enlisted in the low-emission power program. The Council has also appointed a committee to advise it on this program, headed by Dr. Ernest Starkman, of the University of California at Berkeley.

Air Quality Monitoring

Collecting and evaluating data on air pollutant emissions and air quality require a joint Federal-State-local effort. NAPCA is now engaged not only in operating its own air monitoring network but also in supporting State and local monitoring activities. NAPCA's own air monitoring program involves operation of more than a thousand air sampling devices at stations across the country, including six continuous monitoring stations in major cities. Over the past year,

mechanized devices for measuring various gaseous pollutants were put in operation at 145 sites. This expansion of NAPCA's network reflects the increased stress on gathering data for air pollutants which have been or will be the subject of air quality criteria documents.

State and local governments, which have the primary responsibility for monitoring air quality, operate over 2,000 stations. Most of them, however, monitor air quality only intermittently.

State and Local Programs

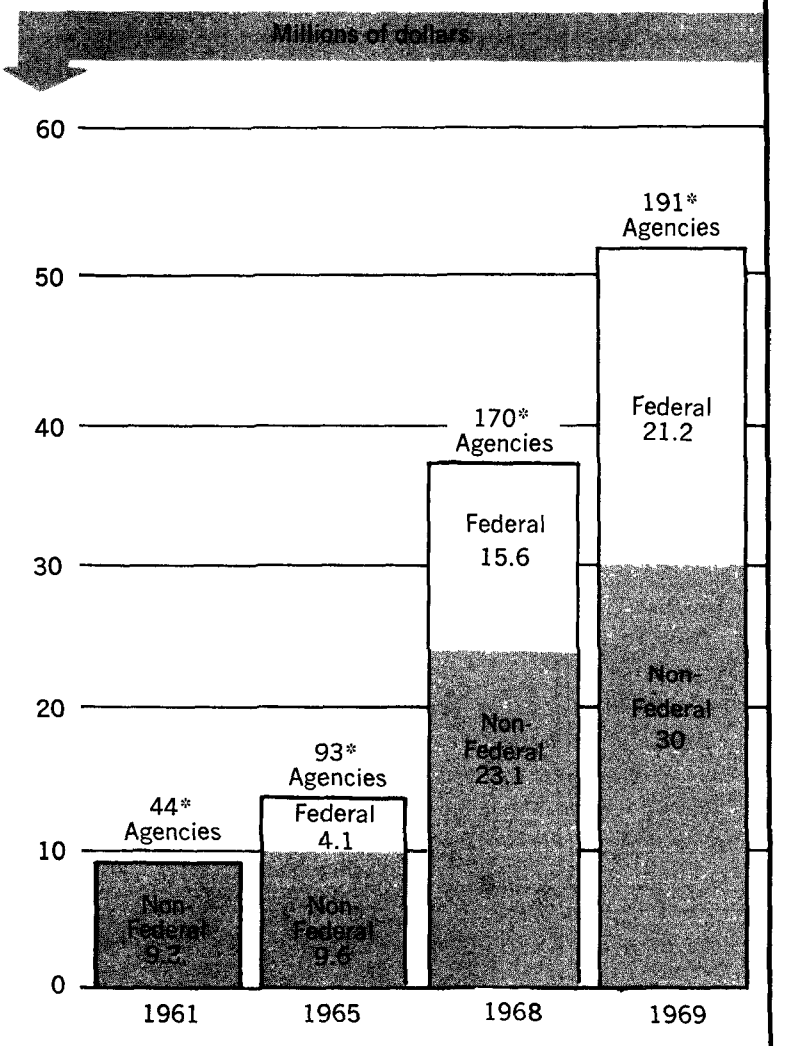
With one major exception—new motor vehicles, whose control the Clean Air Act preempts to the Federal Government—primary responsibility for the control of the sources of air pollution is assigned to State and local governments. An assessment, then, of State and local air pollution control programs is a useful measure of the current efforts to cope with the problem.

A March 1970 Department of Health, Education, and Welfare report to the Congress, "Progress in the Prevention and Control of Air Pollution," traces the considerable increase in State and local budgets for air pollution control, stimulated in large part by the Federal matching grants program initiated in 1963. However, of the 55 State and territorial programs being financed by the grants program in 1970, only six have reached an annual per capita expenditure of 25 cents, which is generally considered the minimum expenditure needed for State programs. Only 23, including the six, are spending as much as 10 cents per person per year. At the local level, the situation is better: 64 of 144 grantee agencies are spending at least 40 cents per capita per year, which is generally considered the minimum needed for local programs.

Table 3, also from the March 1970 HEW progress report, shows the accelerated pace at which States have been adopting air pollution control regulations during the last several years. Prior to passage of the Clean Air Act in 1963, only nine States had adopted air pollution control regulations. By 1967–68, 30 had. By the end of 1970 it is expected that all States will have established the legal basis for controlling the sources of air pollution.

No detailed survey has been made of the adoption of air pollution regulations at the local level of government. However, local agencies set up to deal with the problem have proliferated—from 85 agencies in 1962 to more than 200 today.

Budgets of State, Local and Regional Air Pollution Control Agencies, Fiscal Years 1961–69



*Number of Agencies: Totals for 1961 represent all agencies in existence at that time; Totals for subsequent years represent all agencies receiving Federal grant support.

Source: National Air Pollution Control Administration, HEW.

TABLE 3.—*State Laws and Regulations*

[Number of States enacting laws and regulations in specified years]

	1951–62	1963–64	1965–66	1967–68	Total
Initial law enacted	11	3	9	23	46
First regulation adopted	9		4	17	30
Type of regulation:					
Administrative	9		4	13	26
Fuel burning	2		3	11	16
Open burning	4		3	12	19
Ambient standards	2	1	1	11	15
Visible emissions	5		3	14	22
Incinerator	1	1	2	13	17
Industrial process		1	4	9	14
Vehicle	1			5	6
Sulfur oxides			1	5	6

Perhaps the most significant indicator of the adequacy of State and local air pollution control programs is manpower. The 1970 HEW report to the Congress, "Manpower and Training Needs for Air Pollution Control," indicates that in general control agencies are inadequately staffed. Fifty percent of State agencies have fewer than 10 positions budgeted, and 50 percent of local agencies have fewer than seven positions budgeted. Further, during 1969 the vacancy rate for all agencies was 20 percent. Recruitment of competent personnel is difficult. The report estimates that by 1974 State and local agencies will need 8,000 personnel if they are to implement the Clean Air Act properly—a jump of 300 percent over the number of persons currently employed in these programs.

The chief difficulty is the low salary rates paid by State and local agencies. The HEW report cites a study which indicates that State and local median salaries fall 20 to 50 percent below the median paid by industry for comparable positions.

EVALUATION

In evaluating the effectiveness of air quality efforts, it is useful to separate stationary from mobile sources, since the methods of control and the implementing institutions are so different. It is also useful, for purposes of perspective, to compare air quality and water quality efforts on stationary sources, since many aspects of the Federal legislation are similar.

Stationary Sources

Congressional and public concern focused on water pollution many years before air pollution. The first permanent water pollution legislation was enacted in 1956, the first permanent air pollution legislation not until 1963. There are currently standards and implementation plans for almost all the interstate and coastal waters of the United States, covering most forms of water pollution. Water quality criteria have been developed, and Federal, State, and local governments and industry are beginning to commit themselves to abatement programs.

In contrast, only five air pollution criteria have been issued; only 10 State standards have been approved; and no State implementation plans have yet been approved. There is currently no basis for enforcing standards, because enforcement must await approval of implementation plans.

The air pollution effort is not as advanced as water pollution in terms of stationary sources for three major reasons. First, there is no available technology for a number of air pollutants, although most forms of industrial water pollution are amenable to control. Second, State water pollution control agencies have existed for many years in the United States and have developed capabilities, although often limited. Until enactment of the Air Quality Act of 1967, air pollution control was largely conducted by local agencies. Few States had adequate manpower and resources. Finally, the Air Quality Act of 1967 is no longer an adequate tool to cope with current pollution problems. Procedures for development and implementation of air quality standards are too slow and place an inordinate burden on both the States and the Federal Government.

The current enforcement authority is also inadequate. As with water pollution, the Federal Government has no jurisdiction if the pollution from one State is not endangering health and welfare in another State, unless the Governor of the State in which the pollution occurs requests help. The current conference-hearing procedure is unduly cumbersome and time consuming. The only court action that can be requested by the Government against a polluter is a cease-and-desist order, and the only available remedy in the case of noncompliance is to hold the polluter in contempt of court. The current act does not provide for fines to compel compliance.

Mobile Sources

The attack on pollution from automotive emissions has begun to make progress. Current standards have already reduced emissions, and the 1973 and 1975 standards are expected to bring a further marked decrease. As discussed earlier, however, control systems on vehicles sold to the public lose their effectiveness more rapidly than on test vehicles, and, accordingly, the goals may not be met. Also, the current program does not deal with the millions of cars on the road with no control systems at all or with systems that do not or will not meet the required standards.

Monitoring

Although air pollution monitoring has been underway for years, the current systems—Federal, State, and local—are so spotty in coverage that it is very difficult to determine trends in the quality of air. For example, sampling stations are generally in downtown areas. The deterioration of air quality away from these regions, where the greatest amount of industrialization and urbanization has been taking place, is often not even monitored. Often trend data indicate improvement in one pollutant, while other pollutants not measured in the same city are increasing. Clearly, the total level of pollutants in our major urban areas continues to be above levels at which adverse effects on human health and destruction of vegetation, buildings, and materials occur. But improved monitoring systems are necessary to understand the status and trends in air quality and to develop better control programs.

State and Local Programs

As discussed earlier, until enactment of the Air Quality Act of 1967, air pollution was carried on largely by local agencies. The expenditures by State government were only $1.1 million in 1961. Even under the stimulation of Federal grants, State air pollution control agencies spent only $9.6 million in 1970, compared to $17.2 million for local air pollution control agencies and about $36 million for State water pollution agencies.

NAPCA considers inadequate some 28 to 34 State programs for areas not under the jurisdiction of a local agency. Some 14 to 20 are considered adequate or progressing rapidly, and only two to four are

considered good. Local and regional programs are doing better, with 44 percent of the agencies spending what NAPCA considers adequate for a minimal program.

WHAT NEEDS TO BE DONE

The Council on Environmental Quality recommends the following:

1. *The President's legislative program should be enacted to deal more effectively with stationary sources by setting national air quality standards and national emission standards on substances harmful to health, by streamlining enforcement procedures, and by providing fines of up to $10,000 a day.*

2. *If the President's legislative program is enacted, the major Federal efforts on stationary sources should be directed toward the prompt establishment of national air quality standards covering a wide range of pollutants, and toward development of emission control limits for harmful pollutants such as asbestos, beryllium, cadmium, and other toxic materials.*

3. *Programs must be developed to improve State and local control agencies.* Highest priority should be given to increasing personnel, monitoring, and other control and enforcement activities. The recently developed program of assigning Federal personnel to the agencies is a positive step. But greatly expanded training efforts and higher pay are necessary to provide the personnel needed for effective air quality management.

4. *Federal research and development on sulfur oxides and nitrogen oxide control technology should be accelerated.* Sulfur oxides control technology for large coal- and oil-fired powerplants should be demonstrated in actual operation so that the technology can be applied throughout the industry. Both government and industry share responsibilities for this. Studies of better combustion methods to reduce oxides of nitrogen are also needed.

5. *A more balanced research and development program is necessary to hasten the development of more efficient energy processes.* Although control technology for sulfur oxides will provide appreciable improvement for several decades, a longrun answer to this type of air pollution lies in better energy conversion processes which will emit less pollutants per unit of energy produced. Gasified coal, fluidized bed combustion, breeder reactors, and nuclear fusion all hold promise. Al-

though research for new nuclear power sources has already received significant support, greater attention must be given to these other processes. Even now, the Nation needs to use its fuel resources more effectively through development of a national energy policy. Such a policy would guide the use of natural gas, low-sulfur coal and oil, and other energy resources to assure their availability and minimize air pollution.

6. *Incentives to accelerate industry support for research and to stimulate corrective actions should be considered.* Specifically, incentives might encourage increased research by the electric power industry to develop better control methods and new types of power that are less polluting. Other incentives could encourage a shift to techniques which would reduce pollution from combustion processes.

7. *The President's legislative proposals for regulating fuel and fuel additives, taxing lead to be used in gasoline, and testing emission systems on the production line are critical for meeting motor vehicle emission standards and should be enacted.*

8. *Alternatives available to assure continued control of motor vehicle emissions under actual road conditions should be evaluated.* Some alternatives include warranty of system effectiveness by the manufacturer, incentives to States to check vehicle emissions as part of their automobile inspection procedures, and development of more foolproof emission control systems as a prerequisite for Federal certification.

9. *The development and widespread testing of an inexpensive and effective emission control system for installation on used cars should be accelerated. Consideration should be given to requiring its use on all automobiles or on vehicles in areas with severe pollution problems.*

10. *The program for development of an unconventional vehicle propulsion system (e.g., steam, gas turbine, or hybrid) should be accelerated to assure that the technology will be available if conventional propulsion systems are incapable of meeting increasingly stringent Federal standards.*

11. *Increased research should be conducted on the development of transportation systems that not only move people and goods efficiently but also help reduce both dependency on the private car and, with it, air pollution.* Although the principal goal of mass transit is more efficient transportation, it is also a method to reduce air pollution. It deserves more study as such. Also, more research is necessary on the placement of roadways and traffic flow patterns as a method of minimizing air pollution.

12. *More research should be conducted on the effects of air pollutants on man.* More knowledge is especially necessary about short- and long-term health impacts of air pollutants. The number of health effect studies should be increased and a thorough evaluation made of current epidemiological evidence.

13. *Federal, State, and local monitoring programs must be improved considerably.* There is need to develop inexpensive automated instruments to monitor air pollutants. More monitoring stations, especially in areas of rapid population growth and industrialization, are vital. And standard methods of measurement need improvement.

14. *Land use planning and control should be used by State, local, and regional agencies as a method of minimizing air pollution.* Large industries and power generating facilities should be located in places where their adverse effect on the air is minimal. There is a need for State or regional agencies to review proposed power plant sites to assure that a number of environmental values, including air pollution, are considered.

15. *The United States should work toward cooperative arrangements with other nations in limiting total amounts of air pollutants emitted into the atmosphere.* Air pollution is no longer solely a local, State, regional, or even national problem. It is ultimately an international problem and must be so recognized. As discussed in Chapter V, the addition of particulates and carbon dioxide in the atmosphere could have dramatic and long-term effects on world climate. The United States should take the initiative in forming cooperative arrangements to control air pollutants that could have widespread effects.

POTENTIAL FOR PROGRESS

During the last 15 years, much data on the health dangers from air pollution have been accumulated. During that time, progress in improving air quality has not kept pace with increased population and urbanization—except in some cities where efficiency of combustion and changes in fuel use have reduced soot.

The costs and institutional barriers to higher air quality are not as massive as in water pollution control. Abatement technology can be installed rapidly when available. Clearly the technological gaps in air pollution control must be overcome, but once breakthroughs are made, rapid progress will be possible.

The Council on Environmental Quality believes that a very high priority should be given to air pollution control. The opportunities for making significant improvements in the environment, at relatively low cost, are impressive. Indeed, the benefits which can be derived from greater control of air pollution far outweigh the costs of the control measures.

V

Man's Inadvertent Modification of Weather and Climate

MAN MAY be changing his weather. And if he is, the day may come when he will either freeze by his own hand or drown. The delicate balances within the atmosphere and the history of climatic change in the past suggest that through his inadvertent actions he may be driving the atmosphere either to a disastrous ice age—or as bad—to a catastrophic melting of the ice caps. Either may literally be possible, but it depends on just what he is doing to the atmosphere. He does not know for sure.

Evidence continues to build that his activities and his growing populations alter the chemical composition of the earth's atmosphere and change its heat balance. And in turn these two alterations, in tandem, change weather and climate. But the processes and outcomes of such changes are largely unknown.

The science and technology of weather modification are only in their infancies. But they could grow overnight if man will increase his efforts to learn what he is inadvertently doing to his own atmosphere.

CLIMATIC CHANGES OF THE PAST

Geological and historical records clearly show that major climatic fluctuations have taken place down through history. Since the last advance of the ice sheet in Eurasia about 10,000 years ago, the permanent ice cover in the Northern Hemisphere has been limited largely to the Arctic Ocean, Greenland, and some high latitude islands.

But alternating periods of warming and cooling have occurred during the last 10,000 years. In the last century, instruments have been available to keep current records, and they show a pattern of climatic fluctuations.

Climate is much too complicated to be described by any single parameter. One useful guide is the average annual temperature at the earth's surface. Beginning in about 1890, this average temperature began an irregular climb. By 1940, it was 1.1° F. higher than it had been during the decade from 1880 to 1890. But in the 30 years from 1940 to 1970, the average temperature has fallen about 0.5° F. Thus, during the last three decades, one-half of the warming that occurred during the preceding six decades has been erased.

Associated with rising temperature in the Northern Hemisphere were movements of the frost and ice boundaries. Simultaneously, pronounced aridity gripped the south central parts of Eurasia and North America. This led to dust-bowl conditions in some areas and a northward displacement of the polar fronts. The recent lowering of the temperature has been accompanied by the shifting of frost and ice boundaries to the south and marked increases in rainfall in parts of previously arid continental regions. In the last two winters, ice coverage in the North Atlantic has been among the most extensive in over 60 years. Because of it, Icelandic fishermen suffered great losses, and the colder temperatures substantially diminished Iceland's agricultural output. In contrast, the rains in central continental regions, particularly in India and East Africa, contributed to high wheat yields. These experiences illustrate dramatically how sensitive the complex pattern of human activity is to relatively small shifts in climate. Man's ability to predict such changes is still very limited.

These fluctuations of only a few tenths of a degree observed over decades are small compared to the climatic variations of the "Little Ice Age" from 1650 to 1840, the warmer period between A.D. 800 and A.D. 1000, and the still larger variations of a few degrees associated with the few earlier ice ages and their retreats.

HOW MAN CAN CHANGE CLIMATE

The key question is: To what extent are climatic fluctuations of the past years due to natural processes or to man's intervention?

Man can change the average atmospheric temperature slightly and thus significantly affect climate in at least seven ways:

- He can increase the carbon dioxide content of the atmosphere by burning fossil fuels.
- He can decrease atmospheric transparency with aerosols (tiny solid or liquid particles floating in the air) from industry, automobiles, and home heating units.
- He can decrease atmospheric transparency by introducing dust (particles larger than aerosols), primarily through improper agricultural practices.
- He can alter the thermal properties of the stratosphere (upper atmosphere) with water from the combustion of jet fuels.
- He can heat the atmosphere by burning fossil and nuclear fuels.
- He can change the ability of the earth's surface to reflect sun radiation back into space through urbanization, agriculture, deforestation, and reservoirs.
- He can alter the rate of transfer of thermal energy and momentum between the oceans and atmosphere by spilling oil on the water's surface. Such oil films on the ocean come from incomplete combustion or spills from sources such as vessels and drilling towers.

Carbon Dioxide—An Earth Warmer?

The atmosphere's energy, which determines weather and climate, is derived primarily from visible solar radiation absorbed by the earth's surface and atmosphere. The absorption of that energy tends to raise the temperature at the surface. The earth's surface maintains its thermal balance (keeps from overheating) by radiating energy back to space at longer wavelengths. Carbon dioxide in the atmosphere absorbs incoming visible radiation, but in amounts too small to have any appreciable effect on the radiation reaching the lower atmosphere and the earth's surface. However, carbon dioxide is virtually opaque to some long-wave radiation that is emitted by the earth's surface. Thus, when carbon dioxide concentrations increase, heat loss through radiation from the surface is reduced—the "greenhouse" effect.

Attempts have been made to calculate carbon dioxide effects on the average surface temperature. One investigator calculated that atmospheric carbon dioxide content increased at a nearly constant rate from the 19th-century level of about 290 parts per million to 330 in the late 1950's. This increase—about 14 percent—could have caused the temperature rises observed with instruments during the first 40 years of this century.

Recent surprising findings indicate that as increasing fossil fuel consumption raises carbon dioxide output, a lesser percentage of it is retained by the atmosphere, and a larger portion is absorbed by the oceans. Scientists from Sweden and the Environmental Science Services Administration (ESSA) say that only about half the carbon dioxide produced by fossil fuels from 1958 to 1960 remained in the atmosphere. During the last 5 years, less than 40 percent of manmade carbon dioxide has stayed in the atmosphere. Other calculations also show that the effect of carbon dioxide on the temperature, as illustrated in the preceding paragraph, has been overestimated.

A detailed series of observations by Swedish, Scripps Institution of Oceanography, and ESSA scientists shows that from 1958 to 1970 the carbon dioxide concentration in the atmosphere increased from 312 to 320 parts per million—an average annual jump of 0.7 parts per million. This rate, if continued, would double manmade carbon dioxide accumulations in the atmosphere in about 23 years. Yet the bulk of carbon dioxide has entered the atmosphere at a time when the earth's surface temperature was falling rather than rising. Thus, the heating effects of carbon dioxide are apparently being counteracted by natural fluctuations or by other manmade activities.

Any attempt to extrapolate the future effect of carbon dioxide on climate must be uncertain because the fraction of carbon dioxide that will enter the ocean is unknown. If 60 percent of the emissions of carbon dioxide remains in the atmosphere and there is a 5 percent yearly growth of fossil fuel consumption, then by 1990 there would be about 400 parts per million in the atmosphere. If this were not offset by other activity, then the earth's average surface temperature would increase by 1.4° F. On the other hand, if 40 percent of the artificially produced carbon dioxide enters the atmosphere and the present 4 percent growth of fossil fuel consumption continues, then a level of 400 parts per million will not be reached until about the year 2010.

The maximum amount of carbon dioxide that man might introduce into the atmosphere can be determined by estimating the total available fossil fuels. One estimate puts the maximum available coal at about 7.6 thousand billion (7.6×10^{12}) metric tons. This is about twice the coal resources established by geological mapping. Estimates of petroleum resources vary considerably. Some researchers estimate that approximately 2 thousand billion (2×10^{12}) barrels of oil are ultimately recoverable, while others appear to favor the somewhat lower figure of 1.35 thousand billion (1.35×10^{12}). If these fossil fuels were burned, they would produce about 3.3 million trillion (3.3×10^{18}) grams of carbon dioxide. If one-half of that carbon dioxide were added to the atmosphere and there were no compensating effects, then the earth's average temperature would increase by about 2° to 3° F. Such a rise, if not counteracted by other effects, could in a period of a few decades, lead to the start of substantial melting of ice caps and flooding of coastal regions.

Particle Pollution—An Earth Cooler?

A human activity which may accelerate temperature drops—and thus help compensate for any carbon dioxide-generated temperature rise—is the injection of small particles into the atmosphere.

Certain kinds of industrial processes emit cloud condensation nuclei (small particles around which raindrops can form). This affects the frequency of fog and low cloud layers. These in turn influence the radiation that reaches the earth from the sun. Forest fires also produce cloud condensation nuclei (from dust and ashes) plus large quantities of heat and water vapor. Large-scale burning of forest refuse and accidental forest fires, which are particularly common in the Western States (but less prevalent than in the past), might modify climate and weather over large regions in this way. The net effect depends on the abundance, size, distribution, and altitude of the particles. Some investigators estimate that a decrease of atmospheric transparency of only 3 or 4 percent could lead to temperature reduction of 0.7° F. Another study shows that the addition of 1 percent in the world's average low cloud cover lowers temperatures by 1.4° F. This is almost three times the decrease measured in the last two decades. On the average, about 31 percent of the earth's surface is blanketed by low clouds. If this figure were to reach 36 percent, and there is no evidence

at the present time that it will, the temperature would drop about 7° F. That would bring the earth's temperature very close to that required for a return of an ice age.

Increases of fog and low clouds when open country is turned into urban areas are well documented. But it is not known whether there has been any increase of global cloud cover. With satellites, data are now obtained fairly routinely of clouds above oceans. But data are often incomplete because high clouds prevent satellite observation of lower clouds.

One study, by J. Murray Mitchell, concludes that a major part of the variation is due to fine-grained particles introduced into the stratosphere (upper atmosphere) by volcanic eruptions. Mitchell's calculations are based on estimates of the total debris associated with volcanic explosions, an assignment of 1 percent of this total to stratospheric dust, and an assumption of a 14-month lifetime for the stratospheric dust. All these numbers can be questioned. But if they are correct, it would appear clear that dust from volcanoes overshadows that from urban and agricultural pollution.

Thus, there exists no proof that urban, industrial, and agricultural pollution is the principal cause of the recent cooling trend. But it is significant that the apparent changes of atmospheric transparency caused by volcanic dust may be sufficient to bring about cooling of the earth's atmosphere. If pollution were significantly responsible, then the world would face an important problem of manmade global climate modification. Atmospheric pollution has increased markedly, and at the present time there still are no acceptable means of impeding its growth on a global scale.

Vapor Trails—Do They Change the Weather?

Altering the water content of the high atmosphere can upset the earth's radiation balance. Water vapor, like carbon dioxide, can absorb outgoing infrared radiation. In solid form, as ice crystals, it can also block incoming solar radiation. A rise of the stratospheric water vapor content from 2 to 6 parts per million would increase the earth's average surface temperature about 0.9° F. Aircraft add water from combustion of jet fuel. Before 1958, essentially no jet fuel was consumed by domestic airlines in the United States. In 1970, jet fuel is being used by U.S. domestic airlines at a rate of 7 billion gallons a year. Below the stratosphere, water vapor dilutes quickly. And the

amount added by airliners is small compared with water naturally present at these altitudes. But above the stratosphere, water vapor stays, on the average, for about 18 months because it mixes only slowly with the lower atmosphere. Most commercial jets fly below the stratosphere. But future supersonic jets will travel in the stratosphere at altitudes of 60,000 to 70,000 feet. Assuming that water vapor stays in the stratosphere for an average of 18 months, 500 supersonic transports operating 7 hours per day could increase the water vapor content of the stratosphere over a hemisphere by 0.2 parts per million if it were uniformly distributed.

These changes appear small. But they augment natural fluctuations. For reasons not yet understood, the water vapor content of the stratosphere rose from 2 parts per million in 1964 to about 3 parts per million in early 1970. Artificially produced water vapor can accelerate that natural growth trend. Further study is necessary to better determine the effects of supersonic jet transports in the stratosphere before they are mass produced.

There is also evidence that jets contribute to high clouds. Observations at Denver indicate that from 1950 to 1958, on the average about 8% of the sky was covered by high clouds when there were no lower cloud layers. From 1965 to 1969, about twice that portion of the sky was covered by high clouds. Similar observations have been recorded at Salt Lake City. Both cities are on heavily traveled air routes although there may be other contributing factors. The long-term climatic consequences of such high cloud cover increases are still unknown.

Man and the Thermal Budget

The mean annual difference between solar radiation absorbed by the earth and long-wave radiation reflected from earth into space is about 68 watts per square meter. Most of this net energy surplus is used for the evaporation of water, heating of the atmosphere, and other meteorological processes. A tiny part, less than 1 percent, is used in the photosynthesis of green plants. It is thus turned into a relatively stable form of chemical energy.

Man's activities add slightly to the earth's "thermal budget." Heat generated by industrial, residential, and automotive sources supplement solar radiation. Averaged over the earth's surface, at present man is producing only little more than one ten-thousandth of the net

radiation gain of the atmosphere. This is much too little to influence climate on a large scale, but it certainly alters local climate of cities. And in the future, man's energy input into the atmosphere could increase to major importance.

Energy Output—Disappearing Ice Cap?

In a primitive society, energy utilization consists mostly of the food consumed by the individual. This corresponds to a power output of about 100 thermal watts per person. The world average—including primitive and technologically advanced regions—is somewhat more than 1000 thermal watts per person. In the highly industrialized United States, energy consumption is equivalent to 10,000 watts for each individual. If world population grows to 5 billion and if the worldwide average of energy use increases to 10,000 watts per person, manmade energy input into the atmosphere would reach almost one-hundredth that of the natural net radiation balance over land areas. If energy consumption continues to increase at the present rate of 4 percent per year, then in 200 years artificial energy input into the atmosphere would equal one-third of the natural radiation balance. This level would be reached in only 100 years with a 10 percent yearly increase. These numbers are highly significant because an increase of a few tenths of 1 percent in the radiation balance, if long sustained, would cause polar ice to disappear completely unless other natural or manmade changes compensated for the energy gain.

The combined effect of carbon dioxide pollution and heat pollution is strongly in the direction of warming the earth's atmosphere. Particle pollution tends to lower the earth's temperature. Which pollution effect will ultimately dominate? Will we indeed drown or will we freeze? Despite firm predictions by some ecologists, we do not know the answers. Careful monitoring and extended research are required if we are to manage our global climate wisely. These questions may become critical in the future.

Raising the Albedo

Researchers have calculated that a unit increase in the earth's albedo (reflective surface characteristics) will cause a decrease in average surface temperature of 1.8° F. Thus, manmade changes of the albedo at the earth's surface, if large enough, can cause substantial changes in climatic conditions. Densely builtup regions have a higher albedo

than forests and cultivated soils. Deserts, some of which may stem from man's activities, have a much higher albedo than grass-covered fields.

Proliferation of urban areas and highway systems may increase the earth's average surface albedo. The net effect of the change on climate is not understood because changes in albedo are usually accompanied by alterations in the surface roughness of the earth. These alterations affect the rate at which the surface can exchange heat and momentum with the atmosphere by winds and other turbulent processes. These changes can also affect weather and climate.

Oil on the Water

Effects of oil films on the ocean surface are still poorly understood. With their vast stores of thermal energy, the oceans act as balance wheels to climate. The atmosphere exchanges energy with the ocean through radiation and mechanical processes. The strength of the mechanical interaction associated with air moving over a wave-roughened surface depends on the surface roughness of the water and the velocity and regularity of the wind. Very thin oil films can alter this interchange by reducing turbulence, evaporation, and the radiation emission of the surface.

But it is still unknown if oil pollution contributes significantly to climatic change.

The City—A Thermal Mountain

It has long been known that the climate of cities, which represent the most concentrated form of environmental modification by man, differs appreciably from the climate of adjacent rural areas. There is a growing body of literature showing that industrial activities are modifying atmospheric properties and in some cases may profoundly change the weather.

Cities on the average have a temperature 0.9° to 1.4° F. higher than the surrounding countryside. The effect is even more marked in the winter when the minimum temperature may be 2° to 3° F. higher than that of the surrounding areas. In addition to the difference in temperature, cities are frequently covered with clouds, and the frequency of fog in wintertime can be twice that of the suburbs. Accompanying the increased frequency of cloud cover is a higher total precipitation. Table 1 summarizes the climatic changes produced by cities.

TABLE 1.—*Climatic Changes Produced by Cities*

Parameter	*City as compared with rural surroundings*
Temperature:	
Annual mean	0.9° to 1.4° F. higher.
Winter minimum	2° to 3° F. higher.
Cloudiness:	
Clouds	5 to 10 percent more.
Fog, winter	100 percent more.
Fog, summer	30 percent more.
Dust particles	10 times more.
Wind speed:	
Annual mean	20 to 30 percent lower.
Extreme gusts	10 to 20 percent lower.
Precipitation	5 to 10 percent more.

Several factors make the city warmer than the country. Direct energy input from home heating units, industry, and air conditioning helps raise the annual mean temperature and minimum winter temperature. Buildings naturally shelter the city so that wind speeds are lower, and the turbulent transfer of energy from the city to moving weather systems may decline. The increased cloudiness over cities, together with the effect of buildings and pavements on the amount of solar heat retained, further accentuates the direct input into the atmosphere.

The increased rain and snowfall in cities are probably also caused by a variety of factors. The heat of the city in effect causes a "thermal mountain" in which the surrounding air is pushed up vertically over the city to colder levels, aiding the precipitation process. In addition, industry, home heating units, and automobiles all produce particulate materials. These small particles act as nuclei around which water vapor condenses to form drops. Or if the temperatures are cold enough, certain particles can act as nuclei for ice crystals. R. H. Frederick of ESSA supports the theory that particle pollution plays a role in precipitation. He decribes a systematic tendency for cold season precipitation at 22 urban Weather Bureau stations in the eastern United States to average several percent greater on weekdays than on weekends. If substantiated in further studies on other urban areas, this finding goes far in explaining the differences in rainfall between the cities and the country.

The most dramatic cases of the relation of industrial pollution and weather are found in regions where the pollutants are concentrated in valleys. The emission of water vapor condensation nuclei from the stack of a single wood pulp mill in Pennsylvania causes fog forma-

tion which sometimes fills a valley several miles wide and 20 miles long and spills into adjacent valleys. Peter Hobbs at the University of Washington has shown that certain Washington State pulp and paper mills are prolific sources of cloud condensation nuclei and that clouds often form downwind of the mills. Hobbs argues that regions of abundant artificial condensation nuclei show an annual precipitation in the last 20 years 30 percent greater than the previous 30 years, although part of this increase is probably due to a natural change in climate. Furthermore, University of Washington researchers have found ice nuclei more abundant by as much as an order of magnitude over urban Seattle than over stations removed from industrial activity. These observations, taken along with those of Frederick, clearly show the potential influence of man-introduced particulate matter on the weather in industrial regions.

CONCLUSIONS

Examination of how man can change climate on a large scale leads to these conclusions:

- The chemical composition of the earth's atmosphere has been altered by man in a measurable way. Some of these changes, which have been mostly inadvertent, have only recently been recognized.
- The magnitude of these atmospheric changes is enough to alter the earth's surface temperature slightly. Carbon dioxide added to the atmosphere from burning fuels is sufficient to lift the average temperature by several tenths of a degree Fahrenheit. Other factors, however, have caused world temperature to drop slightly in the last 30 years.
- These changes in the atmosphere cannot be regarded as local. Heat input escaping from a city into the atmosphere changes the climate of that city. The combined effects of many cities may eventually alter regional and global climates.
- Enough is known about the physical environment to establish the fact that inadvertent modification is occurring. But not enough is yet known to predict all the consequences of atmospheric changes confidently.
- Despite its importance, research on inadvertent climate modification has been neglected. Only about 1 percent of Federal Government research monies for weather modification go to programs investigating man's inadvertent modification.

WHAT NEEDS TO BE DONE

The following suggestions should be considered for dealing with long-term problems of climate alteration:

1. *Worldwide recognition should be given to the long-term significance of manmade atmospheric alterations.*

2. *Worldwide ground monitoring of turbidity, carbon dioxide content, and water vapor distribution in the atmosphere should be done with particular attention to oceanic areas.* Ground-based observations should be supplemented by airborne monitoring of the number, density, size, and composition of particulate matter in the atmosphere. Such programs are an essential first step to establish pollution baselines.

3. *Satellite monitoring of global cloud cover, atmospheric heat balance, and surface albedo should be accelerated.* Particular attention should center on effects of altering the thermal balance through changes in albedo, carbon dioxide, and particulate matter.

4. *Research on models of the thermal and dynamical processes within the atmosphere and the boundary between the atmosphere and the solid earth and oceans need emphasis.*

VI

Solid Wastes

SOLID WASTES etch a trail of visible blight that leaves few corners of the country unspotted. Across the Nation the same scenes repeat—refuse in the streets, litter on beaches and along roadsides, abandoned autos on isolated curbsides and in weeded vacant lots, rusty refrigerators and stoves in backyards, thousands of dumps scarring the landscape. And the less visible aspects of the problem—solid wastes in the ocean, contamination of ground water, and wasted resources—are just as critical. America's well-known penchant for convenience has come face-to-face with major environmental problems.

Proper management of solid wastes is a key to upgrading environmental quality. Stricter enforcement of air quality standards has focused attention on burning dumps and inefficient incinerators, many of them operated by municipal governments. Water quality research is beginning to probe the effects of dumps and landfills on the purity of ground water.

Public appreciation of the magnitude of the economic and social costs of solid waste is building and a concept of solid waste management is evolving. It assumes that man can devise a social-technological system that will wisely control the quantity and characteristics of wastes, efficiently collect those that must be removed, creatively recycle those that can be reused, and properly dispose of those that have no further use.

The growing technology and affluence of American society have laid a heavy burden on solid waste facilities. Refuse collected in urban areas of the Nation has increased from 2.75 pounds per person per day in 1920 to 5 pounds in 1970. It is expected to reach 8 pounds by 1980. This spiraling volume of solid waste has a changing character. The trend toward packaged goods in disposable containers has put more paper, plastics, glass, and metals instead of organic matter into the refuse. And technology of solid waste collection and disposal has not kept pace with this change.

There has been little attempt to tie the production of consumer goods together with the disposability of those parts that end as waste. Disposal costs are not included in the price paid by the consumer; rather they are borne by society in general. With few exceptions manufacturers do not accept responsibility for the costs of getting rid of products that have been sold and served their purpose.

Solid waste collection in most municipalities is inadequate and antiquated, partly because over the years it has endured more than its share of public neglect. Refuse collection jobs are low status and low paying, and injury statistics show that only logging is a more hazardous occupation. Sanitation workers have been striking with increasing frequency, and heaps of reeking wastes have been left for days on curbsides in our largest cities. This has dramatized the human factors in the business of refuse collection. It has pointed up the close correlation between the working conditions of trash collectors and the public health menace of inadequate collection and disposal.

Disposal facilities are equally inadequate and antiquated. The Bureau of Solid Waste Management of the Department of Health, Education, and Welfare estimates that 94 percent of existing land disposal operations and 75 percent of incinerator facilities are substandard.

WHAT MAKES SOLID WASTES

The total solid wastes produced in the United States in 1969 reached 4.3 billion tons as shown in the following table:

	Million tons
Residential, Commercial and Institutional wastes	250
Collected	(190)
Uncollected	(60)
Industrial wastes	110
Mineral wastes	1,700
Agricultural wastes	2,280
Total	4,340

Sources: Bureau of Solid Waste Management, Department of Health, Education, and Welfare; Division of Solid Wastes, Bureau of Mines, Department of the Interior.

Most of it originated from agriculture and livestock. Other large amounts arose from mining and industrial processes. A little under 6 percent, or 250 million tons, was classified as residential, commercial, and institutional solid wastes. And only three-fourths of this was collected.

Although wastes from homes, businesses, and institutions make up a small part of the total load of solid waste produced, they are the most offensive and the most dangerous to health when they accumulate near where people live. Agricultural and mineral wastes, although much greater in volume, are generally spread more widely over the land. They are more isolated from population concentrations and may not require special collection and disposal. Nevertheless, as more is learned about the effects of agricultural and mineral wastes on the quality of air, water, and esthetics, steps to curb their production and facilitate disposal seem likely.

The largest single source of solid wastes in this country is agriculture. It accounts for over half the total. The more than 2 billion tons of *agricultural wastes* produced each year includes animal and slaughterhouse wastes, useless residues from crop harvesting, vineyard and orchard prunings, and greenhouse wastes.

Herds of cattle and other animals, once left to graze over large open meadows, are now often confined to feedlots where they fatten more rapidly for market. On these feedlots, they generate enormous and concentrated quantities of manure that cannot readily and safely be

assimilated by the soil. Manure permeates the earth and invades waterbodies, contributing to fish kills, eutrophied lakes, off-flavored drinking waters, and contaminated aquifers. Feedlots intensify odors, dusts, and the wholesale production of flies and other noxious insects. Animal waste disposal is a growing problem because the demand for animal manure as a soil conditioner is declining. Easier handling, among other advantages, favors chemical fertilizers.

About 110 million tons of *industrial solid wastes* (excluding mineral solid wastes) are generated every year. More than 15 million tons of it are scrap metal, and 30 million tons are paper and paper product wastes; a miscellaneous bag of slags, waste plastics, bales of rags, and drums of assorted products discarded for various reasons make up the rest. The electric utility industry produced over 30 million tons of fly ash in 1969 from burning bituminous coal and lignite. By 1980, the figure could rise to 40 million tons. Currently, only about 20 percent of ash material finds any use.

In the past year, 1,700 million tons of *mineral solid wastes*, comprising 39 percent of total solid wastes, were generated in the United States—most of it from the mineral and fossil fuel mining, milling, and processing industries. Slag heaps, culm piles, and mill tailings accumulate near extraction or processing operations. Eighty mineral industries generate solid waste, but only eight of them are responsible for 80 percent of the total. Copper contributes the largest waste tonnage, followed by iron and steel, bituminous coal, phosphate rock, lead, zinc, alumina, and anthracite. By 1980, the Nation's mineral industries will be generating at least 2 billion tons of waste every year.

In 1969, Americans threw away more than 250 million tons of *residential, commercial, and institutional solid wastes*. Approximately 190 million tons were collected by public agencies and private refuse firms. The remainder was abandoned, dumped, disposed of at the point of origin, or hauled away by the producer to a disposal site. About $3.5 billion was spent last year handling the 190 million tons of collected solid wastes—an average of $18 per ton. Collection accounts for 80 percent of the cost ($14 per ton), disposal for the rest. A considerably higher rate of spending would be needed to upgrade existing systems to acceptable levels of operation.

The solid waste collected annually includes 30 million tons of paper and paper products; 4 million tons of plastics; 100 million tires; 30 billion bottles; 60 billion cans; millions of tons of demolition debris, grass and tree trimmings, food wastes, and sewage sludge; and millions of discarded automobiles and major appliances.

COLLECTION AND DISPOSAL

Residential, commercial, institutional, and industrial solid wastes are the clearest threats to health and to the environment. So they are the chief target of the waste disposal strategy. Most such waste comes from the urban areas and requires quick removal. It is increasing at a rate of about 4 percent a year.

Three facets of the production and discard of these growing mountains of solid waste materials need examination: solid waste handling, natural resource depletion, and litter and abandonment. Collection and disposal costs continue to spiral. This is partly because of wage hikes—to bring the pay of sanitation workers more into line with other occupations. But even more, it is to pay for new collection equipment and landfill and dumping sites and, in some communities, to amortize incineration equipment. Researchers are beginning to examine what is entering the solid waste stream. Ultimately they hope to reduce unnecessary discard or even to restrict the manufacture of some items.

Natural resource management requires that minerals in shortest supply be identified and efforts made to cut the quantity discarded and to recycle whatever is collected. Some key minerals are already recycled to a considerable extent. More lead is pulled from scrap than from mined ores, and nearly half of the copper used today comes from scrap. However, for many natural resources, substantial Federal income tax incentives and other laws and policies encourage use of the virgin material instead and undercut the competitive position of recycled materials.

The litter problem—tires, bottles, cans, plastics, and paper thrown away randomly instead of into waste containers—adds daily to collection costs and blight. Many of the nation's roads, beaches, rivers, parks, and other public areas are cluttered with the refuse of thoughtless citizens. Litter collection costs average $88 per ton, more than four times as much as collecting residential refuse.

Collection Methods

Refuse collection methods in most of the United States do not differ substantially from what they were when workers picked up the trash in horse-drawn wagons before the turn of the century. This lack of technological advance is particularly burdensome because up to 80 percent of the funds spent on solid waste management goes into collecting the waste and hauling it to a processing plant or a dump.

The one significant advance has been the compactor truck. These closed-body vehicles now make up a large part of the 150,000 refuse collection trucks in the United States. With hydraulic presses, they compress waste, usually at a 3-to-1 ratio, thus saving vehicle space and cutting the number of trips necessary to cover collection routes. However, the compactor has disadvantages. Because refuse of different types is mixed and crushed, recyclables are lost or contaminated by unusable waste. It is also hazardous to operators.

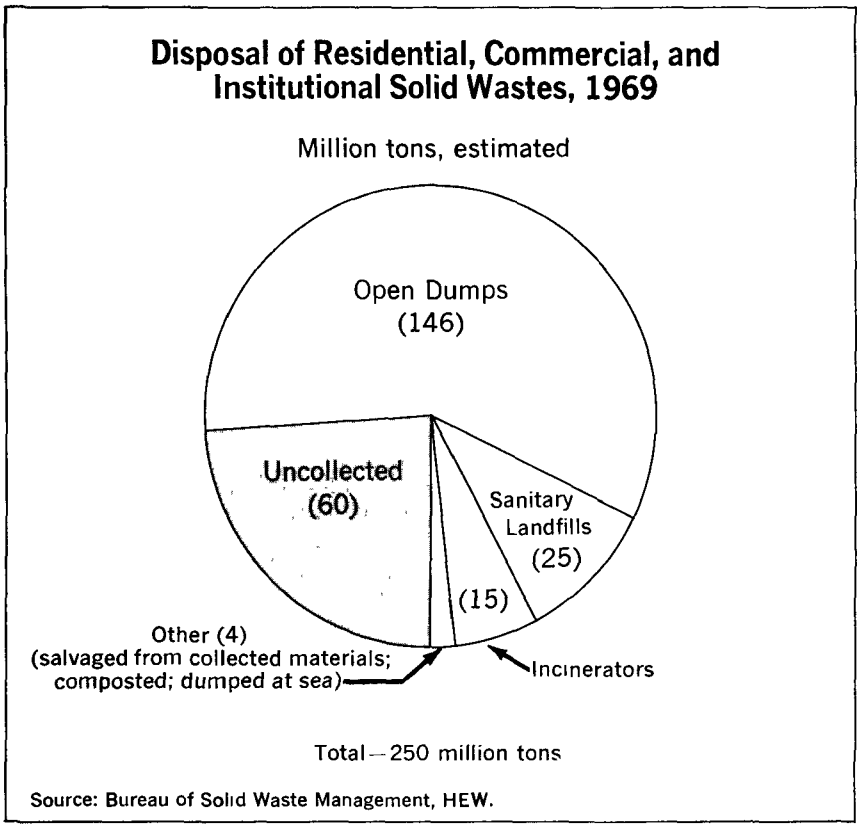
Efforts are underway to modernize trash collection. Under one Federal grant, researchers at The Johns Hopkins University are studying the practicability of transfer points in waste collection systems serving large cities. Under another, the University of Pennsylvania is studying the possibility of pipelines for collecting and removing domestic solid wastes. The pipeline method may be technologically feasible and economically attractive. But these are just beginnings. More research is mandatory.

Disposal Techniques

The final disposal point for an estimated 77 percent of all collected solid wastes is 14,000 open dumps in the country. Thirteen percent is deposited into properly operated sanitary landfills, where wastes are adequately covered each day with earth of the proper type. Nearly all of the remaining 10 percent is burned. Incinerators are used primarily in large cities, where the volume of refuse and the high cost of land make incineration an attractive disposal method. Small quantities of solid wastes are turned into nutrient-rich soil conditioners by composting operations. And a small but troublesome percentage is dumped at sea.

Land disposal of solid wastes can range from the most offensive fly- and rat-infested open dump to technically advanced practices that end in the creation of parklands, golf courses, outdoor theaters, and other public facilities. Disposal sites in or near urban areas can be reclaimed for use as attractive open space if proper sanitary landfill practices are employed.

Imaginative thinking in land disposal practices is not widespread. Collected refuse is dumped in whatever area is available, with little or no provision for soil cover. Often city fathers blame spontaneous combustion for fires at these dumps. But in at least some cases, local sanitation officials set fire to wastes to reduce their volume because dumps are overloaded. Burning at open dumps remains a major cause



of air pollution in some cities. Improper landfill techniques can spawn large quantities of methane gas and breed armies of rats, flies, and other pests. Disposal sites often mar wetlands and scenic areas. Some are uneconomical because of their distance from the city. In California, filling canyons and other natural areas has been censored by conservation groups.

Improved equipment for landfilling is being developed. For example, with a grant from the Bureau of Solid Waste Management, King County (Seattle), Wash., is constructing a machine called the "Mole," which will compact refuse at high pressure and dispose of it below ground level. Under another grant, a landfill operation near Virginia Beach, Va., will be turned into a huge manmade hill for an amphitheater. A similar site near Chicago will be developed for tobogganing and skiing.

The city of Madison, Wis., has a grant to build and operate a hammer reduction mill to test the economic feasibility of salvaging paper and metals. Preliminary investigations of salvage possibilities

are inconclusive, but disposal aspects of the mill look promising. It may be possible, for example, that milled refuse may safely be deposited in a landfill without earth cover.

Strip mining for coal has scarred some landscapes in the United States and left them denuded of vegetation and open to erosion. Several years ago rail haul of solid wastes was proposed as a solution to two environmental problems—unsightly abandoned strip mines and the shortage of disposal sites near large eastern cities. The plan involved using railroad dump cars which usually return from cities to mining sites empty. Many factors, including outlying community resistance to taking in other people's refuse have limited that idea. But disposal costs in large cities have shot up so sharply that the concept is being reconsidered. A Federal grant has been awarded to the American Public Works Association to investigate hauling refuse by rail from large urban areas to remote, mined areas for landfilling.

Nearly 10 percent of domestic solid wastes is processed through *incineration*; 300 municipal incinerators account for about half the tonnage burned; the rest is consumed in thousands of small, privately owned trash burners. After incineration, about 25 percent of the waste by weight remains—as ashes, glass, metals, and unburned combustibles. These then must be removed and recycled, or disposed of in some way.

Since municipal incineration is often cited as a polluter of air, research is underway to improve incinerator technology. A German process involves a mechanically stoked rotary drum incinerator designed for small communities. West Virginia University is studying a fluidized-bed incinerator fueled by mixtures of domestic and industrial solid wastes.

One of the most promising engineering concepts in solid waste management is the CPU–400, now under development by the Combustion Power Co. of Palo Alto, Calif. The CPU–400 is a fluidized-bed incinerator, which burns solid waste at high pressure, which produces hot gases, which power a turbine, which in turn drives an electric generator. Municipal solid wastes constitute a better fuel than might have been expected. They have a heating value of 5,000 British thermal units per pound—about one-third that of a good grade of coal. Municipal wastes are also low in sulfur, a major air pollution source. As designed, the CPU–400 should produce approximately 15,000 kilowatts of electric power daily, while burning 400 tons of municipal refuse. The generator unit should supply 10 percent of the electric

power requirements of the community providing the refuse. Up to three-fourths of the heat in the gas turbine cycle is available for auxiliary functions such as steam production, sewage sludge drying, or perhaps saline water conversion. The CPU–400 concept also envisions using the vacuum produced by the gas turbine to draw refuse to the incinerator from collection points in the city—through pipes buried in the streets.

The Bureau of Mines of the Department of the Interior is applying the process of carbonization (destructive distillation) to the disposal of industrial wastes and urban refuse. This process involves the thermal conversion of materials into usable forms of solid, liquid, and gaseous products.

An insignificant amount of collected solid wastes in the United States is *composted.* Metals, glass, and similar inorganics are sorted from mixed refuse, and the remainder is converted to a peat-like organic fertilizer and soil conditioner. This process is widely used in Europe. Madrid composts 200 tons daily and Moscow is opening a new 600-ton-per-day facility. Composting has never been popular in the United States for several reasons. Compared to many Western European nations, land available for disposal sites in the United States is inexpensive. The compost product has not always been of uniform quality here; nor has it competed with commercial soil conditioners. Also, the composition of refuse in the United States makes it more difficult to compost, since its organic content is low. Finally, composting was first sold to American cities as a profitmaking venture. When it did not pay off, many cities considered the enterprise a failure. The Bureau of Solid Waste Management, jointly with the Tennessee Valley Authority, is operating an experimental composting plant in Johnson City, Tenn. But the results have not been encouraging. In recent years almost all composting plants in this country have shut down.

Some coastal cities and industries are turning to *ocean disposal* to get rid of solid waste. Lack of suitable land disposal sites and stricter air pollution standards for incinerators make ocean dumping look attractive. In his April 15 Message on Waste Disposal, the President directed the Council on Environmental Quality to report to him by September 1, 1970, on environmental problems associated with ocean dumping.

RECYCLING AND REUSE

In his February 10 Message on the Environment, the President announced the Federal Government's goal to reduce solid waste volume and encourage reuse and recycling. Recycling waste materials into the economy has not been widely applied in the United States. Economic considerations and the abundance of virgin resources have forestalled the development of recycling technology and markets. Primary materials producers, often with the help of tax concessions, have developed remarkably efficient technologies for removing metals and other substances from their virgin state. But meanwhile, techniques for separating and recovering waste materials remain primitive and expensive.

There are many aspects to recycling. The characteristics and the volume of the products which enter the market and eventually end up as solid wastes are one. Identification of characteristics and items most troublesome to solid waste management is another. And decisions on how to control their presence in refuse are still another. Some items can be returned by consumers for reuse. Others may be sorted by householders for separate collection. Or the most economical solution may be to salvage from mixed collection wastes.

Sorting Mixed Refuse

Much more work is needed to develop an effective way to salvage the valuable elements of collected mixed refuse. It is difficult and costly. And the instability of salvage markets has only added to the problem. The Stanford Research Institute in Menlo Park, Calif., has constructed a pilot scale unit in which a vertical stream of air separates mixed waste materials. After technical difficulties are overcome, this air classification process may prove an economic alternative to hand separation.

At College Park, Md., the Bureau of Mines has constructed an advanced reclamation system with mechanical separators which sort metals and glass from incinerator residues. Recent technological advances there have produced a highly sophisticated process which sorts glass by color and isolates several exotic metals. It adds $3 per ton to normal collection and disposal costs, not considering any income from the sale of salvaged materials. The Bureau is now developing data for the design of commercial plants based on this process.

Auto Disposal

A number of specific components in solid wastes present particular problems and require special mention. Abandoned autos are one of the most conspicuous solid waste disposal problems. On the average, 9 million autos are retired from service every year. Although statistics on the annual number of abandoned vehicles are subject to dispute, it is thought that approximately 15 percent are abandoned on city streets, in back alleys, along rural roads, and in vacant lots throughout the Nation. Most autos are abandoned because they are no longer serviceable and have little or no parts value to auto wreckers. The total number of abandoned cars in the country is even harder to ascertain, but has been estimated between 2.5 and 4.5 million.

The 85 percent of autos that are properly turned in by their owners enter a complex recycling system, usually beginning with the auto wrecker, whose chief business is selling the parts that can be removed. Some wreckers claim to obtain 97 percent of their sales revenues from parts. The high value of junk cars for parts and their often negligible value for scrap means that wreckers have little incentive to move their inventories to scrap processors. Except when there is demand for scrap, the junk cars just pile up.

Auto wreckers eventually, however, have to move the hulks to scrap processors. Most processors, using powerful hydraulic presses, reduce the cars to small bales containing high percentages of nonferrous materials—copper, upholstery, chrome, plastic, and glass. The bales are then sold to steel mills, which turn them into products which do not require high quality steel, or pass them on to mills which have sufficient capacity to dilute their contaminants. A growing number of processors produce a higher priced scrap through mechanical shredding and electromagnetic separation. Costs for shredding equipment, however, have limited the widespread use of this process, particularly by small scrap processors.

Steel mills and foundries are major users of ferrous scrap. In 1969, 50 percent of the material used for the production of all steel products was scrap. Six percent of that scrap was from junk autos. But changes in steel production techniques make it difficult to predict future scrap needs. Basic oxygen furnaces and electrical induction furnaces are partially replacing the open hearth furnace. The first requires less scrap, but the second uses more. It is even more difficult to predict

export scrap demand and the effects of new fabricating and casting processes on the scrap market.

In his February 10 Message on the Environment, the President asked the Council on Environmental Quality to take the lead in recommending a bounty payment or some other system to promote the prompt scrapping of all junk automobiles. The Council has reviewed the range of alternatives leading to a Federal or State bounty system and concluded that under present conditions it is not practicable.

Most of the systems considered by the Council would be funded by a tax on the sale of all automobiles sold in the future or the collection of a fee from all present owners and future buyers. The bounty payment would be made to the scrap processor, the auto wrecker, or the owner of the car being junked. All of these proposals would put an unfair burden on the owners of the 85 percent of autos that are properly turned over to auto wreckers, in order to take care of the remainder which are not. Furthermore, the Council is not persuaded that the demand for auto scrap would be improved by such a system, nor that it would in fact influence the economics affecting abandonment. The resulting fund of payments would divert billions of dollars from other investments in the private economy. Administration and enforcement of the system would require excessive increases in government personnel and expenditures. The Council also determined that firm penalties against abandonment and improvement of State title and transfer laws alone, particularly for cars of low value, might substantially reduce abandonment and put abandoned vehicles more promptly into the scrapping cycle. Such laws should be strengthened.

Any attempt to solve the problem of abandoned cars, however, must consider the problems of fluctuating scrap demand, steel production technology, transportation rates for scrap, export scrap markets, availability of shredding equipment, and characteristics of the auto parts market. Otherwise, assuming abandonment could be reversed, hulks would only continue to pile up in junk yards. The Council will continue its study of these broader problems, looking toward a solution that will involve the entire auto scrapping system.

Other Items

In 1969, 43.8 billion *beverage containers* for beer and soft drinks were made in the United States. If the trend to throw-away containers continues, by 1980, 100 billion of these bottles and cans will be produced

and discarded every year. Beverage containers already comprise 3.9 percent of all collected refuse, and the number is growing at a rate of nearly 7.5 percent per year—compared to 4 percent for all refuse. Bottles and cans constitute a major part of what is left in incinerators after burning. They must be hauled to land disposal sites. Each year an estimated 1 to 2 billion glass and metal beverage containers end up as litter on highways, beaches, parks, and other public areas. Severe penalties for littering have not worked in the face of the rising sales of the throw-away bottle and can, and strict enforcement of these laws has been difficult.

Paper constitutes almost 60 percent of roadside litter and is difficult to collect. Last year, 58.3 million tons of paper were consumed in the United States. Nineteen percent of this was recycled. Fifteen percent was temporarily retained or lost its identity in manufacturing processes. The remaining two-thirds—or 40 million tons—was discarded as residential, commercial, institutional, and industrial solid wastes. Typically, paper comprising 40 to 50 percent of mixed refuse is disposed of at an annual cost of over $900 million. Paper production is a multiple polluter. It crops up as a factor in timber wastes, in air and water pollution, and in the removal of organic materials from soils in managed forests. Much of the discarded paper consists of technically reusable fiber. Although the United States recycles only 19 percent of its paper, Japan reclaims and reprocesses nearly half of the paper its people use.

Plastics comprise an increasingly worrisome element in solid wastes. They are virtually indestructible, do not degrade naturally, and resist the compression plates of compactor trucks. In incinerators most plastics tend to melt rather than burn and to foul the grates. One range of plastics, polyvinyl chloride (PVC), is a new arrival in the packaging market. When burned, it produces hydrochloric acid. Although not yet widely used in the United States, in Germany it has already been blamed for increased air pollution, damage to incinerator stacks, and—in rare cases—destruction of nearby flora.

Another potential problem arises from disposing of *pesticides.* As stronger legislation and regulation of these agents take effect, the proper disposal of undesirable or condemned commodities becomes important. Even the containers used to market pesticides may retain considerable toxicity after discard. Although there have as yet been no serious cases, concentration of these agents in sanitary landfills and open dumps could contaminate ground water and imperil public health.

Rubber tires are just as difficult to get rid of. Burning them pollutes the air. In sanitary landfills, they defy compaction and tend to gravitate to the surface. Changing technology has lessened the use of old rubber in the manufacture of new rubber products; thus most old tires are not recycled.

The Fish and Wildlife Service and the Bureau of Solid Waste Management are investigating the use of old tires as reefs and fish havens along the Atlantic coast of the United States. The ocean bottom is sandy and relatively flat for great distances. And artificial reefs constructed of tires may promote an increase in desirable species since many game fish require relief features such as reefs for protection and spawning grounds. If this concept proves practical, very large numbers of old tires could be turned into an important ecological side benefit.

THE FEDERAL ROLE

Local governments have traditionally shouldered primary responsibility for solid waste collection, processing, and disposal. Not until 1965, with passage of the Solid Waste Disposal Act (Public Law 89–272), did the Federal Government assume a major role. Under the act, the Federal Government is responsible for research, training, demonstrations of new technology, technical assistance, and grants for State and interstate solid waste planning programs. The legislation focuses attention on studies to conserve natural resources by reducing waste and unsalvageable materials and by solid waste recovery. Under the act, the Department of the Interior, through the Bureau of Mines, received expanded authority to examine problems of mineral, metal, and fossil fuel wastes. The Department of Health, Education, and Welfare, through the Bureau of Solid Waste Management, administers the Federal program for solid wastes from all other sources.

Research and Development

The Bureau of Solid Waste Management and the Bureau of Mines have been instrumental in developing several of the technological innovations so far. Local governments have only limited funds, and municipal officials are timorous about interfering with refuse collection routines for fear of upsetting labor relations and public relations.

Consequently, local innovation has been minimal. Even when the evidence is clear that new methods result in improvements, jealousies and fear of adverse employee relations sometimes prevent implementation. Most State governments have also avoided heavy research and experimental program funding in solid waste management. This emphasizes the need to design Federal research and development programs to assure that once the value of an innovation is evident, it is quickly incorporated into as many systems as possible.

Recycling

The role of government in recycling solid wastes has many uniquely Federal facets. Successful return of waste to some point in the production process is closely tied to the volume and characteristics of manufactured goods. Except for a few large States and a few specific products, it is difficult for State governments to influence these factors significantly. It is virtually impossible for local governments to do so.

The Federal Government is heavily committed to the emerging technology of salvage and recycling. When salvage is technically feasible but economically unprofitable, the Federal Government should evaluate the use of incentives to encourage recycling rather than production from virgin resources. Federal research into mixed refuse sorting and salvage has advanced, and some innovations are nearly ready for widespread application.

Regional Cooperation

Unlike air and water pollution, which can befoul even distant areas, solid wastes harm only the immediate surrounding area. Thus, solid waste mismanagement primarily affects the area where wastes are dumped and secondarily the community from which they are collected. When improper solid waste disposal practices such as burning and poorly controlled sanitary fill operations foul their air or water, areas outside the locality can invoke air and water quality enforcement laws. Where the land resources of other local jurisdictions are used for dumping or incineration, the community can levy a charge to offset the cost of degrading the environment.

Local residents are becoming more aware that municipal solid waste disposal systems are deficient. Communities are modernizing, and in many places citizens have campaigned successfully for new disposal facilities. Federal grants are not always desirable, since they

penalize taxpayers in communities that have the foresight to handle their problems and force them to pay a share of the cost of facilities for communities that do not.

There is, however, one area open to State and Federal help—intermunicipal cooperation. Metropolitan areas, many local jurisdictions, and particularly the central cities face severe disposal problems which are not entirely resolvable at the local level. Disposal sites are hard to find and to buy as land costs spiral and as citizens urge the preservation of nearly every remaining nearby natural area. The cost of municipal incineration with proper air pollution controls is too high for many small jurisdictions within the metropolitan area.

Regional solid waste management is evolving as the only rational approach in many urban areas, even though local officials often balk at turning over control of any aspect of solid waste management to a metropolitan-wide authority. Consolidation jeopardizes vested interests. Patronage, position, and status of individual employees and the degree of control over solid waste management within the community's own boundaries (including location of disposal sites) militate against intermunicipal cooperation. To mitigate these factors, higher levels of government must devise ways to encourage coordination on a regional basis.

WHAT NEEDS TO BE DONE

The Council on Environmental Quality recommends the following:

1. *The programs for research and demonstration projects in the Bureau of Solid Waste Management and the Bureau of Mines should be focused on:*

- *Collection procedures*—More research is needed to develop new collection methods. Eighty percent of the cost of solid waste management is devoted to collection; yet technological change has been slowest in this area.
- *Household sorting*—This should be encouraged. Reliable studies are necessary to determine if greater sorting of solid wastes by households makes economic and social sense. New technologies should be devised to make economical and acceptable to housewives a wider range of sorting techniques. Collection methods for sorted materials must also be developed.
- *Sorting from mixed refuse*—Far greater creative efforts are needed to develop a technology for sorting mixed refuse to

salvage valuable items. The Bureau of Mines has made significant progress in recovery from incinerator residues, but there is still no effective way to salvage from the 90 percent of collected refuse that is destined for dumps or sanitary landfills.

- *Litter*—Ways must be found to remove paper, metal, and glass items mechanically from the Nation's highways, beaches, and other public areas.
- *Recycling*—Methods must be developed to reuse a greater percentage of products and to develop new products from and new uses for solid waste.

2. *Available Federal funding should be directed to selective, large-scale demonstrations of innovations in solid waste management in one or more major metropolitan areas.* One of the major difficulties in changing solid waste management is the reluctance of authorities in major urban areas to commit themselves to significant spending for innovations that have been tested only in small towns or under controlled conditions. Federal support could assist in providing a smooth transition from research to large-scale demonstration projects.

3. *Maximum recycling and reuse of materials are necessary to reduce the growing volume of solid wastes that must be disposed of.* The Council is working with a number of Federal agencies to develop a recycle strategy and is studying a variety of special disposal problems. Industry, private research organizations, and all levels of government must be enlisted to maximize the recycling of solid wastes.

VII

Noise, Pesticides, and Radiation

As POLLUTANTS of the environment, noise, pesticides, and radiation are relative newcomers to the public ken. The three are still shadowy and dimly understood. But they are here, and they must be dealt with.

Noise has been defined as "sound without value," and the intensity, variety, and clamor of unwanted, unvalued sounds have multiplied in recent times. For many, city residents in particular, the din never ceases, and it too rarely diminishes.

Pesticides, created as tools to help forge a better life for man, have turned against him in many ways and have become killers of animal and plant life that they were never intended to harm. We do not fully understand their impact on man and the environment, but we know enough to find them disturbing.

Radiation is potentially a more dangerous pollutant to man than pesticides. Man has tried to turn it to his peaceful benefit—and has done so in several ways. But the effects of low levels of radiation are still largely unknown.

The long-term and cumulative impacts of this triumvirate of pollutants—noise, pesticides, and radiation—could be harmful to man. It is therefore imperative that they and their ways become better known.

NOISE

Noise is everywhere, especially in urban areas, where three-fourths of the Nation lives. The roar of air and surface transportation, the general din and hum of construction projects, and industrial noise all pound against the ear virtually without ceasing. In the decade of the 1960's, the measured amounts and extent of urban noise rose significantly. And so did the social awareness of noise and the discomfort caused by it.

Urban dwellers cannot escape it. They are surrounded by a multitude of noise sources in homes, offices, or places of work. Even at play they are bombarded by scores of outdoor noises.

The most severe noise conditions are generally encountered in the work environment. Excessive exposure to such noise for long periods is known to cause irreversible hearing loss. It is estimated that up to 16 million American workers today are threatened with hearing damage.

The worker exposed to noise during the working hours must also endure high levels of noise on his way to and from work. Furthermore at home he must listen to household appliances, noisy neighbors, and a variety of outdoor noises which surround and permeate his dwelling.

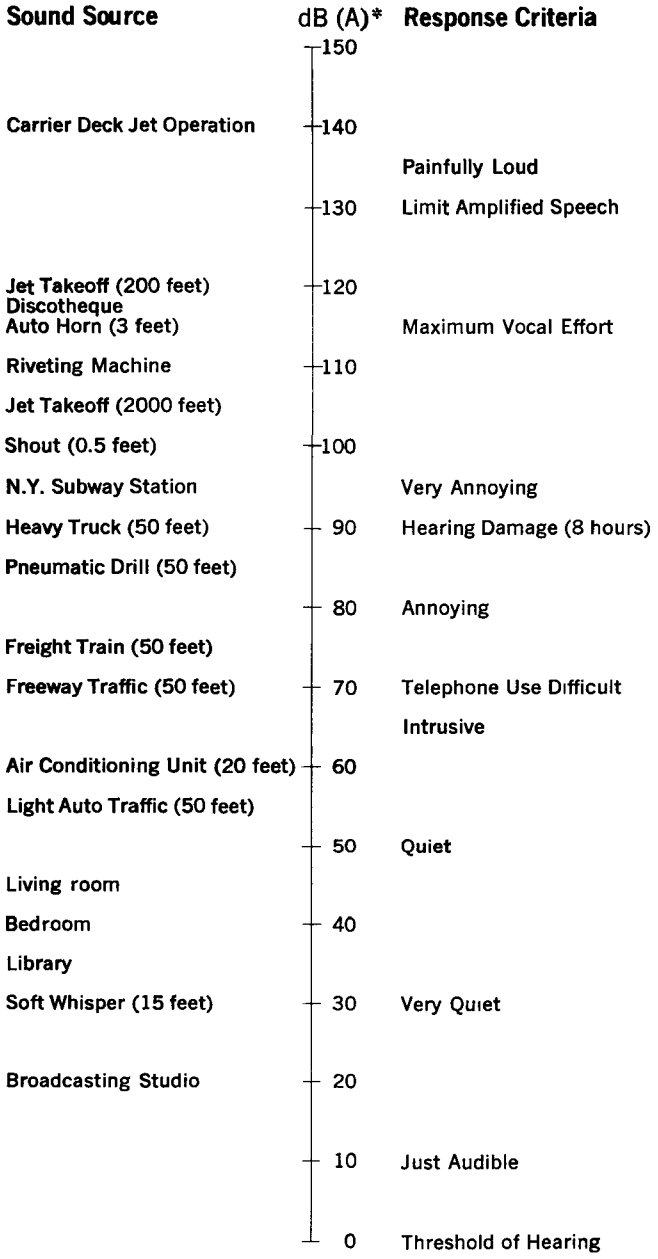
Sources of Noise Pollution

Traffic noise in a modern city may reach 90 decibels. A decibel is a logarithmic measure of sound. Because it is logarithmic, linear comparisons of decibel levels cannot be made. For example, a noise pressure level of 130 decibels is 10 times as great as one of 120 decibels and 100 times as great as a noise pressure level of 110 decibels. It is widely accepted that steady exposure to about 90 decibels can cause permanent hearing loss.

In general, trucks, buses, motorcycles, and rail systems are the worst offenders. With automotive vehicles at high speeds most of the noise comes from the whir of tires, while at lower speeds motor noise dominates. At expressway speeds a single trailer truck can generate steady noise levels above 90 decibels. A line of trucks can produce noise levels of 100 decibels or more.

The high noise level inherent in steel wheels rolling on steel rails makes rapid rail systems noisy. Subways create noise even on the streets when they cause buildings to vibrate or when the noise escapes through ventilators, but most of the noise is absorbed by the ground.

Weighted Sound Levels and Human Response



*Typical A—Weighted sound levels taken with a sound-level meter and expressed as decibels on the scale. The "A" scale approximates the frequency response of the human ear.

Source: Department of Transportation.

Sound bouncing off the walls can raise subway noise levels to 90 to 100 decibels in the cars.

The rapid growth of aviation since World War II and the development of jets have created a major noise problem in airports and the areas around them. A four-engine jet at takeoff generates 115 to 120 decibels. A measure of the resulting annoyance is that about 50 of the 140 major American airports are involved with formal complaints concerning noise, including a sizable number of lawsuits. The Airport Operators Council International estimates that by 1975, 15 million people will be living near enough to airports to be subjected to intense aircraft noise.

Cities suffer from a variety of other noise sources which are rarely curbed by government. Compressors and jackhammers are major offenders. Garbage trucks, lawnmowers, and rock-and-roll music blasting out of discotheques and jukeboxes all add to the din.

At home, the kitchen with its various appliances is the noisiest room. The lack of effective noise standards in building codes allows the construction of apartments and houses in which noise from the outside and from neighbors filters in. Some persons have even taken to adding a low level of constant noise of their own to reduce the annoyance of other noise.

Effects of Noise

Noise can have many adverse effects, including damage to hearing, disruption of normal activity, and general annoyance. Extremely loud noise, such as a sonic boom, can also cause physical damage to structures.

The most common and best understood physiological effect of noise is hearing impairment—either temporary or permanent. The amount of permanent hearing loss produced by sufficient exposure to high-level noise depends on the nature of the noise, the time distribution of particular exposures, the total duration of the exposure over a lifetime, and individual susceptibility. For essentially continuous types of noise, such as that in many factories, enough research has been done to permit some statistical prediction of the risk of hearing damage. More research is needed, however, to predict damage which results from noise of a discontinuous nature.

Noise is known to produce various temporary changes in man's physiological state, in particular a constriction of the smaller arteries. This can mean a speeded up pulse and respiration rate. Some medical au-

thorities believe that continued exposure to loud noises could cause chronic effects such as hypertension or ulcers. Startling noises elicit involuntary muscular responses. Research is still necessary to permit quantitative prediction and understanding of the extra-auditory physiological impact of noise.

More research is needed on the effects of noise on performance of manual tasks. Laboratory studies paint a confusing picture: noise sometimes degrades performance, sometimes improves it. The type of task; the intensity, quality, and repetition rate of the noise; the personality and mood of the worker; and the duration of the task—all seem to interact in unpredictable ways. Workers who must devote constant attention to detail (e.g., console monitoring in quality inspection) may be most prone to distraction. Noise may mask auditory warning signals and thereby cause accidents or cause annoyance and general fatigue.

Individuals vary widely in their sensitivity to noise. A few percent of the population appear not to be bothered by noise, no matter how loud. At the other extreme, a hypersensitive few are distressed by almost any noise. Sensitivity to noise may vary considerably from day to day.

A person may be psychologically predisposed to tolerate and accept a given noise environment when he feels that the noise is an inevitable byproduct of a useful or valuable service. He also tolerates it if his health is not affected and it does not generate fear. One survey of noise around an airport indicated that people's general connection between noise and their fear of aircraft crashing has more effect on the degree of annoyance than did the actual level of noise.

Still another factor is the extent to which people who are annoyed by noise desire to complain and actually do complain about the noise. Complaint data clearly show, however, that new noises will prompt substantial additional response from the community if such noises are heard and identified above the noise level that already exists in the community.

Any characteristic of the noise differing from that to which the community has become accustomed will trigger complaints. New technological developments such as the SST must be examined in light of this phenomenon. Experience has indicated that the new sound of SST sonic booms would not be acceptable to the residents under and adjacent to supersonic flight corridors. (By regulation, the Department of Transportation has proposed banning all overland flights which would produce a detectable boom at ground level.) Similarly, the annoyance levels of noise generated on the sideline areas of the SST

on takeoff is currently expected to be three or four times as great as that of the loudest commercial subsonic jets. On the other hand, the SST is quieter along the takeoff path because of its faster ascent. Solutions to the sideline engine noise problem must be developed and effectively applied *prior to* widespread operation of the SST.

Control and Abatement

Dampening the source noise level or making its noise characteristics less annoying are typical first approaches to noise control. Replacing the noise source with a quieter machine or with one that is no noisier but performs more work (thus displacing many machines whose combined noise levels would be greater than the one) is second, but often costlier approach. Adjusting operating hours to restrict the length or time of day that noise is made is a third approach. Often the simplest solution is to put distance between the noise source and the people—such as truck routes away from residential areas and noisy industry and airports away from homes. This often involves special zoning. Attacking the problem where the noise is heard is often effective. Acoustic insulation (and air conditioning) in residences and offices near airports and highways is one way. Ear protectors for individuals in the industrial work environment is another.

Ultimately, however, decisions must be made as to how much noise must be reduced, how it should be done, who should do it, and who should pay for it.

Implementation of noise abatement and control should not wait until all research is done and all the effects of noise are completely understood. Objective criteria for measuring progress toward the desired reduction of noise can be established without complete understanding of the subjective response to the noise. Working standards can be implemented on the basis of existing knowledge and then refined, if necessary, when more is known. How much noise abatement is forthcoming depends on how badly the public desires more quiet and whether they are willing to pay for what needs to be done.

The recognition of noise as an environmental problem has arrived late in this country, but a beginning has been made toward some of the needed solutions. Of the approximately $34 million allocated by the Federal Government in fiscal year 1970 for noise-related programs, $31 million was devoted to aircraft noise and sonic boom. This comparatively high level of spending reflects the degree of public concern over aircraft noise problems. It suggests, however, that a more balanced

research program that deals with all sources of noise is needed. One particularly pressing need is for new research leading to surer health criteria and to a more refined technology to dampen other transportation, household and industrial noises.

Current Action

Although many noise problems are inherently local, the Federal Government has a responsibility to provide leadership in the fight to combat unnecessary noise. It has already taken several steps toward creation of a quieter nation. This progress is reflected in a number of recent moves:

- The Department of Labor, in May 1969, issued the first Federal standards for occupational exposure to noise.
- The Department of Transportation in November 1969 issued the first of a series of noise standards under Public Law 90–411 regulating aircraft noise. In April 1970, the Department issued a proposed rule banning overland flights of supersonic transports.
- In late 1969, the First Federal Aircraft Noise Abatement Plan was published summarizing the overall program for airport noise research and development.
- The Department of Housing and Urban Development (HUD) is preparing to issue a policy circular. It will set uniform policy and lay down interim standards of noise exposure that HUD will use to determine if proposed housing sites are suitable.
- The National Aeronautics and Space Administration in 1969 successfully demonstrated that new technology could be applied to cut down noise in current jet aircraft. Such research continues. This year NASA was authorized to construct a new acoustics laboratory to conduct advanced research on aircraft noise.

State and local governments must play a major role in legislating and enforcing noise control strategies. Most States, for example, have statutes or codes relating to muffler noise on motor vehicles. But the laws usually fail to spell out enforcement techniques and maximum noise levels. Hence, these regulations are almost impossible to enforce. In 1965, New York became the first State to enact a State highway anti-noise statute. In 1967, California enacted an even more comprehensive statute. Its new highway anti-noise statute specifies maxi-

mum permissible noise levels for passenger cars, trucks, buses, and motorcycles and prescribes levels and test procedures as a requisite for new vehicle sales.

Many cities have noise ordinances, but few are strictly enforced. Attempts by local governments to control traffic noise are often rejected by the courts. State and local noise abatement efforts have been largely ineffective.

What Needs To Be Done

The Council on Environmental Quality recommends the following:

1. *More research is needed on the physiological and psychological effects of noise in order to develop improved remedial programs.*

2. *Noise standards should be developed for all Federally supported or guaranteed construction.* Such Federal standards might serve as a model to standardize State building noise codes and safeguard the competitive positions in different States of housing and building industries. The Department of Housing and Urban Development is in the process of developing such standards.

3. *A thorough evaluation should be made of the extent of the noise problem, its effects, and the various alternatives open to Federal, State, and local governments and to industry to reduce noise.*

PESTICIDES

When Rachael Carson's "Silent Spring" was published in 1962, man's struggle to protect and reclaim the quality of his environment took on a new dimension. It was no longer just a matter of coping with dirty water and air. Suddenly man was confronted by the distinct possibility that one of his seemingly proudest achievements—the development of pesticides—had set into motion, subtly and invisibly, a chain of biological modifications which could diminish the quality of life everywhere.

Unquestionably, pesticides are, and will continue to be, of enormous benefit to man. They have helped to produce food and protect health. Manmade chemicals have been the front line of defense against destructive insects and rodents. Through pest control, man has modified his environment to meet esthetic and recreational demands.

However, in solving some environmental problems pesticides have created others of yet undetermined magnitude. The unintended consequences of the long-term use of certain pesticides have been injury

or death to a variety of life forms. Pesticides have killed shellfish, fish, and birds, and they have caused cancers in test animals. Each year between 100 and 200 human deaths are known to be caused by pesticides in the United States. There are many more acute illnesses, but the statistics are incomplete. Most, if not all, of this morbidity and mortality results from acute poisoning from highly toxic pesticides, sodium arsenite, parathion, and others. There is still relatively little information on the impact of the persistent chlorinated hydrocarbon insecticides, such as DDT, on humans. Consequently, it is not yet known with certainty what are the long-range effects on humans of accumulation of these substances, although some investigators consider that the results from test animals show that a significant threat exists for humans. Such materials accumulate in the body, especially in fat. Investigations show that Americans carry an average of about 8 parts per million of DDT and its metabolites in their body fat. Workmen who handle large quantities of DDT may have several hundred parts per million and still show no harmful effects. The milk of nursing mothers contains DDT. It is also metabolized and excreted in the urine. If exposure decreases, the body concentration diminishes. Therefore, current reductions in DDT use will bring a gradual reduction in body burden, but how fast this may take place is not known.

Pesticides and Their Use

Pesticides embrace a wide variety of chemical compounds for controlling undesirable forms of life which threaten man, his possessions, and portions of the natural environment that he values. A report of the Department of Health, Education, and Welfare Secretary's Commission on "Pesticides and Their Relationship to Environmental Health" of December 1969 pointed to some 900 active pesticidal chemicals formulated into over 60,000 preparations in the United States. In 1968, production and sales of synthetic organic pesticides reached 1.2 billion pounds, of which about 20 percent was exported.

Slightly more than half of all pesticides made are used in farming. (About 45 percent is actually used on crops.) Government agencies use about 5 percent; residential and industrial users account for the rest. At the current growth rate—almost 15 percent a year—a billion pounds of pesticides will soon be applied annually in this country. Most of the increase over the past few years is laid to the expanded use of herbicides. Insecticides and fungicides have not expanded as much. Pesticides can be grouped as nonpersistent, moderately persistent, persistent,

and permanent, based on how long they last in the environment. These lifetimes are critical in predicting and assessing ecological effects.

Nonpersistent pesticides last from several days to about 12 weeks. Most are *moderately persistent* with lifetimes of 1 to 18 months. Examples are 2,4–D and atrazine.

Persistent or hard pesticides include most of the chlorinated hydrocarbons. DDT, the most widely used pesticide in the world, and aldrin, dieldrin, endrin, heptaclor, and toxaphene all belong to this family. They are not broken down easily to nontoxic compounds and have persisted in the environment for many years. For example, present information indicates that DDT can remain toxic for at least 20 years.

Pesticides based on toxic, inorganic elements such as mercury, lead, and arsenic are virtually *permanent.*

Nonpersistent chemicals have been replacing persistent ones, particularly in agriculture. The HEW Secretary's report traces shifts in insecticide ingredients between 1964 and 1966 that reflect slight decreases in chlorinated hydrocarbons. Most insecticides used on fruit and vegetable crops are now of the less persistent variety. However, some pests such as termites can still be attacked only with the hard pesticides. The growing public concern with the use of persistent pesticides may accelerate their replacement by other types or other control measures.

Another group of substances which has effects similar to persistent pesticides is the polychlorinated biphenyls (PCB's). PCB's are used in plasticizers, asphalt, ink, paper, and a host of other products. Action is now being taken to curtail their introduction into the environment.

Even pesticides that degrade rapidly are not without serious drawbacks. Many organophosphate insecticides are extremely toxic and nonselective. Places where they are applied are left nearly devoid of insects, including the natural enemies of the intended targets. Since the chemicals then disappear rapidly, fields are extremely vulnerable to new attacks by insects from adjacent areas. Pests always multiply more rapidly than their predators. In addition, insects resistant to the pesticides emerge rapidly. The typical response is to apply heavier doses of the same pesticide at shorter intervals.

Effects of Pesticides

A pesticide may move through an ecosystem in many ways. Hard pesticides ingested or otherwise borne by the target species will stay in the environment, possibly to be recycled rapidly or concentrated

further through the natural action of food chains if the species is eaten. Most of the volume of pesticides do not reach their target at all.

Whether pesticides are introduced into the environment by spraying or by surface application, air usually is the medium through which the chemicals move to their intended and unintended targets. Very few data exist on pesticides in the air, largely because of a lack of adequate monitoring. Their presence and fate are functions of their chemical nature, physical state, method of application, and atmospheric conditions. It is clear that pesticides may be blown long distances on dust particles.

The persistence of pesticides in the air is influenced by gravitational fallout and washout by rain. They build up in the soil to concentrations which may eventually reach man by a number of routes: through water drawn from the soil by consumable crops, through leaching or washing into water supplies, and by his direct contact with the soil. Pesticides linger on, often to injure organisms and crops which grow later in the same soil.

Pesticides enter water chiefly through spraying, runoff from treated areas, or waste discharge by producers. Percolation through soil to ground water and accidental dumping are minor sources. Pesticides can reach humans directly through drinking water, but the concentration in most cases is far below toxic level. There is no evidence at present that long-term consumption of such water is harmful, although the buildup of pesticides in water may eventually prove dangerous.

Some pesticides bind tightly to soil particles; therefore, pollution by pesticides may occur from silt and soil washed off agricultural land into rivers, lakes, and coastal waters. Although a portion of the residues is released to the water, some dissolved and some suspended, an unknown amount remains with sediments after they settle. The sediments may then act as reservoirs, continually releasing residue pesticides to the overlying waters.

Initially, low levels of persistent pesticides in air, soil, and water may be concentrated at every step up the food chain. Minute aquatic organisms and scavengers, which screen water and bottom mud having pesticide levels of a few parts per billion, can accumulate levels measured in a few parts per million—a thousand-fold increase. Oysters, for instance, will concentrate DDT 70,000 times higher in their tissues than it is concentrated in surrounding water, but they partially cleanse themselves in water free of DDT. Fish feeding on lower organisms build up concentrations in their visceral fat which may reach several thousand parts per million and levels in their edible

flesh of hundreds of parts per million. Larger animals, such as fish-eating gulls, can further concentrate the chemicals. To date, the effects of pesticides have been studied in less than 1 percent of the animal species present in the United States.

Much of the information on the effects of pesticides comes from studies of birds. Heavy mortalities among robins which fed on earthworms contaminated during spraying to eradicate Dutch elm disease spurred the first public concern and scientific inquiry. Many aquatic birds, including egrets, grebes, herons, and gulls, have also died from insecticide poisoning. Much of the drastic loss among certain species of falcons, hawks, and eagles is believed due to the DDT family of pesticides. High levels of persistent pesticides cause some birds to lay eggs with thin shells. There is experimental evidence from the Patuxent Wildlife Research Center that DDE, a metabolite of DDT, reduces the birds' ability to provide calcium for egg shells, causing premature breakage. Ducks, ospreys, hawks, and eagles have all laid thin-shelled eggs. The sudden decline of the Brown Pelican along the southwest coast of the United States is believed to have been caused by widespread breakage of pesticide-affected eggs with shells so thin that they are little more than pliable membranes. As a result, reproduction of the Brown Pelican has virtually ceased. Pesticides affect the nervous systems of both fresh and salt water fish, causing instability, respiratory difficulty, sluggishness, and death. In 1955, when the fish hatchery on Lake George, N.Y., lost 100 percent of nearly 350,000 eggs removed from lake trout, DDT was suspected. Pesticides killed more than 2 million fish in a Florida marsh and over 5 million in the Lower Mississippi River. Laboratory studies show that DDT reduces the ability of salmon to detect temperature changes, an ability upon which they depend to find their spawning grounds.

Some fish may build up a tolerance for pesticides. Mosquito fish have been reported to accumulate endrin at levels sufficient to poison the fish's predators. Concentration of pesticides in big enough doses in edible fish species could pose a threat to food supplies.

Marine invertebrates, such as crabs, shrimps, and scallops, are also susceptible to pesticides, and large mortalities have been reported. Indirect toxicity has taken a toll among crabs feeding on fish killed by dieldrin. And fiddler crabs feeding on DDT-laden detritus became so uncoordinated that they lost their defense mechanism. The growth of several types of oysters was severely retarded in laboratory tests when pesticide levels in the surrounding water were increased.

It is clear that different species respond in different ways to the

same concentration of a pesticide. Reproduction is inhibited in some and not in others. Eggs of some birds become thin and break; others do not. Relatively high concentrations of DDT appear in seals and whales. Dead porpoises in the Gulf of Mexico contained residues ranging up to 800 parts per million, but the role, if any, of pesticides in these deaths is uncertain.

Laboratory studies of mammals, including rats, mice, hamsters, dogs, and monkeys, revealed that under experimental conditions some pesticides increased the incidence of cancers, birth defects, and genetic mutation. No clear evidence exists on the long-term effects on man of accumulation of pesticides through the food chain, but the problem has been relatively unstudied. Limited studies with human volunteers during the past 5 years have not shown that persistent pesticides, at the normal levels found in human tissues at present, are associated with any disease. However, further research is required before results are conclusive about present effects, and no information exists about the longer-term effects.

The HEW Secretary's report states: "While there is no evidence to indicate that pesticides presently in use actually cause carcinogenic or teratogenic effects in man, nevertheless, the fact that some pesticides cause these effects in experimental mammals indicates cause for concern and careful evaluation." Further, "the field of pesticide toxicology exemplifies the absurdity of a situation in which 200 million Americans are undergoing lifelong exposure, yet our knowledge of what is happening to them is at best fragmentary and for the most part indirect and inferential. While there is little ground for forebodings of disaster, there is even less for complacency."

Population studies would provide definitive data. But the incidence in man might be so low (one case in 10,000 might be significant) and the period between exposure and observable disease so long that such studies would be difficult to devise and expensive to conduct.

Meanwhile, decisions must be made on the basis of extrapolation from experimental animals. Extrapolation is always risky, and judgments on the chronic effects of pesticides on man will continue to be highly controversial.

Options

Pest control with or without pesticides is essential for protecting man from disease, discomfort, and annoyance and for producing adequate food and fiber. Developing countries with rapidly growing

populations, particularly those in the tropics, have a special stake in the battle against pests. A recent report by the World Health Organization stated: "We must not forget the enormous benefits insecticides have brought to humanity. . . . Limitations on the use of DDT would give rise to greater problems in the majority of the developing countries."

A number of choices are available to reduce the dangers of pesticides in the environment. Some persistent pesticides, primarily organochlorine-based insecticides, can be replaced with degradable ones.

Nonchemical methods of pest control are also under development. Federal outlays for such methods have increased to $45 million annually, but with little success. The list of nonchemical controls remains small and almost all have disadvantages. Industry has invested little in this area, so public agencies are left with the leading role in research and development. Many different techniques are under study, including pest control by parasites and predators—such as the use of a species of weavil to combat Klamath weed in California pastures. Introducing pest-killing animals to new areas is risky. The mongoose has itself become a pest in Jamaica and Puerto Rico after having been imported to control rats.

The use of pathogens—viruses, bacteria, and fungi—has had some success. But they may be dangerous to human health. One of the most effective and safest pest control measures is the selective breeding of resistant species of plants. The Hessian fly, a serious pest of wheat, has been controlled in this manner.

Cultural control, based on selection and diversification of planting time, crop rotation, and water and fertilizer management, has proved effective in specific cases. Control of the screw-worm fly through release of many males sterilized by irradiation promises to be dramatically successful. However, this technique or use of chemical sterilants appears to be limited to certain pests and also may be more expensive than the use of pesticides. The HEW Secretary's report called attention to the fact that about 80 percent of the pesticides used are for the control of fewer than 100 species of pest organisms. The report suggests that nonchemical approaches to controlling these specific pests would significantly reduce the pesticide burden.

Shipment of pesticides in interstate commerce is regulated by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947, which is administered by the Secretary of Agriculture. The act requires pesticides and other "economic poisons" to carry labels bear-

ing certain information, including any warnings necessary to prevent human injury. A pesticide which fails to comply with the labeling requirement, or which cannot be rendered safe by any labeling, is misbranded, and the Secretary must refuse or cancel its registration as an economic poison approved for shipment in interstate commerce.

The 1954 amendments to the Food, Drug, and Cosmetic Act (FDCA) require the Food and Drug Administration (FDA) to establish residue tolerances for all pesticide products designed for use on or in human or animal food. FIFRA protects interstate commerce; FDCA protects the Nation's health. Any application to USDA to register a pesticide must be accompanied by scientific data on residues that will remain on the crop at marketing time. The FDA must establish the residue tolerance for a particular use before USDA grants the registration. The law provides for seizure and destruction of commodities that contain pesticide residues in excess of established tolerances.

For years FDA has regulated the residues permitted on raw agricultural produce in interstate commerce. An additional problem is how to regulate inadvertent residues on crops from indirect exposure and in fish and other uncultivated foods when the residue accumulation is beyond the control of the harvester. This problem is receiving attention by the FDA. There is also growing concern about human exposures not associated with food (for example, air, water, and clothing). Legislation may become necessary before these hazards can be adequately regulated.

The Department of Transportation (DOT) plays an important role in regulating pesticides. Its licensing of aerial applicators provides the only Federal regulations directly controlling non-Federal use of pesticides. DOT also regulates the interstate shipment of some pesticides as hazardous chemicals and is reviewing and strengthening these regulations.

Significant efforts during the past year to control pesticides include:

- On July 9, 1969, all USDA-operated pest control programs involving nine persistent pesticides were suspended pending a 30-day review of their environmental contamination. Uses of dieldrin, heptachlor, and DDT were drastically reduced or eliminated. In October, the Secretary of Agriculture declared that the Department would "practice and encourage the use of those means of effective pest control which provide the least potential hazard to man, his animals, wildlife, and the other components of the environment."

- On November 20, the Cabinet Committee on the Environment (at that time called the Environmental Quality Council) established a subcommittee on pesticides. As of June 15, the working group of this subcommittee, which consists of pesticide experts, had received for evaluation 45 pesticide programs—embracing 1,033 projects—from 30 Federal agencies. As of that date, 38 of these programs had been evaluated, and significant changes made in many, including substitutions of pesticides and improved control procedures.
- Also on November 20, the White House announced that the Secretary of Agriculture had initiated action, effective in 30 days, to cancel all DDT uses for house and garden pests, shade tree pests, pests in aquatic areas, and tobacco pests. These cancelled uses account for 14 million pounds or 35 percent of the total DDT used annually in this country. However, three registrants have appealed this decision. The DDT products of these three continue to be sold until the courts rule on the appeals. All remaining uses of DDT found to be nonessential will be cancelled by December 31, 1970. The Secretary also announced that beginning in March 1970, action regarding other persistent pesticides would be taken using the same criteria and procedures applied to DDT. A Department spokesman announced at the Senate Commerce Committee hearings in June that within 3 months an evaluation will be completed on the dioxin content in 18 pesticides and their hazards to humans.
- In January 1970, the Secretaries of Agriculture, the Interior, and HEW signed a new interdepartmental agreement designed to strengthen the review of pesticide registrations in relation to the protection of human health and the environment.
- In late February and early March, the Department of Agriculture suspended the registration of 42 alkylmercury fungicide products used for seed treatment. It asserted that growing misuse of the treated seed, despite label warnings and other precautions, constituted an imminent hazard to the public health. This has been appealed, and as of July 1, the appeal had not been decided.
- All uses of aldrin and dieldrin insecticides in aquatic environments were cancelled by the Department of Agriculture. Certain uses of lindane and benzene hexachloride (BHC) on beans,

corn, peas, and citrus fruits were canceled after FDA repealed its tolerance listings for these chemicals. As of July 1, no appeals had been made.

- The Secretaries of Agriculture, HEW, and Interior announced on April 15, 1970, the suspension of liquid formulations of 2,4,5-T for use around the home and of all formulations for use on lakes, ponds, and ditchbanks. The action was taken on the basis of imminent hazard to the public health because of new data which showed that this herbicide caused defects in laboratory animals. Three registrants have appealed the cancellation as it pertains to certain food crops, and their 2,4,5-T products can be lawfully produced and sold pending outcome of the appeal.
- On June 19, the Secretary of the Interior stopped the use of DDT, aldrin, 2,4,5-T, dieldrin, endrin, DDD, mercury compounds, and nine other pesticides on the 356 million acres of public land controlled by the Department.

Forty-eight States have laws, patterned on Federal law, which govern the marketing of pesticides. Thirty-nine States also regulate their use. Most of these States require commercial applicators to obtain licenses or permits. Within the past year, a number of States—including California, Michigan, Wisconsin, and Florida—enacted regulations or laws restricting the marketing or use of certain chemicals, particularly DDT. More such actions are likely.

Public concern is manifested in legal actions initiated by conservation groups. In May 1970, the U.S. Court of Appeals for the District of Columbia ordered the Secretary of Agriculture to suspend the registration of DDT within 30 days for interstate shipment or to show cause why the shipments should continue. As of July 31, the court had not yet heard arguments on the Secretary's reply. The same court ordered the Secretary of HEW to publish in the Federal Register a proposal by an environmental group that the Secretary set a zero tolerance for DDT residues on raw agricultural commodities. This action means that a thorough study and public hearings must be conducted.

Another suit was initiated in June against the Olin Corporation and the Corps of Engineers to halt discharge of DDT from the Olin plant into the Tennessee River and the Wheeler National Wildlife Refuge in Alabama. Shortly thereafter the company closed the plant.

What Needs To Be Done

Although substantial progress is being made in the control of pesticides, much remains to be done. The following represents high priority areas for further action:

1. *The Administration is considering a broad range of legislative and administrative proposals for more effective pesticide regulation.* These include measures to assure adoption of less persistent or toxic materials, limit the availability of certain types of pesticides, and regulate disposal of unused pesticides.

2. *There is a need to ensure that information on the dangers of pesticides and on innovations in pest control is spread worldwide and consideration should be given to international control over use and shipment of pesticides.* Although the need for pesticides may be great in developing countries, the risks to human and environmental health are very great also, and knowledge, techniques, and standards developed in the United States do not necessarily apply elsewhere. For example, recent studies have shown that application of the nonselective, persistent pesticides under tropical conditions in some cases aggravate the pest condition rather than the reverse. New guidelines governing the distribution of persistent pesticides abroad are being prepared by the Agency for International Development.

3. *Incentives to industry should be explored to stimulate research and development by the private sector on substitutes for persistent pesticides and on nonchemical control.*

4. *Finally, the effects of pesticides on man and the environment must be vigorously studied, particularly through controlled exposure experiments.*

RADIATION

In the past when people thought of radiation, they thought primarily of nuclear bombs. Today many still think of it that way. But more and more, Americans are starting to realize that radiation is a byproduct of some forms of our modern technology. Now medical applications are the central source of manmade radiation. Tomorrow increased applications of nuclear power may cause additional concern.

The exposure of larger segments of the world's population—particularly in the industrialized nations—to a variety of low-level, manmade radiation sources is increasing. These sources include X-rays,

radioactive materials, and electronic devices in the home, office, and industry. The increase both in the number of sources and in the number of people exposed raises questions about the magnitude and nature of the hazard to human health of ionizing radiation. This questioning has occurred both among the general population and within the scientific community and focuses on the adequacy of existing radiation protection standards.

Effects of Radiation

It is known that high levels of radiation adversely affect human health in a number of ways. Various forms of cancer in humans and experimental animals have been associated with relatively high doses of radiation. It has been demonstrated in leukemia and other cancers that at doses above approximately 100 rems a proportional relation exists between the size of the dose and the incidence of the disease. (The unit "rem" stands for "roentgen equivalent man" and reflects the amount of radiation absorbed in human tissues and also the quality of the type of radiation.) This evidence has been gathered from studies of persons exposed to the atomic bomb explosions in Japan and from patients treated with high doses of radiation for medical purposes.

It is much more difficult to assess the potential biological effects of low-level radiation. Measurements of effects at very low doses (comparable to those which might be expected in the natural environment) are technically difficult or impossible. One reason is that man's biological responses to ionizing radiation depend on myriad factors—type, amount, and rate of radiation received; whether it comes from external sources; and whether the whole body or particular organs are exposed.

One of the major potential effects of low level radiation is that human genes may be damaged or altered. The risk of genetic damage lies behind most of the recommended standards for radiation exposure. There is a natural mutation rate among humans which is believed to be caused, at least in part, by natural background radiation. From this it is reasoned that any manmade sources of radiation which augment natural background radiation will similarly be responsible for a proportionate statistical increase in the number of genes affected. The risk of such an increase argues most strongly for conservative radiation exposure practices.

Information is still not complete regarding potential biological injuries from exposure to radiation from electronic products. Research

in this field requires basic and long-term studies of large numbers of humans and animals. The results of preliminary studies on animals show that microwaves of sufficient intensity can induce chromosomal abnormalities, cause cataracts, and alter protein synthesis. Ultrasonic vibrations intense enough to be of therapeutic value can cause tissue damage. However, at this time it appears that nonionizing radiation from sources such as lasers, switching and communications equipment, and microwave ovens has less of an impact on the general population than ionizing radiation.

Sources of Radiation

Natural (background) radiation—The earth's natural background of radiation arises from two general sources. One is cosmic radiation which enters the earth's atmosphere. The dose received at any point on earth from cosmic sources varies with altitude and latitude. The other major source of natural background radiation is radioactive isotopes found in water and in mineral deposits. The total radiation from natural sources can contribute an average individual yearly dose of about 125 mrem (see table 1).

TABLE 1.—*Average Annual Genetically Significant Dose to General Population From Various Environmental Sources* [1]

Source	Dose (mrem)[2]	Percent—	
		Of total from all sources	Of manmade sources
Natural background	125	68.3	
Medical sources	55.2	30.1	93.8
Diagnostic X-ray	(50.0)	(27.3)	(85.0)
Therapeutic X-ray	(5.0)	(2.7)	(8.5)
Radioisotopes	(0.2)	(0.1)	(0.3)
Other sources	1.7	0.9	2.9
Occupational	(0.2)	(0.1)	(0.3)
Fallout	(1.5)	(0.8)	(2.6)
Miscellaneous (includes TV sets, luminous markings on watches, etc.)	2.0	1.1	3.4
Total		100.4	100.1

[1] Based on data reported by John B. Little, "Environmental Hazards—Ionizing Radiation," New England Journal of Medicine, 275, 929-38 (1966) and the United Nations Scientific Committee on the Effects of Atomic Radiation.

[2] mrem=millirem (1/1000 rem).

Manmade sources of radiation—Medical uses of radiation now represent the largest single source of manmade radiation—about 94 percent of all manmade radiation or roughly 30 percent of all radiation sources to which the average person is exposed. An increasing awareness of this fact and its potential hazard has led to some reduction in medical uses of radiation in recent years and to improvements in their techniques of use.

Radioactivity released during past atmospheric nuclear tests currently contributes about 3 percent of the manmade radiation to which individuals are exposed. The radioactive fallout of main concern from these tests is strontium-90 and cesium-137. Their half-lives, 28 and 30 years, respectively, mean that they will exist in the environment for many years. A significant amount of tritium produced by atmospheric weapons testing also remains in the biosphere. The U.N. Scientific Committee on the Effects of Atomic Radiation reports that individuals who lived in the United States during the period of heaviest fallout in the 1950's and early 1960's will accumulate a total genetic fallout dose of about 110 millirem by the year 2000. This is approximately what man is already receiving annually from natural background radiation. This "extra year" of exposure takes into account all sources of fallout, including radioactivity which may enter the body through food and water.

Nuclear powerplants provided about 1.4 percent of the country's total electric power capacity in 1969. The U.S. Atomic Energy Commission estimates that nuclear plants will furnish almost 25 percent of the total in 1980 and between 60 and 70 percent by the year 2000. With the projected substantial increase in demands for electric power, environmental problems arising from the operation and siting of all powerplants will require careful scrutiny, since both fossil fuel and nuclear plants can cause adverse environmental effects.

Effluents from nuclear power reactors contain small amounts of radioactivity. Two significant isotopes, krypton-85 and tritium, are released mainly from fuel reprocessing plants and to a much lesser extent from nuclear reactors. AEC experience with commercial reactors shows that exposure to persons living near a typical operating reactor may range from 1 to 10 mr per year. In March 1970, the AEC announced proposed amendments to its regulations. These would improve the framework for assuring that even within regulatory limits, reasonable efforts are made by licensees to keep exposures

to radiation and releases of radioactivity in effluents from light water-cooled nuclear power reactors "as low as practicable" consistent with Federal Radiation Council guidance. Two of the four suppliers of water-cooled reactors have already announced that they are designing systems that should be capable of further reducing the effluent levels.

Because krypton is long-lasting (half-life of 10.76 years) and does not react chemically with other substances, its quantity in the atmosphere is increasing. There is no evidence that it can concentrate through food chains. Estimates indicate that by the year 2000 the average annual genetic dose to the population from krypton-85 will be about 0.02 mrem, assuming that it continues to be fed into the atmosphere.

Tritium (half-life of 12.26 years) is extremely difficult to remove from the liquid discharges of power and fuel reprocessing plants. However, the addition of tritium to the environment is not expected to increase the world population's radiation exposure significantly. There is no known mechanism by which tritium can concentrate in fish and shellfish or other food chains, and studies show no evidence that it does concentrate. If one assumes that tritium from nuclear plants is diluted in the oceans to a depth of 40 feet and in the atmosphere to a height of 10 kilometers, the resulting population doses are estimated at 0.002 mrem per year by the year 2000.

Reactor Safety Record

A nuclear reactor cannot explode like an atomic bomb. The most serious safety hazard it poses is that excessive heating could melt the core and spill large quantities of radioactive materials into the environment. To make this possibility extremely remote, an extensive safety program has been developed.

Since the beginning of the nuclear energy program in 1943, there has been only one reactor accident in the United States involving fatal injuries. This accident occurred in an experimental reactor, the SL–1, at a remote AEC testing station in Idaho in 1961. It killed three reactor operators. A very small amount of fuel melting occurred in the Enrico Fermi reactor near Monroe, Mich., in 1966, but no radioactivity was released from the plant. In the commercial nuclear power program, no radiation injuries or deaths have resulted from the operation of licensed nuclear powerplants in the United States. There have been other deaths from high-level radiation not associated with reactors.

Radioactive Waste Storage and Disposal

The management of radioactive waste material in the nuclear energy industry can be put into two general categories. The first is the treatment and disposal of materials with low levels of radioactivity. These materials are the gaseous, liquid, and solid wastes from reactors and other nuclear facilities. The second category involves the treatment and permanent storage of much smaller volumes of wastes with high levels of radioactivity. These high-level wastes are byproducts of the reprocessing of used fuel elements from nuclear reactors. Their disposal will become more and more of a problem, particularly as their volume increases with society's expanded uses of radiation sources in the future.

Low-level wastes—Reactors are permitted to release low concentrations of radioactivity to the atmosphere and to receiving waters. These amounts are generally well below the limits specified in regulations issued by the AEC.

Low-level solid wastes are packaged and shipped for storage at AEC-owned or AEC-licensed burial sites. There are currently five licensed private sites and five AEC-owned burial sites in use. They are located on Federally or State-owned land and were chosen so that the local geology and hydrology are least likely to allow the buried radioactivity to escape. A close watch is maintained to assure that leakage does not occur. About 650,000 cubic feet of low-level solid wastes were buried at licensed burial grounds in 1969. The total of solid wastes for AEC sites was about 1,800,000 cubic feet.

High-level wastes—After used fuel is removed from the reactor, it is packaged and shipped in solid form to a reprocessing plant. After reprocessing, the high-level liquid wastes are concentrated and stored in tanks under controlled conditions at the site of the reprocessing plant. In anticipation of the growth of the nuclear industry, the AEC has developed the technology to reduce these liquid wastes to solid form, thereby reducing the final volume to one-tenth that of the original liquid material. The liquid wastes (approximately 80 million gallons) stored at AEC sites are now in the process of being solidified. The AEC has announced a proposed policy that will require high-level wastes from the reprocessing of commercial reactor fuels to be stored in solid form. (Approximately 520,000 gallons are now in tank storage at the one licensed fuel reprocessing plant site.)

It has been estimated that through the year 1980, commercial power reactors will generate approximately 3.5 million gallons of high level wastes. Upon solidification, it would be equivalent to a cube about 33 feet on a side, or 35,000 cubic feet.

Standards for Protection Against Ionizing Radiation

The formal procedures and scientific bases for developing and establishing standards for protection against ionizing radiation are the most comprehensive of any applied to environmental stresses. However, the effects of radiation on man are not fully understood, and there remains room for disagreement over the adequacy of current standards.

Radiation exposure standards are re-examined as knowledge expands. Although the biological effects on man of low-level exposures have not been precisely quantified, current standards use a conservative extrapolation of measured data at high exposures to set radiation standards of low levels. Further, as advised by the Federal Radiation Council, efforts are made to keep exposures as low as practicable. Experience has shown that actual exposures are small fractions of radiation protection standards. However, as the number of radiation sources grows (for example, nuclear power plants), increasing attention will have to be paid to the apportionment of radiation doses from these sources.

Despite this conservatism, some scientists have questioned both the rationale and the levels of existing standards. The State of Minnesota has proposed radiation standards more stringent than those established by the Atomic Energy Commission. The AEC argues that the Atomic Energy Act gives it exclusive authority to establish radiation protection standards, but this prerogative has been challenged by Minnesota. The issue is currently being litigated in the courts of that State by a private utility in a suit against Minnesota.

The continued increase in the use of radiation sources will undoubtedly lead to increased concern over radiation standards, and the need to determine more precisely the effects of low-level doses will become even more urgent than it now is.

What Needs To Be Done

To assure that adverse effects due to radiation are kept to an absolute minimum, the following are necessary:

1. Continued research to determine the effects of low-level doses of radiation and their cumulative effects.

2. Intensified research on problems of radiation arising from medical uses and from consumer products.

3. Careful regulation and control of the release of radiation to the environment from nuclear reactors, underground nuclear testing, and the transportation, storage, and disposal of radio-active wastes.

VIII

Population, Growth, and Resources

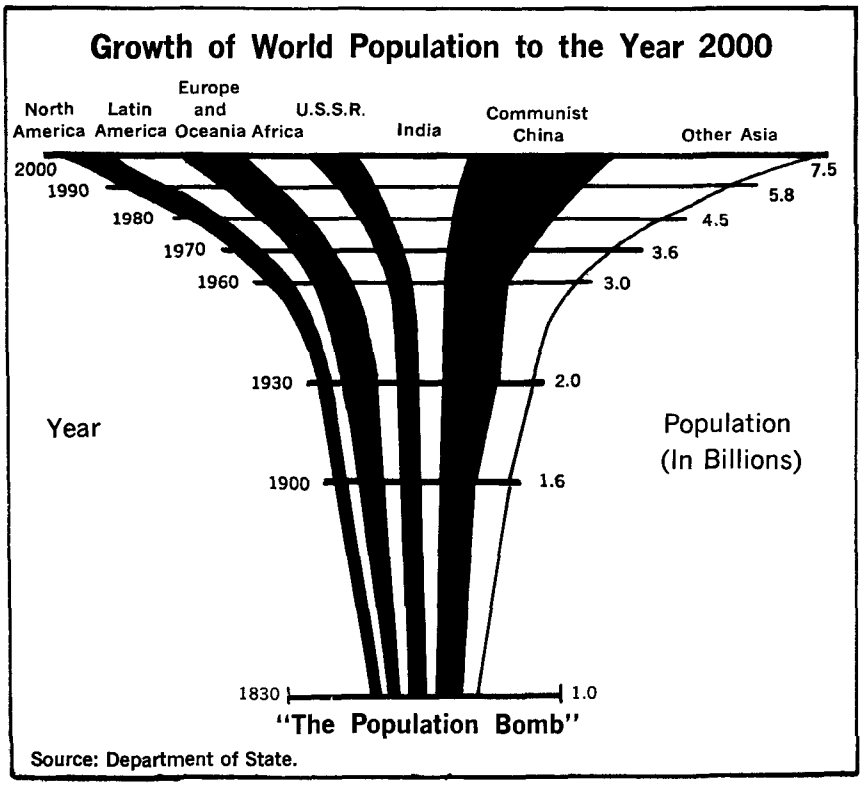
As POPULATION grows, it creates more environmental problems and intensifies those that are already there—just by dint of its growth. For all the decades of the country's national existence, population growth has been in a steady spiral. As it grew, there were more people to want more services, which can only come from natural resources. In those nearly two centuries of growth, Americans took what they wanted with little counting of the cost in natural resources and the toll this took on the environment.

We have wanted automobiles, TV sets, and household appliances and a variety of clothing, food, and housing. We have wanted to flip on a switch and immediately have electricity or to turn on a faucet and have an unlimited flow of water at low cost. And we have wanted to dispose easily and rapidly of personal, household, and industrial wastes produced by our style of living.

POPULATION AND GROWTH

Between 1830 and 1930 the world's population doubled from 1 to 2 billion. By 1970, it had almost doubled again, reaching 3.6 billion. Between now and the end of the century, a mere 30 years, it probably will more than double again—barring catastrophe or a marked change in values—to an estimated 7.5 billion. The U.S. population is growing less rapidly than that of most of the rest of the world, but the increase is still significant. One hundred million people lived in the United States in 1915. The population has passed 205 million today and may reach between 265 and 322 million by the end of the century.

Population growth was of little relevance and of no concern to man during the first several hundred thousand years of his existence. Less than 200 years ago, some of the negative implications of population increase first began to be realized.



Although the rate of population growth in the United States and other industrial nations has declined, its absolute growth hasn't. And that contributes to environmental decay. More people mean more congestion, more urban sprawl, and vast networks of highways to transport them. They require more goods and services—more steel, more paper, more cars, and more beer cans. And they put more severe demands on urban land. Moreover, people themselves produce waste that must be handled by treatment plants.

Mushrooming population growth doesn't necessarily mean more polluted air and water. But it is more difficult to have environmental quality with the pressure of population. It is more difficult to avoid congestion, preserve green space and keep a pleasant environment. Whatever the environmental problem, rising population requires effort just to stand still and great effort to make progress—requiring institutions not now available and management tools not yet perfected.

Population Control—A Matter of Values

The increased attention focused on the environment has already changed values in American society. Increasingly, concern has shifted from quantity to quality and from the desirability of growth to the desirability of stability. These are not absolute alternatives, but rather broad differences in emphasis. The quantitative increase in GNP has generated significant qualitative improvements in the way people live, and certain kinds of growth are necessary for the stability of society. However, the significance of values in determining population policy should not be underestimated.

Quantitatively Americans have achieved heights which could not be imagined only a few decades ago—metropolitan areas of unparalleled size, a GNP approaching a trillion dollars a year, and consumption of goods and resources on a scale far exceeding that of any other society, past or present. Although growth has been accompanied by a better life in some ways, growth has not led to a high quality environment. It has become clear that a finite planet cannot withstand infinite population growth.

An optimum population range is a matter of considerable dispute. Many feel that the country has already reached the desirable limits of growth, and their view may come to be generally accepted. It is not generally accepted now, however, and evidence to indicate what the optimum population should be is scanty or nonexistent. The work of

the President's Commission on Population Growth and the American Future should help explore this question.

How much time the United States has to deal with the size of its population depends on the view of the optimum population range. However, two things are clear—there is some limit beyond which the population should not go, and it will take a considerable time to achieve a stationary population when, and if, it is decided that this is a desirable goal. Even if fertility rates were to fall immediately to levels required for "replacement" of the existing population (2.11 children per woman), given the large proportion of Americans currently of child-bearing age, the population would continue to increase for over 60 years and would level off at about 275 million. It is possible that fertility rates could drop below the replacement rate, in which case the population would level off sooner and at a lower figure.

Some steps are now underway which may reduce the rate of population increase. Research is being conducted on improved methods of contraception. If an inexpensive and effective method with no adverse side effects is developed, it will contribute significantly to population control. Some demographers estimate that about 20 percent of the children born in the United States are unwanted. If they had not been born, the average family size would be close to the figure needed for population replacement. Thus a situation of "perfect contraception" might bring the birth rate close to what is needed for zero population growth—unless other factors intervene.

One method of avoiding unwanted births being widely discussed today is abortion. In the past few years, a number of States have liberalized their abortion laws, and the movement toward liberalization or complete abolition of such laws is continuing. This movement could bring a significant decrease in the rate of population growth.

There has been some talk about the effects of economic penalties or incentives on family size, but there is almost no good evidence on what the effects are. Federal tax policy theoretically encourages people to get married and to have children by taxing single persons more heavily than families and giving a significant deduction for each dependent. However, the tax relief from having children is small compared to the cost of rearing them, and it is questionable whether the marginal economic effects of tax policies can or do have much impact on family size.

The major key to achieving a stationary population lies in the values which people hold. Most couples in the United States still want more than two children, and so long as this is true, the population will con-

tinue to grow. Values concerning family size cannot be changed directly by public policy, but there are measures which can be taken to influence such values. One, for example, would be to improve training and employment opportunities for women, opening up for them many acceptable roles other than rearing children. There are now only half as many women as men enrolled in colleges and universities, and only 10 percent of the students in professional schools are women. Opening more career possibilities for women would move the country toward a wider range of family size, since some career women will choose to have no children, and at the same time would make available to the Nation a valuable and underutilized pool of talent. Increased employment for women would also provide an indirect economic incentive for smaller family size because of the finanical loss involved in dropping a career to rear children. Unlike taxes, such an incentive might be sufficiently large to influence the number of children a woman will have.

The broad problem of population growth will be studied by the President's Commission on Population Growth and the American Future, headed by John D. Rockefeller III. That Commission will explore the implications of future population growth and make recommendations to the President within two years.

People on the Move

The U.S. population is geographically mobile. From its earliest days the Nation has undergone great movements of population to different parts of the country. Such movements are still going on. Significant numbers of people are moving from the interior to the edges of the country (Atlantic Seaboard, Florida, the Gulf Coast, the West Coast, the Southwest, and the Great Lakes regions), from rural areas to cities, and from central cities to suburbs.

The implications of these movements are hard to discern. They are obscured partially by differences in focus and interpretation. If one looks at the national population, an ever higher proportion of the people are living in large metropolitan areas and thus are exposed to dense concentrations and the problems of urban living. However, within the metropolitan areas the general trend is toward steadily lower densities (fewer persons per square mile) because of suburbanization. Nationally, there has been fairly constant economic growth, but certain regions (Appalachia, parts of the South, and New England) suffer chronic problems of poverty. Although the population as a

whole is highly mobile, residential segregation of blacks has increased. The population of the country is increasing rapidly, but between 1960 and 1970 half of the counties in the Nation lost population.

These differing trends and other related factors make it difficult to weigh the advantages and disadvantages of increasing urbanization. Much more thought and research needs to be devoted to how and in what ways the Federal Government should influence patterns of population distribution.

The ills which beset both urban and nonurban areas are numerous and familiar; examples will be found throughout this report. Many of these problems, particularly those relating to metropolitan areas and to environmental quality, arise from an absence of rational, enforceable planning. The structures of local governments and taxes work hand-in-hand to undermine the application of foresight to urban development. Insufficient open space is provided, jobs are created without regard to residences of potential employees, and transportation networks are built with little thought of their social or environmental consequences.

Many of these problems are related to population growth in metropolitan areas. But they are also clearly related to the inadequacy and ineffectiveness of local and regional planning. This aspect of urban development will be discussed in more detail in the chapter on land use.

The GNP—Does It Hurt or Help?

Economic growth is closely linked to population growth. Some conservationists and ecologists believe that the Nation should aim at zero GNP growth as a way of avoiding ecological catastrophe and preserving a decent environment.

Economic growth is often accompanied by more industrial pollution, greater consumption of natural resources, and larger quantities of discarded materials. If the sole objective were pollution abatement or the conservation of natural resources, a reasonable argument could be made for reducing GNP to the lowest levels possible.

However, this report is taking a broad view of the term environment, and this broader view reveals many benefits of continued economic growth. Our society needs more goods and services of many kinds—better housing, improved public transportation, more adequate facilities for health and education, and increased pollution control. It is likely that the funds for such investments will come not from a

cutback in the production of cosmetics, for instance, but from an overall increase in national output. Moreover, a reduction in growth would result in a severe blow to the aspirations of the economically disadvantaged, especially minority groups.

Thus, looking at the total environment of the Nation, it seems probable that direct attempts to reduce GNP growth would create many more problems than they would solve. If the rate of population growth is reduced, there will undoubtedly be some reduction in the rate of GNP growth, but environmental problems probably can be dealt with most successfully by alterations in the composition of the GNP, particularly alterations in that portion of GNP which represents growth over the current level.

1968 GNP by Industry, in 1958 prices

[In billions of dollars]

Agriculture, forestry, and fisheries	24.9
Contract construction and mining	[1] 34.0
Manufacturing	229.5
Transportation, communication, and utilities	74.9
Wholesale and retail trade	123.3
Finance, insurance, and real estate	99.9
Services	67.8
Government and government enterprises	70.0
Rest of the world	3.9
Residual	[2] 7.7
Total	735.9

[1] Specific figures for contract construction and mining as separate categories are not available.

[2] Difference between gross national product measured as sum of final products and gross national product as sum of gross products by industries.

Source: Department of Commerce, Office of Business Economics.

The composition of gross output in the United States is constantly undergoing change. From the standpoint of environmental quality, two likely changes in the GNP makeup are especially noteworthy. On the one hand, there will be increased expenditures specifically for protecting or improving environmental quality. The costs of pollution control, of ultimate disposal of products, and even of esthetic attractiveness will have to be reflected in the price of some goods. Although the increased expenditures will be counted as GNP in the year in which they occur, they will divert funds from investment in facilities to produce goods and, hence, may actually reduce GNP in future years.

The other set of changes involves the increasing shift in the propor-

tion of GNP devoted to providing services as against the production of goods. Almost all of the increase in employment in recent years has been accounted for by increases in the service occupations. This has been and will continue to be reflected in the GNP. One result will be a reduction in the adverse environmental effects of increased national product since most such effects arise from manufacturing processes.

The shift to services should not obscure the extraordinary increases in output which can be anticipated in many nonservice sectors of the economy. In some cases where the environmental consequences are extremely damaging and are also unavoidable given current technology, the choice between increased output and environmental protection may have to be made. We already have begun to see isolated instances of production facilities being closed or being prevented from being built because of their adverse environmental effects.

Anticipation of the possibility of having to curb firms and industries should provide a spur to research and regulatory efforts so that such a possibility does not become a reality. The choice between environmental deterioration and economic deprivation is one which should and can be avoided.

The potential uses of the economic system in controlling pollution should not be overlooked. A wide variety of economic incentives may be useful for preventing the introduction of wastes into the environment and for overcoming the incentives to pollute which are built into the present pricing system. This report notes several such possibilities, and the Council is working on other similar proposals. In dealing with environmental problems focusing on structuring economic incentives is far more productive and beneficial than worrying about the overall growth of the economy.

NATURAL RESOURCES

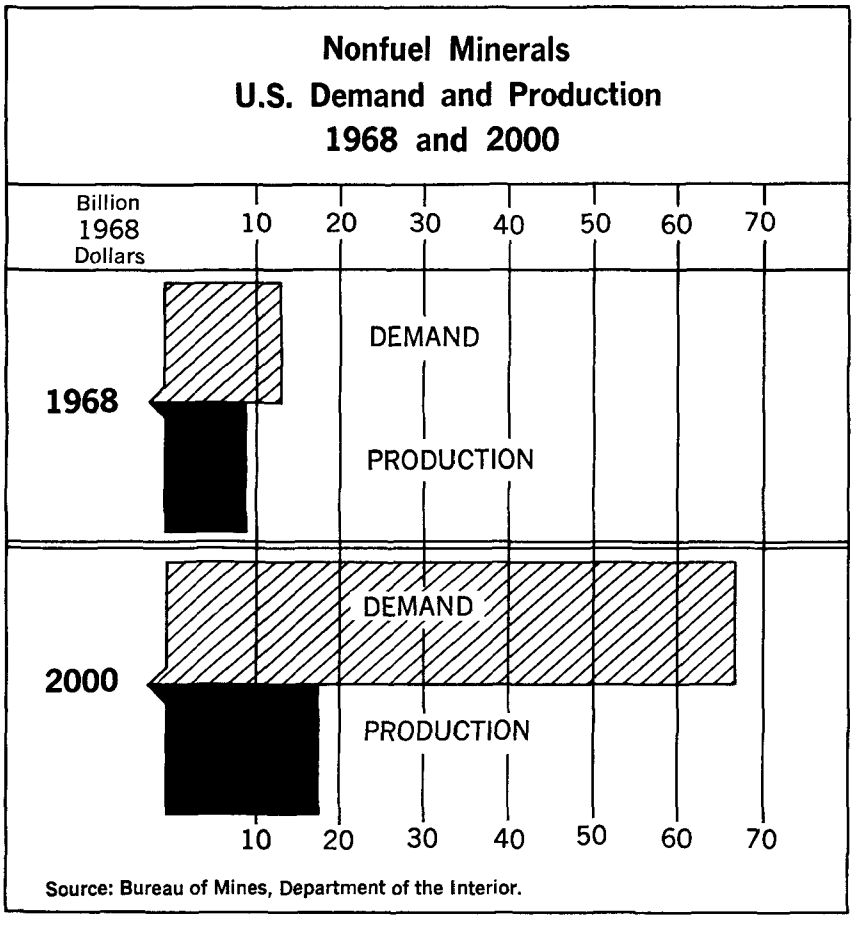
The quality of life depends substantially on the availability of a wide variety of natural resources. Their availability provides the basis of the economy, and influences daily life in innumerable ways.

A comprehensive assessment of the current status of natural resources is beyond the scope of this report. However, a brief analysis of some of these assets may help to place the resource status of the Nation in perspective. One major document on this matter was published during 1969. A special joint committee of the National Academy

of Sciences-National Research Council prepared the report, "Resources and Man." It is a sobering statement on resource availability. Other writers have spoken in still more alarming terms, fearing that a crisis is imminent; still others have confidence that the capability of the American society for adjustment and innovation is great enough so that many present trends will not continue to the point of ruin.

Our Diminishing Minerals

Estimates of the world reserve supply of mineral resources are extremely difficult to make. Most of the important minerals are found in workable concentrations in relatively limited portions of the earth's



crust. In some cases, minerals exist in low concentration which could become workable as the price rises. Even taking into account such economic factors as increased prices with decreasing availability, it would appear at present that the quantities of platinum, gold, zinc, and lead are not sufficient to meet demands. At the present rate of expansion of about 6 percent a year, silver, tin, and uranium may be in short supply even at higher prices by the turn of the century. By the year 2050, several more minerals may be exhausted if the current rate of consumption continues.

Faced with dwindling supplies, one or more of the following alternative courses of action will have to be followed: Reduce dependence on the technologies using these materials, seek substitutes, seek new supplies, seek new extractive techniques, or recycle minerals. Mineral substitutes are being sought by industry, but many minerals are likely to become so scarce that even the substitutes may have a short life. Some substitutes present particularly difficult problems. For example, the widespread use of plastics has created solid waste disposal problems. Substitutes may not be available at all for some materials such as mercury and helium which have special properties. Despite spectacular recent discoveries, there are only a limited number of places left to search for most minerals. Geologists disagree about the prospects for finding large, new, rich ore deposits. Reliance on such discoveries would seem unwise in the long term. Extraction of minerals from some large reserves of very low-grade ores may become economically feasible in the future. However, the techniques of extraction themselves may pose significant environmental problems. For example, the power requirements for extraction may be immense. That would add to thermal pollution. In addition, the yield of waste products can be substantial. It seems desirable from the conservation viewpoint to obtain large fractions of our mineral supplies from recycling metals.

Statistics on the recycling of scrap metals are presently inadequate. The contribution of scrap to domestic smelting of iron and lead has declined since 1960. That of copper has increased from about 37 percent to about 46 percent in the same period and that of aluminum from 14 percent to 19 percent. There is room for the development of a substantial industry in recycling.

Recycling of minerals would also appear to be desirable in view of a lessened environmental impact. The amount of waste products that must be disposed of is reduced, and the energy requirements for re-

cycling appear to be less than those required for primary production. In the longer term, there appear to be no adequate substitute to recycling.

Energy—An Environmental Battleground

The conflicts between the consumption patterns that we all want and the environmental ill effects that we all wish to avoid is sharper for energy than for perhaps any other aspect of natural resource use. On the one hand, everyone wants to use as much electricity as he needs for consumption or production, whenever he wants it; yet few love a power plant or a transmission line. Similarly, each individual desires ample power for pleasant driving; yet no one consciously wishes to contribute to air pollution and traffic congestion. The prices consumers pay for these goods and services do not reflect the damages they cause to the environment.

In recent years there has been a rapid upward surge in demand for electricity, caused not only by rapid population growth but also by the successful efforts of utilities and appliance manufacturers to promote new uses for electricity. For example, since 1964 annual sales of window air conditioners have increased from 2.75 million units to almost 5 million.

During the past year, there has been a great upsurge in public controversy over the locations of new power plants. Public objections on environmental grounds are delaying construction of new facilities at many sites. Industry is genuinely concerned over its ability to meet consumer demands in 1970 and in successive years. Utilities are producing 75 percent more electricity nationally than they did in 1960. But power reserves in many regions are below the 15 to 20 percent reserve which the Federal Power Commission considers adequate. The situation in some regions is worse than these national figures suggest, for inadequate capacity is concentrated in some regions; 39 of the 181 major power systems in the country have reserves of less than 10 percent. Since the Atlantic coast blackout of 1965, there have been 37 major power failures and numerous local power disruptions; in addition, there have been brownouts in which customers are asked to restrict their use of electricity. In the spring of 1970, several metropolitan areas along the Atlantic coast were put on notice that home power consumption during the daytime would have to be restricted during the summer.

Part of the objection to powerplants and powerlines is esthetic; few regard them as an addition to the beauty of the landscape. But some of the objection is based on other environmental grounds. High sulfur coal and oil plants pollute the air with oxides of sulfur and small particulate matter and thus are a major source of air pollution. Another principal problem is their need for cooling water and the effect of returned heated water on stream, lake, and bay ecosystems. Food chains can be interrupted if chlorine is required to keep down algae growth in the circulating chambers. The long-term problem of thermal effects on air requires intensive study and continuous monitoring.

If a crisis between rising demands for electricity and environmental ill effects is to be avoided, then a massive effort must be made to find powerplant locations where both minimum damage to the environment and maximum public acceptance are possible.

Other sources of energy for electric power generation also present problems. Hydropower possibilities have largely been exhausted, and further developments would alter the free-flowing character of the remaining unaltered streams. Solar energy, tidal generation, and geothermal sources appear unpromising on a large scale without technical breakthroughs that are not even on the horizon. The development of magnetohydrodynamics (MHD) as an energy source is currently the subject of extensive research. Fossil fuels are finite in amount. The earth's coal supplies are sufficient to serve as a major source of industrial energy for a few hundred years. Petroleum can be expected to supply its present large fraction of total power needs for a limited time. And natural gas is our scarcest fuel resource. Although no crisis exists this year or this decade, the time is surely coming, perhaps within the lifetime of persons now alive, when petroleum can no longer play the major role in providing needed energy. Even coal must some day yield its large role in energy supply, though that day is further off.

Nuclear power presents a more optimistic picture for the longer run future. Although the supply of uranium 235 is limited, the prospects for development of nuclear breeder reactors capable of consuming natural uranium and thorium are reasonably good. Renewed optimism is also felt for the development of nuclear fusion as a major source of power for a still longer run future. If these sources develop, more effort will have to be put into the radioactive waste disposal problem.

Petroleum is at present the best fuel for autos, and no commercially feasible substitute has yet been developed. But petroleum suffers from several major disadvantages. It is a major source of air pollution, although the automobile engines of the future may remove most of

this disadvantage. And its transportation presents hazards of pollution, whether by pipeline from offshore wells, or across land, or by tanker on the seas. The oil spill off Santa Barbara in January 1969 and many spills in the Gulf of Mexico in later months dramatized the potential dangers of oil production and transportation. Concern is great in many quarters over the ecological damage possible from a pipeline break in the fragile tundra area of Alaska or from a tanker collision in ice-strewn waters.

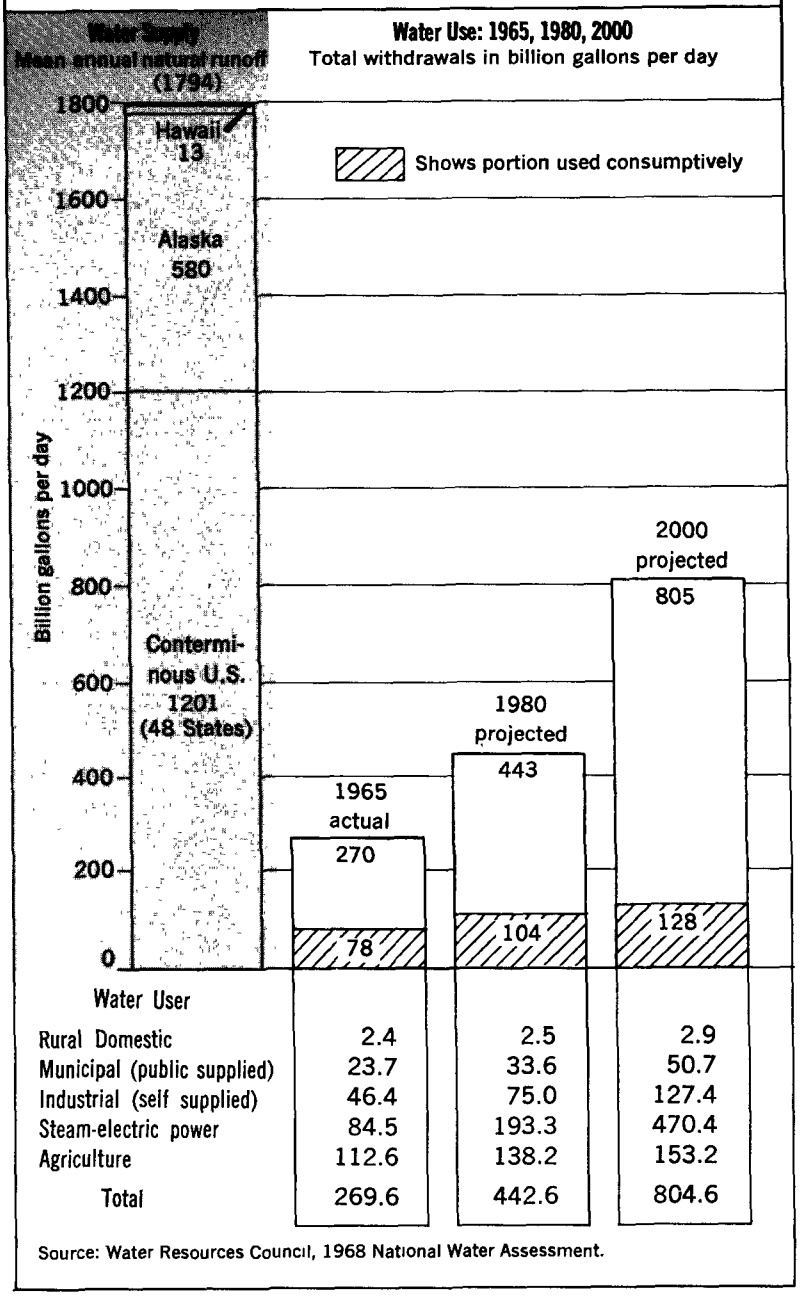
All in all, the short-range energy situation seems tolerable with the exception of the environmental ill effects. The longer run outlook causes more concern, as does the need to provide the research base and the climate of public opinion for major future shifts in energy sources. These research and public opinion factors force us to take a closer look than the immediate present.

Water—Workhorse of the Environment

Water is used for many purposes: In agriculture, for irrigation; in industry, as a cooling medium as well as directly in many industrial processes; in the home, for varied domestic and personal needs; and, almost everywhere, as a medium for carrying away wastes of all kinds. The use of water is rising for almost all these purposes in nearly all parts of the country. For example, in 1969, domestic use of water increased by about 1.5 percent; agricultural use by approximately the same amount; and industrial use by about 2.5 percent.

In the past, the Nation has used water lavishly, in part because it was blessed with a large supply. For many decades, water was the classic free good, widely and easily available as needed. But that day has passed, and increasingly stringent water problems are arising. Present use exceeds, or shortly will exceed, available supplies in much of California, the arid Southwest, and some parts of the Middle Atlantic States. Some of the demand has been met by drawing on groundwater reserves, but this obviously cannot continue indefinitely unless the water drawn from aquifers is replaced. Groundwater levels have been drastically lowered in some areas, particularly where heavy irrigation demands have been met by pumping in excess of recharge. For example, in an area 100 by 300 miles in southern California, levels have been lowered by as much as 200 feet. In some such areas, the surface of the ground has subsided as the groundwater was drawn out, in turn producing serious disruptions of activities on the land surface.

U.S. Water Supply and Projected Water Use



Water User	1965 actual	1980 projected	2000 projected
Rural Domestic	2.4	2.5	2.9
Municipal (public supplied)	23.7	33.6	50.7
Industrial (self supplied)	46.4	75.0	127.4
Steam-electric power	84.5	193.3	470.4
Agriculture	112.6	138.2	153.2
Total	269.6	442.6	804.6

Source: Water Resources Council, 1968 National Water Assessment.

As water use increasingly presses on water supplies, various adjustments in its use and reuse will become necessary. The present lavish use is in large part related to the present low or modest cost of water. If water costs were higher, many ways to use less water would doubtless be found. For instance, the technical problems of recycling cooling water can usually be solved if it becomes profitable to do so. A relatively modest increase in water price will often be the decisive factor. This will become particularly important for the electric power industry, which today is such a large user of cooling water. Industrial and domestic water can be purified and recycled in most cases if the cost or availability of water so requires. "Used water," or purified and recycled water, will necessarily become more common. Unless it does, large areas in California and elsewhere will face serious water problems in another decade or two.

As with various other natural resources, the water supply situation today is not generally critical, although some serious local and regional situations exist. It is the future suggested by present trends that provides the greater concern and the need for more effective action in water conservation.

Forests—A Renewable Resource

Forests are an old natural resource, long of major value to many people. But today forests are being exposed to new and urgent demands which create many management problems.

The availability of wood fiber for lumber, plywood, and pulpwood is reasonably satisfactory. For the past decade or more, the annual growth of wood fiber has been greater than the annual loss from cutting, fire, insects, and disease. As a result, timber inventories have been building up, following many decades when they declined. The volume of standing timber is normally so large in relation to annual growth that year-to-year changes in standing volume are not great. Over the past decade, there were no major changes in stock of timber or in acreage of forested land.

The situation today only partly shrouds problems that may grow more intense tomorrow. Future demands in the construction industry are sure to place increased demands on the Nation's forests. The needs for housing directly conflict with the interest of those who work to preserve the forest. In the West, cutting of old growth timber is reducing timber stands faster than they are growing; in the South and East, timber is growing faster than it is being cut. But the heavy cut-

ting is in timber species, tree sizes, and log qualities which are not being grown in large volume. The excess is largely in less desirable species, consists of smaller and lower quality logs, and is generally less valuable wood than that which is being cut. If one considers only volume of wood fiber, the picture looks good; if one examines the kinds, qualities, and locations of that fiber growth, a less satisfactory situation surfaces. Moreover, a great deal of forest land is stocked at less than optimum, and some land capable of growing trees needs reseeding or replanting.

Lumber production, however, is only one of a number of values realized from the forest resource. Other resource values which forests provide include watershed areas, wildlife habitat, recreation opportunities of many types, grazing land for domestic livestock, and local climatic moderation. Good forest management is no longer synonomous with timber production. The emphasis increasingly is on multiple use management, although it is important to recognize that the same piece of land may not simultaneously support all types of use. The increasing human population places a continually rising pressure on the forest resource. And a higher degree of planning is required to assure that these needs are met without severe damage to this resource.

CONCLUSION

Many traditional assumptions are being questioned, and our attitudes toward population growth, economic expansion, and the use of natural resources are no exception. We have begun to ask what the optimum population of the nation or of a given metropolitan area *should* be. We are looking more critically at proposals for the construction of new power plants or factories and asking what the environmental effects of such projects *will* be. We are gaining an increased sophistication about our consumption of natural resources and a better understanding of the limited availability of natural resources. We must begin to translate these new attitudes into effective long-range policies if we are to achieve the goal of a satisfactory environment.

IX
Land Use

The first men upon this land, the American Indians, treated it with reverence, blended with it, used it, but left hardly a trace upon it. Those who followed have been less kind. They brought with them a different creed which called on man to conquer nature and harness it for his own use and profit.

Now more than halfway into the 20th century what they have done is being turned back upon them. Misuse of the land is now one of the most serious and difficult challenges to environmental quality, because it is the most out-of-hand, and irreversible. Air and water pollution are serious, hard to manage problems, too. But they are worked at with standards, with enforcement tools, and by institutions set up for those specific antipollution purposes. Land use is still not guided by any agreed upon standards. It is instead influenced by a welter of sometimes competing, overlapping government institutions and programs, private and public attitudes and biases, and distorted economic incentives.

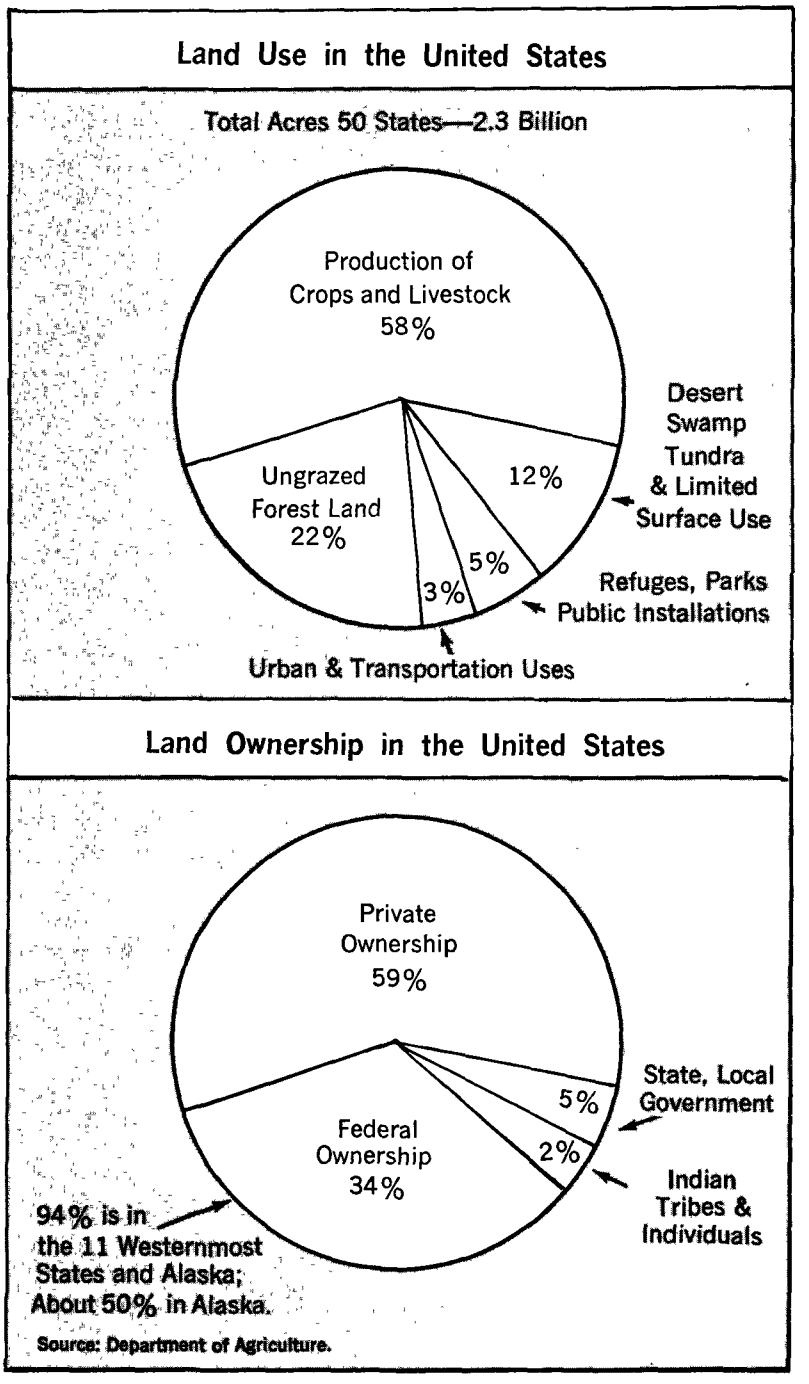
The 50 States comprise about 2.3 billion acres of land. Of that, 1.9 billion acres lie in the contiguous 48 States. Nearly 58 percent of the land area is used for crops and livestock. More than 22 percent is ungrazed forest land. Less than 3 percent is in urban and transportation uses, although it is increasing. Areas designated primarily for parks, recreation, wildlife refuges, and public installations and facilities account for about 5 percent. The rest—12 percent—is mainly desert, swamp, tundra, and other lands presently of limited use by man.

Almost 59 percent of the land is in private hands. Thirty-four percent is owned by the Federal Government. Some 94 percent of all Federal lands lie in the westernmost States—about half in Alaska alone. About 2 percent of the Nation's land is held by Indians. The rest—about 5 percent—is State, city, or county owned.

But land is not just acreage. Land embraces the complex biological systems of the soil and the plants and animals which are all part of a continuing life cycle. Man's understanding of these biological processes, particularly of the permanent damage that begins subtly with piecemeal alterations of the land, is still limited. Yet his dependence upon its stability is enormous.

In the Nation's early history, easy availability of land prodded millions to join the massive migrations west and along the major river basins. The wilderness was to be tamed, the trees cleared, and the soil put to crops. Much of the wilderness is now gone, and most of what is left is far distant from the three-quarters of the Nation that lives in the cities and the suburbs. The landscape visible to most Americans is cluttered with traffic, neon signs, powerlines, and sprawl. Flood plains are not just for the river but are subjected to intense development. Open space, the elbow room for urban man, continues to dwindle. Unfortunately, traditions of land use have derived from an assumption that land is a limitless commodity—not a finite biological community.

Government spurs much of this land development by where it locates and how it designs airports and highways, insures home loans, permits filling of wetlands, and lays water and sewer lines. Local governments exercise the primary authority over land use. But effective public influence is hampered by a lack of agreement on objectives, by misplaced economic incentives, and by failure of local governments to harmonize land use.


Land Use in the United States
Total Acres 50 States—2.3 Billion
Production of Crops and Livestock 58%
Ungrazed Forest Land 22%
12%
Desert Swamp Tundra & Limited Surface Use
5%
3%
Refuges, Parks Public Installations
Urban & Transportation Uses
Land Ownership in the United States
Private Ownership 59%
Federal Ownership 34%
5%
State, Local Government
2%
Indian Tribes & Individuals
94% is in the 11 Westernmost States and Alaska; About 50% in Alaska.
Source: Department of Agriculture.

THE STATUS OF THE LAND

The Urban Environment

Twentieth-century America has known two great population displacements—the first from farms to cities and the second from the cities to the suburbs. Three out of four Americans now live in urban environments—in incorporated settlements of at least 2,500 population and in metropolitan areas consisting of central cities and suburbs. Metropolitan areas alone are home to two of every three Americans, and the percentage is rising.

Residential patterns in many metropolitan areas resemble a series of sharply defined concentric circles. The decaying inner city houses the majority of the urban poor, usually nonwhites who ordinarily have little choice but to stay. Surrounding the inner city are neighborhoods commonly less old and less dense, usually populated by white working-class families. These families often lean toward leaving the central city because of rising property taxes, deteriorating school systems, and racial changes. But they have stayed because they could not afford the newer suburban housing or because of strong ties to their neighborhoods. The 1970 census may show some shifts from this pattern. Beyond the city is suburbia. The suburbs are a magnet for those seeking escape from the burdens of urban life while retaining some of its advantages. (In some areas the pattern is different; the poor often live on the fringes, and the affluent in the city itself, and mixed patterns occur in other metropolitan areas.)

The financial plight of the cities is well known. The influx of the poor and the exodus of the middle class and the wealthy, among other factors, have drained the cities of many of their revenue sources. Public services, such as police protection, park maintenance and sanitation, have deteriorated.

The most visible effects of these economic pressures are the rapid pace and nature of physical change. This is clearly evident in downtown areas where the constant cycle of construction and demolition is often considered a city's badge of growth. Pressed for revenues, many cities bow to the demands of developers to replace historic buildings and distinctive architecture with almost uniform steel and glass box office buildings. Unfortunately, this construction may simply put more people on the sidewalks and more cars on the streets, more monotonous skyscrapers towering above, and more noise and congestion below. Much downtown rebuilding has furthered the trend

toward daytime cities with facilities such as offices and banks, which have no nighttime uses. Cities lose their uniqueness as their historic buildings and neighborhoods are replaced by the dullest in modern architecture. The result is often a dreary sameness in the appearance and character of downtown areas.

Physical deterioration is overtaking the housing in many areas of central cities. The oldest housing traditionally filters down to the poorest families as previous occupants better their lot and move to new apartments or suburban homes. Of the 1.7 million substandard housing units in urban areas, nearly all lie in central cities. In slum neighborhoods of some large cities, the amount of abandoned housing is as high as 15 percent.

With the well-known reliance of the suburbanite on the automobile, often to commute to the center city, many downtown and other urban centers have gradually become auto dominated. Much of the change and reconstruction in downtown areas is for freeways, parking garages, and lots—lavish users of space. However, the alternative, public transportation, is constantly frustrated by rising costs, the sprawling nature of the suburbs, and dependence on the automobile.

Many cities have lost the spirit to attract people downtown. With the growing number of shops and other services locating in the suburbs and with crime threatening many local businesses and frightening people from the streets, much of the vitality is missing from the central cities. Many city officials, however, are trying to bring people and excitement back. Apartments in downtown areas, sidewalk cafes, outdoor concerts, bicycle routes, even saving the cable cars in San Francisco—all are small but key efforts to recapture this lost spirit. Rehabilitation, successfully carried out in Philadelphia, and a few other cities signals that the character of the urban environment can be revitalized.

Few cities have kept pace with parkland needs. Trees have not been planted to shade busy avenues at the same rate that they have been felled for street widening. Too often only a few species are planted, and they are often blighted by disease and insect invasions so common to unstable ecosytems. In the Midwest, Dutch elm disease has decimated row on row of beautiful elms.

The immediate economic pressure on a city to permit a parking lot or building on what might remain open space, or to use parklands as part of a freeway route, is often insurmountable. Nevertheless, the accelerating cost of land acquisition and the growing need to preserve open space in a crowded urban environment make the purchase of open

areas a sound long-range economic practice, which continues to pay immeasurable dividends. The Boston Common, New York's Central Park, Washington's Rock Creek Park, San Francisco's Golden Gate Park, and many other city parks are tributes to the foresight of early planners in saving large open areas. The protection of streams, ponds, and marshes within cities permits the survival there of numerous species of wildlife, including small animals, birds, and waterfowl which adapt surprisingly well to the urban environment.

Man requires a feeling of permanence to attain a sense of place, importance, and identity. For many persons in the city, the presence of nature is the harmonizing thread in an environment otherwise of man's own making.

The Suburban Environment

Although rural to urban migration was primarily economically motivated, the suburban impulse is largely a matter of social preference. Because of economic and social obstacles, these population shifts have affected the races unequally. Eighty percent of the blacks in metropolitan areas now live in central cities, while 60 percent of the metropolitan whites live in the suburbs. Zoning practices, subdivision controls, and the higher costs of suburban living have made it difficult for lower income minority groups to move from the city to the suburbs.

From 1950 to 1969, while the population of central cities increased only 12 percent, the population of suburban areas soared 91 percent. By 1969, there were 71 million suburbanites and 59 million central city residents.

The suburban tide—Since the late 1800's a blend of town and country has stood for the optimum residential environment. The suburb is thought to offer the best of both worlds. Besides enjoying ready access to the large city with its concentrated economic and cultural facilities, the suburban resident seeks a crime-free neighborhood amid clean air, open lawns, and quiet and uncrowded living. Streetcar and occasional subway lines started what at first was but a trickle of people from the central cities to the outskirts of town. The Federal Government quickened the outward flow after World War II by providing mortgage assistance, which enabled many central city residents to become suburban homeowners. Later the vast urban freeway systems turned the flow into a flood. The automobile now controls suburban life.

To the couple living in an apartment downtown, the birth of a second child is a common signal to abandon the city. And often families with school-age children leave for the better educational systems of the suburbs. As industries convert to modern, single-flow assembly production processes, manufacturers also forego the city for rambling suburban plants. Since World War II, space needs per industrial worker have quadrupled, and three of every four new manufacturing jobs have been created in suburbs.

Each year, expanding urban areas consume an estimated 420,000 acres of land in an undiscriminating outward push. Development moves out from the city along transportation corridors, branching out from the highways and expressway interchanges. Extension of water and sewer services generates whole new developments on quickly divided farms. After outlying areas are built up at moderate densities, developers often return to land which was passed over as undesirable or too costly in the first wave.

Many suburban communities zone to assure that house lots are large and apartment houses few, a practice that assumes that land is abundant. This zoning practice, in seeking to attract moderate to high income families, tends to exclude those in greatest need of the jobs opening in the suburbs. Excluding them deepens the concentration of poverty and unemployment in the central city ghettos.

Highways and freeways become congested as the tide of suburban commuters to the city grows. This congestion, together with the lengthening distances from suburban homes to downtown offices produces tension and robs the typical suburbanite of time with his family.

The impact of growth—Although the impact of the rural-to-suburban shift of land use varies greatly throughout the country, certain effects tend to be common to this change. Open space is continuously eaten up by housing, which, with most present subdivision practices, provides few parks but instead only offers each family its individual front and back yard. Space is likewise diminished by other facilities required by suburban development. Shopping centers and highway interchanges, made necessary by dependence on the automobile and truck, consume large portions of land. Airports, commonly constructed in suburban or exurban areas and constantly growing in size and number, pose similar problems on an even larger scale, attracting a vast conglomeration of light industry and housing. Consequently, the growing suburban population finds less and less public open space.

Building and construction practices, together with the quickened pace of development and complementary zoning, often end in severe abuse of the land and are ultimately costly to the public. The popular practice of stripping subdivisions of all cover before commencing construction destroys tree and plant cover and can trigger heavy soil runoff. Sedimentation from this runoff in urbanizing areas loads nearby streambeds and ultimately river channels. This can cause costly downstream dredging, upstream flood control and destruction of the esthetic quality of lakes and rivers.

Public pressure for flood control projects is often spurred by suburban development along flood plains, which usually contain fertile soil supporting an abundant variety of native plant and animal life. Construction over aquifer recharge areas, where the groundwater is normally replenished, accelerates rapid runoff, increases flooding, and contributes to water shortages.

Suburban development often spreads across ridges and slopes which should be left alone because of their beauty and because their trees and plant cover absorb rain and inhibit flooding. Trees are not only important for their esthetic qualities and as habitat for birds and wildlife, but they affect temperature and air pollution as well. Building on steep slopes can affect soil stability, causing severe erosion which then undermines foundations. Nevertheless, few cities or counties adequately control development of flood plains, steep slopes, or land above aquifer recharge areas. Important data concerning aquifers, subsoil composition, cover, wetlands, and wildlife are not considered by many planning and most zoning boards.

Esthetically, this current pattern of growth triggers at least three adverse consequences. First, much commercial development along roads and highways through suburbs is of cheap and unimaginative construction. Gaudy neon signs, billboards, powerlines, and clutter characterize this development. Second, many residential subdivisions are visually boring—block after block of treeless lawns, uniform setbacks, and repetitious housing designs and street layouts. Finally, wooded streambeds, slopes, and ridges, which could help break the monotony of uniform housing developments, are often destroyed.

The future—Many local governments and developers are learning that careful site planning can forestall abuse of the natural environment and help meet both housing and environmental goals.

The combination of open space with cluster zoning or planned unit development lowers the initial community service costs because of

smaller networks of roads and utilities, and it makes a more livable environment for the long term. These developments can vary from new satellite communities like Columbia, Md., to small, sensitively designed clusters of townhouses around a common green. The challenge is to change traditional ways of building and development and to break down the economic and institutional barriers that obstruct widespread use of these innovations.

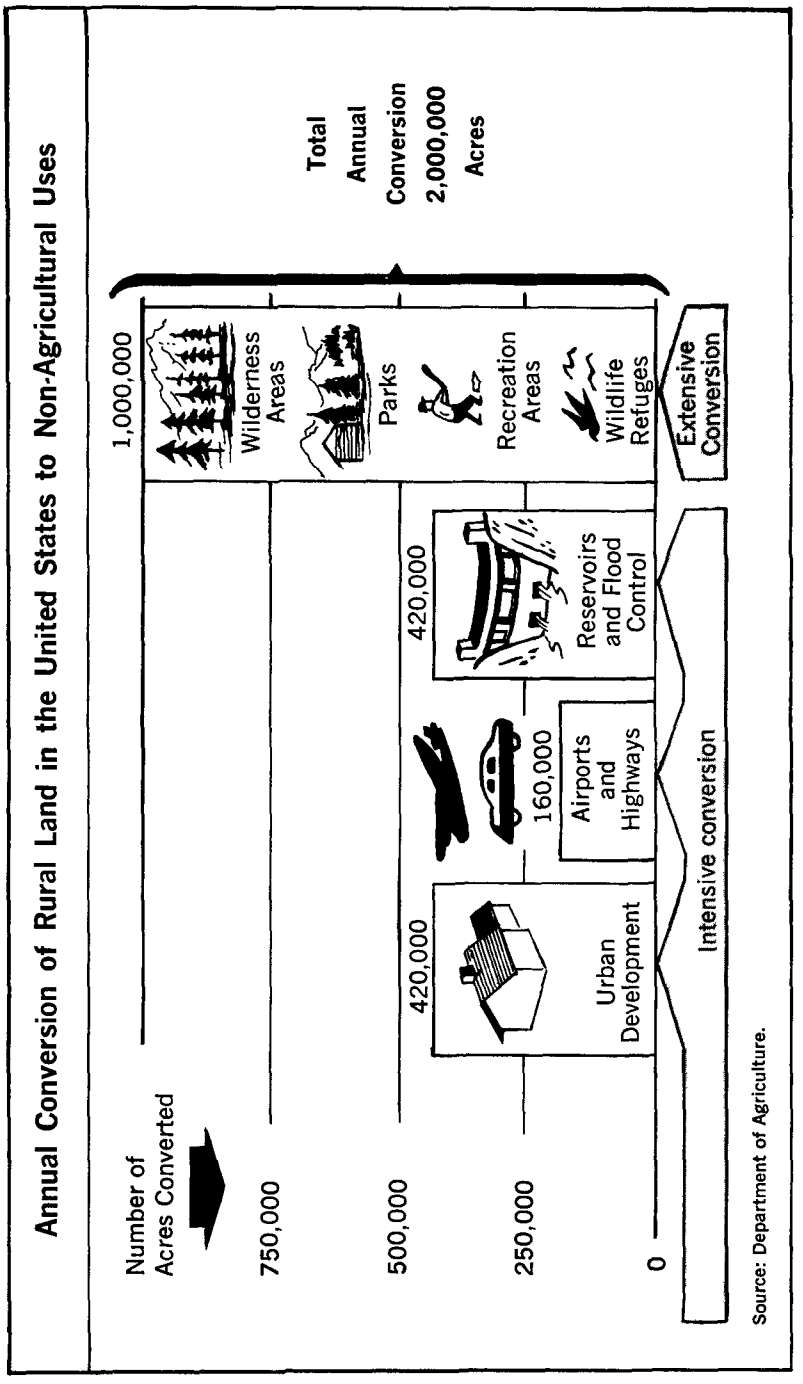
The Rural Environment

Although polls have consistently uncovered a strong American preference for life in small towns and rural areas, the last few decades have seen a huge exodus to urban centers. About half of the Nation's 3,000 counties, most of them rural, lost population between 1960 and 1970. Of the 53 million Americans living in rural areas, the number living on farms has dropped below 10 million. The remaining 40-odd million rural residents live in villages and towns of less than 2,500 people or on small plots of country land.

Changing rural land use—Statistics on rural land use show conflicting trends. The Department of Agriculture estimates that 2 million acres of land each year, excluding surface mining, are converted to nonagricultural use. Half of this is shifted to such uses as wildlife refuges, recreation areas, and parks. The other 1 million acres are converted to more intensive uses. Of that, 160,000 are covered by highways and airports. An estimated 420,000 acres become reservoirs and flood control projects. The remaining 420,000 acres are developed for urban uses. About half the national acreage converted every year to urban uses is cropland and grassland pasture. The rest is forest and other land.

Food and fiber production by U.S. farmers in 1967 exceeded by 38 percent the 1950 volume. Yet during the same period the number of farms diminished by 2.5 million, and the number of acres harvested declined by a net of 34 million. In 1969, about 334 million acres of land produced all the country's crops for domestic consumption and export. Another 98 million acres of cropland lay idle, in soil improvement crops or in pasture.

From 1944 to 1964, roughly 22.5 million acres were brought into production through private and Government-assisted drainage and irrigation programs. At the same time, in parts of the East not yet urbanized, much of abandoned cropland changed to grassland. It was managed as such for pasture or simply left idle in the first stage


Annual Conversion of Rural Land in the United States to Non-Agricultural Uses
Number of Acres Converted
750,000
500,000
250,000
0
1,000,000
Total Annual Conversion 2,000,000 Acres
Wilderness Areas
Parks
Recreation Areas
Wildlife Refuges
Extensive Conversion
420,000
Reservoirs and Flood Control
160,000
Airports and Highways
420,000
Urban Development
Intensive conversion
Source: Department of Agriculture.

of natural revegetation. Some of this land now is undergoing or has passed through grass and brush stages to a final forest state.

Effects—The agricultural land use pattern today reflects a highly technical, mechanized, and product-specialized food and fiber industry. It has used the most productive land in the Nation, and it has altered other lands for crop production through vast Government expenditures—often at the expense of marshes, swamps, and bottom lands needed as waterfowl and wildlife habitat. The impact that this highly intensive use of land has on the preservation and diversity of our wildlife and on the integrity of our soils is just beginning to be understood.

Much of the character of farming today is dominated by monoculture, the production of single cash crops. Monoculture has increased production efficiency but has reduced the plant and wildlife diversity essential to a stable ecosystem. These less complex ecosystems are highly susceptible to attack by insects and diseases which can devastate a standing crop or single species regionwide. Moreover, monoculture has forced a heavy dependence on pesticides and fertilizers.

Farmland near cities is increasingly disappearing into suburban development. The scenery of diversified rural landscapes—with their fields and hedgerows and woodlots—is an important esthetic resource, particularly to urban populations. Although not entirely comparable, much of the charm and beauty of European countrysides derives from such landscapes. Unfortunately, insufficient effort has been made to keep the most attractive rural lands near cities from being consumed in the massive conversion to urban life.

The Coastal Environment

In the land and water areas of the American coasts lie some of the most fertile parts of the environment. The coastal zones, which include beaches, estuaries, tidal flats, bays, marshlands, lagoons, and sounds, with their adjacent lands, comprise areas of great biological diversity and productivity. The coastal zone includes urban, suburban, rural, and natural areas and faces all the problems of each. It is, however, a unique system which has important national significance and is subject to intense and conflicting manmade pressures.

Its surface is relatively small—only 15 percent of the U.S. land area. But 33 percent of the Nation's people are concentrated on the coasts, four-fifths of them in urban areas. While the national population in-

creased 46 percent from 1930 to 1960, the population in coastal counties increased by 78 percent.

Life at the edge—Because of the natural mixing of fresh and salt waters, the estuarine environment produces a wide variety of living organisms, from microscopic species to large numbers of fish and shellfish, birds, and mammals. Many species, such as clams and oysters, spend their entire life cycles in the estuaries. Others, particularly shrimp, migrate from the sea to estuarine nursery areas. In these rich waters, they grow to sub-adult size before returning to the sea to complete their life cycles. The anadromous species, such as salmon and striped bass, pass through the estuaries to their spawning grounds farther upstream, and the young return through the estuaries to the ocean. At least two-thirds of the animal populations in the oceans spend an essential portion of their life cycle in estuarine waters or are dependent on species that do. Innumerable waterfowl and shorebirds depend on the plant and animal organisms of the coastal zone for their food. Many winter and nest in these waters.

The base for all animal life in estuaries is the abundant variety of plant growth, from mangroves to eelgrass and algae. They are supported by the mixing and flushing action of the tides and the organic nutrients which collect to produce the rich bottoms and wetlands. While estuarine zones are physically varied, they all share the slow mixing action of the seaward flow of fresh water with the landward tides of the sea. Because of the concentration of people within the coastal zone, the estuaries receive large volumes of all kinds of waste, which are thereby trapped and concentrated. When estuarine waters are polluted, vast numbers of important fish and shellfish are affected as well as the numerous birds, reptiles, and other wildlife which are part of this food chain.

The conflicts—Competition for the use of the limited coastal zone is intense. Shipping activities are increasing, with larger vessels needing deeper channels. Mining and oil drilling in coastal waters grows daily. Urban areas expanding throughout the coastal zone continue to enlarge their influence over these waters. Industrial and residential developments compete to fill wetlands for building sites. Airport and highway construction follows and further directs growth patterns in the coastal zone. Recreation—from enjoyment of the surf and beaches to fishing, hunting, and pleasure boating—becomes more congested as available areas diminish. Since over 90 percent of U.S. fishery yields come from

coastal waters, the dependence of the commercial fisheries industry on a stable estuarine system is obvious.

Although some uses of coastal areas are undoubtedly necessary, many are not. Much industry, housing, and transportation could be sited elsewhere.

Dredging and filling—Besides water pollution, the major adverse effect on the coastal lands and waters stems from physical alteration of submerged and adjacent land and habitat—particularly the shallow marshes and wetlands. The major alterations of wet and submerged coastal lands comes from draining, dredging, and filling. Cumulatively these actions can entail the disappearance of the essential food base for practically all organisms in these waters.

The consequences of dredging and filling, because they often represent a series of incremental activities, do not usually become apparent until much of the permanent damage is done. Some 2 million to 3 million waterfowl used to nest and feed in San Francisco Bay before a large part of it was gradually filled. Their numbers are now down to less than 600,000. The State of California, with support from citizens and communities in the Bay area, has now formed the Bay Conservation and Development Commission to provide regional control over that irreplaceable estuary.

To the developer with little appreciation of the biological importance of estuaries, wetlands represent attractive waterfront acreage in particular demand by industrial and commercial concerns and home buyers. Relatively inexpensive to dredge, fill, and bulkhead for building sites, shallow wetlands attract many industries which are not dependent on waterfront sites but which find an economic advantage in developing these low-priced lands. Too often local governments acquiesce, anticipating the increased tax revenues. Consequently, natural coastal areas are being nibbled away. The long-range economic and ecological costs of this process are borne not just by the particular local community but by the people of the State and the region, and no less by the rest of the Nation.

The vacation industry—A growing part of the development pattern spreading throughout the coastal zone is the growth of vacation homes. The Department of the Interior has estimated that over 68 percent of the total recreational property values along the coasts and Great Lakes are accounted for by shorefront homes. They occupy over 90 percent of the recreational lands on developed coasts.

Only 6 percent of the land that can be classed as recreation shoreline is in public ownership, and not all of that is accessible to the public, particularly the many miles of Department of Defense holdings.

Management—Ownership of the wetlands in many States is a confusing tangle of State, local, and private claims, and in some coastal States valuable State-owned wetlands have been transferred to private interests for the specific purpose of development. Likewise, restrictions on development of the contiguous lands and wetlands are, with some exceptions, inadequate. Only a few States, notably Massachusetts, Connecticut, and North Carolina, have wetlands protection laws which require permits or other controls before alterations can be made to private coastal lands. Even fewer States have exercised any statewide powers over the contiguous dry lands. Hawaii, Wisconsin, and to some extent, Oregon, are among the exceptions.

The most important Federal permit authority affecting coastal zones is held by the Army Corps of Engineers. Dredging, filling, and all other structural changes in navigable waters require Corps permits under the Rivers and Harbors Act of 1899. The Fish and Wildlife Coordination Act and an interagency agreement also provide for review of all Corps permit applications by the Department of the Interior and State fish and game agencies. Their role is to review fish and wildlife, water pollution, recreation, and other environmental considerations. The National Environmental Policy Act of 1969 bolstered the authority of the Corps to consider all environmental aspects of a particular permit application. And the Water Quality Improvement Act of 1970, as a condition to granting permits, now requires State certification that the particular activity will not violate State water quality standards.

The Administration has recommended legislation to Congress to assist the Great Lakes and coastal State governments to manage and protect their coastal resources. The proposed legislation seeks to encourage these States, in cooperation with local units of government, to prepare and implement comprehensive land use plans for their coastal zones. To be eligible for Federal grants, the States would be required to assume regulatory and eminent domain powers. At a minimum, this would assure that local zoning actions would comply with statewide plans. Further, public notice, public hearings, and review of all Federal and federally assisted State and local projects would be conditions of grant eligibility.

The Natural Environment

Natural plant and animal communities—besides satisfying man's yearnings for beauty and recreation—perform indispensable roles in his welfare. Wild areas are part of man's past and essential to his future. The biological rhythms of modern man, which shape his life, are often tied to the natural forces beyond his urban surroundings. And yet wild areas are not fully free from man's influence. Some—for instance, where man is present for short periods and leaves hardly a trace—are little influenced. Others—lands actively mined, logged, or grazed—are heavily influenced.

For many years, the American people have realized that the most unique and spectacular of these natural areas should be protected and saved by Government.

The Federal lands—Management of most Federal natural lands falls under four agencies:

	Million acres
Department of the Interior:	
Bureau of Land Management	470.4
Fish and Wildlife Service	30.5
National Park Service	27.1
Department of Agriculture: Forest Service	186.9

Many other forests, parks, and recreation and conservation areas have also been set aside by State and local governments and by citizens' groups with an interest in the natural environment.

Their management varies from protective preservation to multiple use. Most of the Federal lands are managed to combine outdoor recreation, range, timber, watershed, and fish and wildlife uses. Many of the management programs permit the extraction of oil, gas, and other minerals; others aim primarily at esthetic values. Although Federal land management is meant to maximize public benefit and not to reflect only economic gain, land management agencies have been criticized for policies that overemphasize developmental values.

As other natural areas are staked out for intensive resource development, they are bound to come into even more serious conflict with preservation and recreational interests. Statutory resolution of many of these potential conflicts may be necessary, as may administrative reforms by the Executive Branch. The report of the Public Land Law Review Commission will serve as a focus for the debates that will shape such changes. The report has just been published at the time of this writing; consequently, a review of its findings and recommendations is not attempted here.

Federal lands managed primarily for the protection of their natural characteristics and the preservation of their fish and wildlife can take only so much use by man. Allowing people to enter these areas in large numbers must be weighed against their impact on the region's ecology. Protected areas must be managed so that constraints are placed on certain uses, including recreational uses requiring motorized transport.

The wilderness system—Some large areas under Federal control are expressly set aside as wilderness. The Wilderness Act of 1964 already protects approximately 10 million acres, although less than one percent of this is east of the Mississippi River. The Wilderness Act requires the Secretaries of Agriculture and the Interior to submit plans to Congress for including in the National Wilderness Preservation System additional natural areas having substantial wilderness qualities and presentlymanaged by the Forest Service, the National Park Service, and the Fish and Wildlife Service. These areas are to be of sufficient size, permanently roadless, and without commercial development.

Delays in setting aside wilderness areas, especially those within national parks, have stirred a public controversy. Sixty Forest Service areas have already been designated by Congress in accordance with a 10-year plan to have all wilderness areas set aside by 1974. But not a single National Park area and only one small area in a National Wildlife Refuge have been officially designated. The process of designating wilderness areas requires surveys and master planning by the lead agency, followed by public hearings, before the proposals go to Congress. Conservation groups have complained that the Federal agencies are not adequately staffed to complete the planning and hearing procedures. Conservation leaders also have criticized Forest Service and Park Service proposals for not including some additional areas with outstanding wilderness qualities in their recommendations for Wilderness Act protection.

Scattered throughout the Federal lands under various agencies are 336 "research natural areas"—a specific classification for lands left undisturbed for purposes of research and education. A number of ecosystems, however, such as the tall grass prairie of the Central Lowlands, are sparsely represented or are not included at all. Plans are now under consideration to add approximately 300 areas so that all major ecosystems will be represented.

Acquisition of natural areas—The major source of funds to purchase most Federal natural areas is the Land and Water Conservation Fund. Revenues for it come primarily from a tax on motorboat fuel, sale of

surplus Federal property, Treasury appropriations, user fees from Federal recreation areas, and—to bring the total to $200 million each year—Outer Continental Shelf mineral receipts. For the first time, the full authorization of $200 million is being requested by the President for appropriation in fiscal year 1971. The President has also asked that the unappropriated balance from past years be tapped to increase funding for 1971 to $327 million, compared to $124 million in the 1970 budget. Finally, the Administration has recommended raising the $200 million annual authorization of the Fund to $300 million. This would take effect in fiscal year 1972.

Over half the allotment from the Fund this year will go to the States and through the States to local governments. These funds are matched dollar-for-dollar by the States for the planning, acquisition, and development of outdoor recreation areas. The remaining funds are budgeted for land acquisition by the Federal Government to the National Park Service, the Forest Service, and the Bureau of Sport Fisheries and Wildlife (for rare and endangered species' habitat and for recreation lands adjacent to wildlife refuges). Major recent Federal purchases have been made from the Fund, notably the Redwood National Park in California and land within the national seashores. The new funding requested by the Administration will permit the Government to consolidate and protect many other important natural areas, including Point Reyes National Seashore in California.

The Migratory Bird Conservation Act of 1929 authorizes the Government to purchase additions to the 30-million acre National Wildlife Refuge System. Funds for this come mostly from the Migratory Bird Hunting Stamp Act of 1934, which requires all waterfowl hunters to purchase a Federal hunting stamp. Although about 25 million acres in the present 328-unit system are Federal lands which were withdrawn for refuge purposes, most of the national wildlife refuges acquired in the past 15 years have been bought with funds from sale of these "duckstamps."

Crowding—Natural areas under the direction of the National Park Service have become immensely popular with the millions who visit them each year. Yet the enjoyment diminishes as the number of tourists rises. Some of the more popular natural areas in our parklands have become clogged with traffic, noise, litter, smog, and most of the other elements of our technological society from which the visitors are trying to escape.

Identifying the best mix of uses for natural areas is difficult because scales for measuring esthetic value and natural phenomena are elusive. In the future, limits on use may have to be set at crowded parks or in ecologically fragile areas. California has attempted a system of advance reservations in some of its crowded camping areas in State parks. Some national parks may soon follow suit. Control of auto traffic will be forced upon many areas to preserve the values that the park or forest seeks to maintain. Alternative modes of transportation may be necessary. Yosemite National Park, long threatened by overcrowding, has excluded cars from the eastern part of the valley and converted other roads to one-way traffic. Where traffic is prohibited, access is provided by small buses. As Americans are more frequently attracted by their natural heritage to places where they can know nature firsthand, controls of these kinds will become more common.

Exploitation—Timber is cut and sold from the national forests, and to a lesser extent, from lands administered by the Bureau of Land Management. This use is a growing one. Cattle and sheep are permitted to graze on approximately 273 million acres of Federal land. Mineral leasing, mostly oil and gas, now uses over 64 million acres. Most of the public lands are open for recreation in one form or another. Across all these lands are spread diverse habitats which support varied species of wildlife.

Overgrazing, widely practiced during the latter part of the 19th and early parts of the 20th century—and still a problem today—has dramatically affected these lands. The semiarid and arid climate of the West has added to the destruction. Dry years have usually coincided with falling market prices. And when that has happened, cattle and sheep ranchers short of cash have often overstocked already depleted ranges. Much of this land, particularly the vast public domain, remains today in desperate condition, as wind, rain, and drought have swept over them and eroded their exposed soils. Although the effects of overgrazing in rich pastures or prairie farmland can be quickly corrected, the process is often irreversible on the limited soils and arid climate of much of the public lands.

What overgrazing does to the soils and habitat of the vast range lands, poor lumbering practices do to the forests. Mismanagement of timber cutting, in addition to being an eyesore, can also damage natural systems far beyond the forests. Debris and erosion of the limited soils of the forested West often choke streambeds far downstream. The tendency toward monoculture for the benefit of lumber and

pulp has its environmental results. Not the least of these is the loss of many native species. The greatest loss of timber is not from fire and disease but from insects, which can devastate large forests of single species. Widespread application of insecticides often follows.

Wildlife—Ultimately these and other uses of the Federal lands fall most harshly upon things wild and free, for protecting and improving habitat is the key to saving wild species.

Wildlife protection in the United States today paints a complex picture. The populations of most game species are high, and their status constantly improves, particularly deer, elk, and various game birds. However, until recently, nongame species of wildlife have been largely ignored and their condition is less well known.

Wildlife in the United States has long been equated with "game" and most public attention, research and management efforts have been directed towards species of sport value. However, trends indicate that persons wanting only to observe wildlife are likely in the future to outnumber hunters. Unfortunately, this change in public attitude has not yet been reflected in increased funds for nongame species. In 1969, total funding from all sources—Federal, State, and private—aimed at wildlife research, management, and habitat protection was about $142 million. Only $6 million of that was clearly related to nongame species.

Nevertheless, sportsmen in this country have contributed impressively to wildlife preservation through the Government use of duck stamp revenues, and tax revenues on sporting arms and ammunition to heavily support State fish and game agencies. Numerous outdoor organizations have also helped conserve land and teach wildlife conservation to their members and the public.

As a group, the large predators stand in greatest danger of extinction. The belief that most predators should be exterminated was central to the early days of ranching and wildlife management. In some areas this unfortunate belief endures. There are still strong pressures on State and Federal wildlife agencies to continue predator control programs for certain bird and mammal species, despite their diminishing numbers and their importance in making room for young, vigorous animals by killing off the old, the weak, and the sick. Nonetheless, most States are making progress in providing legislative protection for the large predators. Some notable exceptions are Arizona, where mountain lion hunting is not controlled, and Alaska, where bounties are still paid for wolves.

Threatened species are getting more attention at Federal and State levels, but limited funds still restrict effective management and research. The new Endangered Species Act should strengthen control over marketing illegally obtained species. It also will place the United States in a better position to cooperate with other governments in the protection of their threatened wildlife. Its effect is already visible in the diminished poaching of alligators in the Everglades. Their numbers have increased because of it.

The emphasis here is on wildlife. Fish are dealt with in the water pollution chapter and in the foregoing section on the coastal zone. Unfortunately, the status of fish and shellfish species is less known than that of terrestrial wildlife.

Epilog—These pages have tended to emphasize the worst effects of grazing, lumbering, recreation, and other uses. The point is that many uses can be compatible and often are. Many modern timber practices can improve forest conditions, and increasing numbers of stockmen are sensitive to range conditions. It is the excess, promoted by overemphasis of the short-term economic gain, which needs curbing. The lesson of man, of land, and of wild things is hard to learn. Aldo Leopold put it well: "A land ethic of course cannot prevent the alteration, management, and use of these resources, but it does affirm their right to continued existence, and at least in spots, their continued existence in a natural state."

THE INFLUENCE OF GOVERNMENT

As the Nation has grown, so have the number of local agencies empowered to decide how land is used. But because of their limited geographic scope, they cannot provide anything resembling a land use system. The narrow authority of each permits it to ignore what the decisions of all will do to the natural and human systems regionwide.

Land Use Controls

Public officials can now call upon a growing inventory of sophisticated land use tools at local, regional, and State levels. But often these devices are little used, and seldom in a way that rationally shapes or directs development.

A wise mix of land use techniques and powers can often balance private economic interest and public benefit. However, the relative importance of particular devices depends on the degree and nature of the control desired at a specific time in a given community.

Conflicts among the rights of an individual landowner, his neighbors, and the community should be resolved by the unit of government best able to take into account broad regional interests. Urban growth has outstripped the ability of small government units to handle environmental decisions that have metropolitan, regional, or even statewide impact. To offset this, many State governments have begun taking back some of the land use powers that they had delegated to municipalities. Although it has been long in coming, Americans are recognizing the need to examine carefully what government can do to assure that land is treated as a resource to be managed and not merely as a commodity to be marketed.

The police power—This term covers a wide array of land use devices designed to protect the welfare of the general public. They limit the free use of property rights in return for protecting the general community. All exercises of the police power have a common characteristic—they are subject to easy change. This is a disadvantage of the power as a land use tool—although flexible, its exercise may be only temporary.

Zoning—Zoning is the major police power employed to control land use. It classifies and segregates the land according to the permitted uses. It can curb those uses up to the point of taking private property without compensation. Within each classification, zoning can set limits on the nature, extent, and improvement of land. Although it has worked in well-established communities where there is little land speculation or pressure for new commercial facilities, it has had less success preserving open space or channeling growth in developing areas. While ideally zoning should implement sound land use plans, it does not necessarily do so. It is usually honored in the breach by the granting of variances or amendments once the pressure of development is on.

The close relationship between the land developers and members of zoning boards in many jurisdictions often jades public confidence in zoning as a tool for sensitive land planning.

In many suburbs zoning has become a device to exclude less desirable residential, commercial, and industrial newcomers. In such communities, it is used primarily to discourage the kind of development that will cost more in municipal spending than it will pay in property

taxes. This often means that apartment houses which accommodate large families, public housing, and even one-family homes on small lots are outlawed because they raise the tab for schools, parks, and other public facilities without bringing in commensurate revenues. Zoning accomplishes this by limiting construction to single family homes on large lots with large side yards and setbacks.

Subdivision controls—Subdivision controls embody some of the most promising tools for regulating urban growth. They comprise all the local ordinances and regulations that tell the landowner what he can and cannot do in dividing his land into lots and selling them or developing them. Where controls are used solely to benefit the developer economically, they can lead to tedious and unattractive developments with uniform setback and lot size, unimaginative street patterns, and little provision for open space or for commercial facilities within walking distance of homes. On the other hand, when subdivision controls permit cluster development, open space preservation, planned unit development, and other imaginative innovations, they can bring a sense of community and vitality. The flexibility of subdivision controls allows increased sophistication in the development of urban and suburban areas. For example, by the proper use of timed development, a community places all of its expenditures for new public utilities and services in one geographic area at a time, allowing for ordered growth at lowest public cost.

Sewer and water permits—Before water and sewer service may be extended to new housing and other facilities, most communities require certification that public capacities are adequate to supply the services and that equipment and other facilities on the property meet local specifications. When combined with adequate control over the use of wells and septic tanks, these permits can dictate the pace and direction of urban growth. Nevertheless, sewer and water lines today more often are installed in response to already uncoordinated and poorly thought-out development.

Suburban and regional shortsightedness has left some towns with inadequate water supplies and sewage treatment facilities for new residential, commercial, and industrial growth. Because of stricter enforcement of water quality standards, it has been necessary for regional and State authorities to prohibit further sewer hookups in large parts of several metropolitan areas, including Washington, D.C., Cleveland, and the northern New Jersey urban region. The disruptive conditions which led to these recent decisions dramatize the need for proper land use planning techniques to assure a predictable rate and

direction of growth and development and to prevent economic hardship for builders, businessmen, industrial concerns, and homebuyers.

Eminent domain—Eminent domain gives to government the right to acquire lands. It is an outgrowth of the old English common law principle that the Crown held ultimate power to buy any lands in the realm and, the landholder unwilling, to seize them and pay compensation. The right of eminent domain in this country likewise may be invoked in the case of a reluctant seller, provided the property is used for the public benefit and there is just compensation. Urban renewal and highway construction projects have used eminent domain to purchase vast numbers of properties. But eminent domain is also available for smaller public benefits—such as purchasing an easement for access to a public beach or preserving an historic building.

Land purchase or acquisition of limited land rights by a public body is, in theory, an effective way to control urban sprawl. But so far, little of this has been done, either to assemble large parcels for proper development or to preserve open spaces. For financial and political reasons, local governments in rural areas have not acted while prices are still low and unaffected by urban pressure. Once an area starts urbanizing, local governments are unwilling and often unable to pay the inflated land prices. By that time, it is also too late to purchase limited rights, such as scenic easements to preserve the land, because they often cost nearly as much as full purchase.

The planning function—Comprehensive urban planning is a commitment by government to help foresee and direct growth and change within its borders. With it development decisions can be made more knowledgeably. Planning is a natural extension of the traditional goals of police power and eminent domain power to promote public welfare. When planning determinations affect private property, they require the same standards of reasonableness and fairness to the owner.

Planning has often been misunderstood. The public often fails to understand that a comprehensive plan is a living, changing mechanism and not a static set of maps. Many citizens believe that the planning process has ended when the municipality approves a master plan. The long period of time required to prepare land use, public facilities, and transportation plans for large metropolitan regions has caused many citizens to regard planning as an academic exercise. Often this feeling is only strengthened by those planners who ignore the opinions of local residents. However, growing numbers of cities, metropolitan areas, and regions adhere to and implement their plans. As planners

begin to take greater cognizance of public attitudes, the value of planning as a predictive and directive tool may be better understood.

Planning has been criticized because it has often been unable to influence important land use decisions. This is not necessarily the fault of the planning process, although in many communities the planning organization is often pressured to conform its plan to unwise developments. It may be due instead to inadequate institutional arrangements that have been made to implement the plan. In many localities, the planning bodies are distinct from the action agencies. Consequently, the planning function becomes little more than advisory, and the planning office spends inordinate time and resources inside city hall lobbying the departments possessing the large budgets and the authority.

Finally, planning efforts to direct all development forces in a rational manner are often inadequate. What should be "comprehensive" sometimes deteriorates into a complementary set of specific functional planning goals for transportation, open space, schools, or some other single goal. In the process perspective is lost. Economic growth and efficiency become design criteria. Environmental aspects are often neglected for short-term economic gain. Planning that is not comprehensive and long range cannot hope to evaluate ecological factors properly.

The role of private agreements—Covenants, conditions, easements, and like restrictions on property use comprise a special set of land use devices which traditionally have been employed by neighboring property owners. Recently they have also been invoked by government and private groups to protect land. For example, citizens of several towns in Massachusetts have executed agreements with local conservation trusts, funded in part by the towns, to protect their wetlands from further development. Covenants, conditions, and easements can be tailored to carry out specific purposes. They are well established in the law and continue in their effect even if the property is sold.

Permits—The Federal and sometimes State Governments require permits for a range of activities on land and submerged lands. Although the control of individual land use decisions regarding private land is primarily local and varies widely, these permits may influence major growth patterns and economic development.

Federal permits are issued when public lands are involved. Leases, use permits, and licenses are granted to extract oil, gas, coal, and certain other minerals, and for grazing, recreation, and timbering. These

permits affect not only the public lands, but also may influence the use of nearby privately owned land.

The permit authority of the Army Corps of Engineers is a significant tool in land use decisions affecting navigable waters in the United States. These permits are discussed in this chapter in the section on the coastal environment. Some States have enacted legislation requiring permits for alteration of wetlands, bottomlands, and in some cases adjacent land areas. The trend is toward stronger State controls on dredging, draining, and filling of coastal areas.

Tax Policy

Tax policy is a vital cog in deciding income and profit for land investors, suburban developers, urban developers, and landlords—the big influencers of land use. Taxation therefore is an essential tool in shaping the manmade environment and preserving the natural environment.

Local property tax—A major cause of the decline of services in some core cities is the loss of actual and potential tax revenue when residential, commercial, and industrial development spreads to the suburbs. With strict zoning and subdivision controls, many suburban communities exclude all but those who will add more to the tax rolls than they will require in municipal expenditures. Rather than finance government activity for the benefit of all people in an interrelated urban complex, the property tax has abetted local isolation from regional land use problems.

Assessment procedures have improved in many municipalities, but more reform is necessary for a fair spread of the tax burden. At present, land in urban areas tends to be undervalued and the improvements on land overvalued for tax purposes. Consequently landowners in urban areas are discourged from restoring structurally sound buildings or replacing deteriorated ones with new structures, since such improvements will raise the taxes disproportionately. On the developing fringe of urban areas, low taxes on raw land have encouraged speculative purchase and leapfrog development.

As mentioned earlier, an increasingly serious problem in city cores is property abandonment. There are delinquent taxes on some of these vacant lots and buildings, but little is done to collect them. Even less

often are such properties confiscated by the city and turned to public use or sold to redevelopers.

The threatened loss of the tax base in urban areas has forced some cities to offer concessions to keep industries from moving to the suburbs, often including failure to enforce air and water pollution standards and other controls of industrial activities damaging to the environment.

Finally, few communities have constructively exploited the interrelationships of zoning, subdivision controls, and other land use devices with property tax policy. The local property tax could be a useful device, particularly in encouraging cluster development and open space preservation where no such options exist. Special tax treatment for commonly owned open space and community facilities also encourages protection or enhancement of the environment by subdivision developers.

The Federal income tax—Some aspects of the Federal income tax deliberately encourage specific types of land development. Other aspects cause inadvertent effects. The Council, with the aid of its task force on tax policy, has undertaken to examine many of the leveled criticisms. Some are outlined below.

An important land use impact of the Federal income tax stems from the deductibility of local property taxes. The intent of this provision is to relieve the homeowner from paying a tax on a tax. Often, however, major benefactors of the deduction are slum landlords and land speculators. The latter are said to be relieved by this provision from the burden of local taxation as pressures of urbanization increase the value of their holdings.

Although tightened by the Tax Reform Act of 1969, depreciation provisions of Federal income tax laws are still in need of study to determine whether they adversely affect land use decisions. Accelerated depreciation and redepreciation of buildings may foster high numbers of substandard rental housing units in core cities. Such provisions have encouraged ownership of rental property for a limited number of years, then a selloff rather than improvement of the property. These so-called fast writeoffs encourage poor quality construction in new rental units since the first owner seldom plans to own the property more than a few years.

Tax laws benefit the homeowner by allowing him to deduct mortgage interest. But they do not permit rent payments to be deducted. Much has been done recently to determine to what extent present living and

land ownership patterns of the slums, the central city, and the suburbs are traceable to these tax policies.

There is growing interest by private citizens in preserving forest and woodland, protecting additional animal and fish habitat, and preventing further deterioration of their own and nearby landscapes. Some landholders have sold or donated development and other rights on their land to public bodies or private conservation groups for permanent preservation. Recent Internal Revenue Service rulings have attempted to establish the value of these gifts in light of general tax rules by basing it on the fair market value of the land as restricted compared to its value previously. Some have argued that greater certainty and more liberal treatment should be provided in establishing the value of what was given in order to encourage conservation easements and similar devices for environmental protection.

The Impact of Federal Activities

A myriad of Federal loans, grants, projects, and other programs enacted for specific public purposes often has direct impact on the use of land. Because of the interrelationships of these programs with those of other levels of government and the private sector, it is difficult to assess the degree of Federal influence. The most significant Federal activities include the highway, airport, and mass transit programs, the sewer and water grant programs, home mortgage assistance, open space funding, agriculture subsidies, planning assistance, the location of major Federal facilities, and water resource projects. A brief discussion of these programs and their land use consequences is included in the Addendum following the section "What Needs to be Done."

WHAT NEEDS TO BE DONE

Land use influences, trends, practices, and controls in the United States are complex. While by no means an exhaustive survey of all the environmental problems that are land related, the above summary does indicate the need for developing standards to evaluate what is happening to this basic resource and to develop policies that will guarantee its continued integrity. In short, there is a need to begin shaping a national land use policy.

The reforms in Government activity needed to institute a national land use policy are undeveloped at this time. It will be necessary first to determine which levels of government must assume which specific responsibilities and to identify the appropriate mechanism at each level to achieve such a policy. However, this chapter has identified certain aspects of a strategy which the Council feels merit special consideration:

- The Federal Government should encourage, through project approval under existing programs, widespread use of devices such as cluster zoning and timed development.
- Although a number of Federal programs exist to preserve buildings and neighborhoods of architectural quality and historical significance, there is a need for increased attention and a comprehensive strategy if significant progress is to be achieved.
- Comprehensive metropolitan planning should identify flood plains, wetlands, aquifer recharge areas, unstable surface and subsurface characteristics, and areas of value for scenic, wildlife, and recreational purposes. Development in these areas should be controlled.
- Federal grants for sewer and water projects and open space acquisition should be directed toward communities or project areas which will use them to control development rather than to those which merely respond to uncontrolled growth.
- Home mortgage and interest subsidy programs should be used to encourage the proper siting and environmental compatibility of the subdivisions in which new housing is constructed.
- Congress should act to reverse the degradation of the coastal zones by enacting the Administration's recommended legislation, S. 3183 and H.R. 14845.
- National wilderness areas should be designated as quickly as possible; the appropriate Federal agencies should comply with the intent of the Wilderness Act even if substantial temporary reassignment of personnel is required.
- The National Park Service should accelerate its control systems experiments to prevent overcrowding and traffic congestion in the National Parks.
- Greater emphasis should be given through existing programs to acquire small parks and natural areas near cities.
- Additional areas of special ecological significance should be protected, and the Federal Government should identify and establish a national registry for research natural areas.

Addendum

THE LAND USE IMPACT OF FEDERAL ACTIVITIES

Major Federal Installations

The Federal Government is responsible for constructing installations throughout the country for research, national defense, and other purposes. The largest such facilities are frequently placed in remote areas where the impact on surrounding natural values can be severe. Until recently little was done to assure full consideration of these impacts, particularly as they relate to the environment.

The construction of facilities by NASA at Cape Kennedy, Fla., is a case in point. The massive needs of this complex for men and materiel brought an entire county of Florida under severe development pressures. Brevard County was engulfed overnight by residential subdivisions, commercial strips, and highway corridors. Large areas were cleared of vegetation, wetlands were filled, and stream systems were altered. Recent cutbacks in space exploration have brought the county quickly from boom to economic decline, contrasting the short-term economic benefits with the long-range ecological costs resulting from development, federally encouraged or otherwise, without adequate planning and control.

Equally important are the large Federal properties, mostly Department of Defense holdings, in and near urban areas which are being underutilized by Federal agencies. The President has ordered a survey of all such Federal real property. The aim is to identify those lands which could be better used, especially for public recreation.

Water Control Projects

The Federal Government also spends heavily on resource development. Every year as much land in the United States is converted to reservoirs and flood control use as for urban and suburban development. Most of the development is undertaken by four Federal agencies with responsibilities for water resources. The Army Corps of Engineers, with an annual development budget of $1.36 billion, is active throughout the Nation with heavy emphasis on flood control and navigation improvement projects. The Bureau of Reclamation of the Department of the Interior, with its $300 million budget, operates in 13 Western States developing irrigation and municipal and industrial water supply and electric power. The Tennessee Valley Authority spends $10 million a year on multipurpose water resource projects, with the emphasis on flood control, water quality control, recreation, and economic development. The Soil Conservation Service of the Department of Agriculture spends approximately $100 million annually on its small watershed and flood prevention programs.

The primary rationale for these vast Federal outlays is to supply water for agricultural, industrial, and domestic use and to prevent floods. However, the environmental implication argues for a reevaluation of certain programs. Although the concern has been to produce water for growth and expansion, the decline of the quality of the natural and human habitat, which too often results

from such projects, requires a broader perspective. Alternatives are now more seriously considered, along with the potential loss of environmental values. When the public outcry has been strongest, it has prevented the inundation of beautiful stream valleys and canyons.

But understanding of the proper balance of water resources and environmental needs is only in its infancy. The number of free-flowing streams and rivers declines yearly as new dams, canals, or channels impound and divert the waters. Although extensive recreation areas are often created from such projects, they often irreversibly destroy the natural systems of land and water in addition to recreation uses of free-flowing streams and rivers. While millions of fertile acres are being abandoned in some areas, millions of dollars are spent in others to irrigate deserts and to dike wetlands for farming. Although some shifts in agricultural land use are clearly necessary, there is no coherent policy to assure that environmentally damaging projects are kept to a minimum. We continue to develop flood plains, then spend millions to protect man's use of them from natural flooding cycles. We continue to view the provision of water resources as a challenge to our engineering ability rather than as a challenge to weigh against man's ecological obligations.

Aids to Other Government Bodies

Although major Federal grant programs to State, regional, and local governments require compliance with numerous criteria, the criteria are rarely environmental. Stronger enforcement of the procedures outlined in Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966 and greater consideration of environmental planning criteria are logical first steps toward developing a national land use policy.

Highways—Aid to States for highway construction is a major Federal outlay. The Federal authorization for fiscal year 1971 will total $5.4 billion. Four billion dollars is for work on routes of the interstate system. Seventy percent of this 42,500-mile network of high-speed, limited-access highways was complete as of January 1, 1970. Since 1956, $39 billion has been spent on the interstate program.

One and two-tenths billion dollars in Federal funds for fiscal year 1971 have been apportioned for the continuing Federal-State program to improve primary and secondary highway systems. This program predates the interstate system, has expended a total of $27 billion over the years, and has aided in upgrading over 250,000 miles of highways.

Both of these major construction programs are funded exclusively from the Highway Trust Fund created by 1956 legislation. Revenue paid into the Fund in fiscal year 1969 totaled $4.67 billion. About 68 percent of this total comes from the 4 cent per gallon Federal tax on motor fuel; the rest is collected from various taxes on automotive products, trucks, and trailers.

Federally assisted highway construction has been the major determinant of growth patterns and development in this country since 1956. The program has given the American people a degree of mobility never before known. But the momentum of construction and the economic importance of new road building have raised obstacles to thoughtful long-range planning for the environment. Urban expressways have relieved congestion on our city streets but sometimes in the process have disrupted established neighborhood patterns,

consumed urban parklands, and raised noise levels in residential areas. In some cases, expressways have abetted the conversion of downtown commercial districts into places that live only from 9 to 5. Construction of suburban arteries can easily be justified as a short-range solution to pressing problems of congestion. Yet it can also spur new development far from the city core, reward land speculators, create a need for more public services, destroy natural areas, dump more cars into the central city and promote a pattern of suburban settlement that nearly precludes mass transit.

Mass transit—Mass transit services have declined in many cities as riders turned to the automobile for the commute to and from work. However, failure to maintain and expand city bus, subway and commuter rail systems will lead to further congestion of expressways. And it will necessitate giving over more of the downtown areas to more expressways, parking lots, and garages. Mass transit legislation would award up to $3.1 billion over the next 5 years to State and local governments to help finance acquisition, construction, reconstruction, and improvement of mass transportation equipment and facilities. This legislation contemplates a full Federal commitment to the program of $10 billion over a 12-year period. It would permit State and local long-range public transportation planning to proceed in an orderly fashion, assured of uninterrupted Federal assistance.

Airports—The President's Budget for 1971 asks for $220 million in grants-in-aid for airport development and expansion. Available to burgeoning airports on a 50–50 matching basis, this money is for land acquisition, runway and ramp construction, and other airfield costs. The new Airport and Airway Development Act of 1970 envisions annual Federal appropriations over the next 5 years of $280 million.

But airports also have significant environmental impact. They bring high noise levels, new access highways, air pollution from automobiles and aircraft, and sewage and solid waste disposal problems. Airport construction requires that large land areas be cleared and leveled. This often means draining wetlands and other natural habitat areas to remove birds, small mammals, and other wildlife. Even more important, residential, commercial, and industrial activity cluster around airports, intensifying environmental threats manyfold. A proposed airport in the Dallas-Fort Worth area may attract support activities equal to a city of 80,000 people. Construction of a mammoth 39-square mile jetport just north of the Everglades National Park in Florida has been blocked by the Administration. If completed, it would have significantly disrupted the natural systems of the National Park and, worse, stimulated development already threatening the surrounding Big Cypress Swamp. The draining and filling of that swamp, the last natural flow of water to the western third of the park, would disrupt the hydrologic cycle and ecosystem of southern Florida and destroy the Everglades National Park.

Planning—Major Federal Government grants to fund comprehensive planning are distributed through three principal programs. Other specific functional planning grants are available from dozens of Federal programs. The Department of Housing and Urban Development (HUD) is the most important source. Its "701" program expends $50 million a year in direct aid to metropolitan areas and regions and in indirect aid to counties and smaller urban units. One and one-half percent of Federal Highway Trust Fund spending is earmarked for planning, although

much of the $60 million available from this source is expended on transportation-related planning activities. HUD's Community Renewal Program also sets aside $12 million for planning.

Comprehensive regional planning can control the pace and direction of development. As such, it can be an important protector of environmental values. It also helps State and local officials coordinate various policies and programs and develop the framework to guide functional planning for schools, transportation, public utilities, or other specific purposes. There is a temptation at the Federal level and in many communities to use HUD funds for functional instead of comprehensive planning, thus losing the "glue" to hold together the disparate planning activities.

Sewer and water lines—A considerable block of Federal assistance—more than $500 million—is devoted annually to sewer and water projects that often affect land use.

The involved Federal agencies, particularly the Department of Housing and Urban Development, believe that past administration of these programs has augmented suburban sprawl and misdirected development. Builders and landowners know that they can develop lands far from built-up areas and use septic tanks and wells with the hope that funds will ultimately be available to extend sewer and water lines. Meanwhile, local officials delay construction of facilities in expectation of Federal funding. These outdated practices are undergoing challenge and change. And as new criteria are developed, Federal sewer and water grants can become useful to better direct the pace and pattern of growth.

There are three important Federal programs. The Department of Housing and Urban Development has a programming level of $150 million for 1970. Last year, three hundred and sixty five communities benefited from the program; most were suburban jurisdictions. The funds are not available for interceptor sewers or treatment plants. The Department of Agriculture has available for fiscal 1970 $190 million for water and sewer projects in communities of less than 5,500 persons; $64 million of this is for direct loans, and $80 million for insured loans; the remainder is grant monies. The Economic Development Administration of the Department of Commerce also funds construction of sewer and water facilities within its areas of jurisdiction. Expenditures for 1970 of $119 million are allocated primarily to economically depressed rural areas.

Open space—Acquisition of open spaces for recreation and conservation attracts growing public interest and government response. There are two major Federal grant programs. As described in the previous section on the natural environment, over half of the appropriations from the Land and Water Conservation Fund are available to States on a matching basis each year. Many States make a share of these funds available to local governments for purchase of small parks and recreation areas. The States have already used the Fund to purchase thousands of acres of recreation and conservation lands.

The other major open space grant program is operated by the Department of Housing and Urban Development under title 7 of the Housing Act of 1961. In the last 9 years, this program has spent $350 million in matching grants to acquire 350,000 acres of urban land for recreation, conservation, and historic preservation.

The combined impact of these two grant programs has significantly increased the land available in urban areas for recreation. Thousands of acres of urban open space have been preserved. But at the same time many thousands more were converted to residential, commercial, and industrial use by urban expansion. Some suburban communities have been among the most irresponsible in failing to provide adequate open space; many others have found their best efforts frustrated by soaring land costs.

Aids and Inducements to Individuals

The Federal Government over the years has loaned and granted money to individuals—among them homeowners and farmers. These programs have had noticeable side effects on the way the country has developed its land.

FHA-VA home mortgage programs—Buyers of 17 percent of the new housing units in the United States still choose Federally insured (FHA) and guaranteed (VA) loans to finance their homes. These programs were first implemented on a wide scale after World War II. Policies of low down payments and readily available low-interest loans provided financing for millions of families who otherwise would have been unable to buy new homes.

At the same time, by encouraging suburban home construction, these programs helped to form the concentric circles of racial and economic separation that persist in many metropolitan areas. Federal Housing Administration and Veterans' Administration examiners have traditionally favored new homes over restoration or renovation, and suburban communities over the urban core.

Agricultural programs—Farmers aid programs of the Department of Agriculture are a second set of significant inducements to individuals. Price support programs of the Commodity Credit Corporation are budgeted at $3.5 to $3.8 billion per year. These funds go to keep land out of production, prop agricultural prices, and provide farmers with loans against their crops. Each year the Farmers Home Administration provides $775 million in direct and insured loans for rural housing. Its Operating Loan Program furnishes $275 million annually for short-term purchases such as feed and equipment. The Farm Ownership Loan Program provides $225 million of direct and insured loans for the purchase of lands to expand or establish farms. And individual erosion control projects funded by the Agricultural Conservation Program amount to $200 million each year.

The original purpose of this aid was to protect the family farm and to encourage proper practices of agricultural conservation. Today intensive farming and modern methods of raising livestock often strain the capabilities of our lands and waters. Extensive use of pesticides and vast amounts of concentrated animal wastes are just two of the changes which have had profound environmental effects.

X

International Cooperation

ENVIRONMENTAL PROBLEMS do not stop at national frontiers, or ideological barriers. Pollution in the atmosphere and oceans taints all nations, even those benignly favored by geography, climate, or natural resources. The smokestacks of one country can pollute the air of another. Toxic effluents poured into an international river can kill fish in a neighboring nation and ultimately pollute international seas. Even in Antarctica, thousands of miles from pollution sources, penguins and fish contain DDT in their fat. And recent layers of snow and ice on the white continent contain measurable amounts of lead.

International cooperation, therefore, is necessary on many environmental fronts. Sudden accidents that chaotically damage the environment—such as oil spills from a tanker at sea—require international cooperation both for prevention and for cleanup. Environmental effects cannot be effectively treated by unilateral action alone.

Air and water pollution, moreover, are not the only environmental problems that have international aspects. Some world resources such as seabed minerals and ocean fish can be wisely dealt with only by international agreement. What nations do to clean up domestic pollution can affect international commerce. The costs of pollution control can change the competitive position of a nation's industry. And

how the nations regulate international transportation and imports to eliminate sources of pollution can also have a profound bearing on trade. These considerations should receive increasing attention in the context of international trade policy. In addition, nations can reap economies and foreign policy benefits by undertaking joint research and environmental information sharing with other nations. Studies on pollution abatement, urbanization, population distribution, and the use of herbicides and insecticides, undertaken by one country, can help others.

The National Environmental Policy Act directed all agencies of the Federal Government to recognize the worldwide and long-range character of environmental problems. Where consistent with the foreign policy of the United States, it directs the agencies to support initiatives, resolutions, and programs designed to maximize international cooperation and prevent a decline in the quality of mankind's environment.

PROGRAMS WORLDWIDE

The United States is already engaged in international cooperation on environmental matters through a variety of channels. These include the United Nations and its specialized agencies and other such intergovernmental organizations as NATO, the Economic Commission for Europe and the Organization for Economic Cooperation and Development. It works with nongovernment organizations such as the International Biological Program and the International Union for the Conservation of Nature and Natural Resources. A number of environmental programs such as those discussed below are being developed by international agencies.

The United Nations

Economic Commission for Europe—The ECE, one of the four regional U.N. commissions on economic and social matters, is composed of the European members of the United Nations and the United States. Its current activities include air and water pollution control, urban development, and exchanges regarding government policy problems in these fields. It is preparing a Conference on the Environment in May 1971 in Prague. This conference will be a key preliminary to the full U.N. Conference on the Environment in 1972. The ECE is

important as a forum for international environmental cooperation because it includes most of the major industrialized countries of the world, East and West, in working-level discussions of environmental problems.

Intergovernmental Maritime Consultative Organization—Since its establishment in 1959, IMCO has encouraged an exchange of research and information on the rapid, safe, and workable handling of oil spills and other aspects of ocean pollution. It has already established an international mechanism for reporting oil spills. In 1969 IMCO convened major international legal conferences on marine pollution. One proposed strengthening the 1954 Treaty on Prevention of Pollution of the Sea by Oil. The other proposed two new conventions to permit action to deal with damaged vessels threatening oil spills on the high seas and to fix liability for the costs of oil spill cleanup. President Nixon has submitted these treaties to the Senate for ratification.

U.N. Educational, Scientific and Cultural Organization—UNESCO promotes scientific investigation of man-induced and natural changes in the character of the oceans. It supports programs to identify effects of waste disposal at sea and to prevent depletion or extinction of valuable marine species because of man's activities. UNESCO-sponsored studies of atmospheric pollution are also underway. In 1968, UNESCO convened the International Conference on the Rational Use and Conservation of Resources of the Biosphere. Out of recommendations of that conference, it is developing a long-term, comprehensive program of research and action on environmental problems, called Man and the Biosphere.

World Health Organization—WHO has conducted studies of coastal pollution and is planning to lend technical guidance on coastal water quality and on ways to prevent pollution. It is developing a worldwide program of monitoring certain environmental conditions which directly affect health. WHO has also assisted many member countries in carrying out field projects on waste disposal and water pollution control.

Food and Agriculture Organization—FAO is undertaking studies on water quality criteria for fish, on pesticides and pollution, on pulp and paper mill effluents, and on sewage effluents. Although more concerned with pollution of inland waters, FAO has also turned to the study, monitoring, and management of the sources and effects of pollution on ocean fisheries. FAO also carries out ecological studies and

surveys connected with land use, stressing increased productivity and management of natural resources, particularly in the developing countries. FAO has programs in wildlife management, in tourist development and protein production, in national park development, and in the traditional agricultural and forestry areas.

World Meteorological Organization—WMO has launched the World Weather Watch to improve the collection of meteorological data for forecasting and for studies of atmospheric pollutants. Basic research is being promoted and coordinated through the Global Atmospheric Research Program jointly organized by WMO and the International Council of Scientific Unions. Studies of the meteorological factors involved in air pollution are being conducted by two WMO commissions.

International Atomic Energy Agency—IAEA environmental activities concentrate on pollution from radioactive substances. It draws up regulations, conducts programs for exchanging information, and supports research projects. IAEA has published guidebooks on nuclear safety and radioactive waste management. With the World Health Organization and UNESCO, it has set up a worldwide sampling network to measure the amount of radioactivity in precipitation and is working on techniques for measuring atmospheric and other environmental radioactivity.

U.N. Conference on the Human Environment—The United Nations Conference on the Human Environment will convene in Stockholm in June 1972. Although the conference agenda has not yet been approved by the General Assembly, these fundamental purposes have been agreed to:

- To focus attention of governments and public opinion on the importance and urgency of environmental problems, both in developed and developing countries.
- To provide a forum for exchange of views among governments on ways of handling environmental problems, including legislative and administrative action.
- To identify environmental problems which can only, or can best, be solved through international or regional cooperation.
- To consider methods to meet the need for intensified action at the national, regional, and international levels—especially ways in which the developing countries can minimize or forestall the adverse effects of industrialization and urbanization.

- To encourage wider participation and support for the environmental activities and programs of U.N. bodies and other international organizations and to help give them a common outlook and direction.

A 27-member preparatory committee was formed early this year to prepare an agenda for the conference. At its first session in March, the committee defined three major agenda topics: population distribution and its effects on the environment, management of natural resources, and environmental pollution. The conference agenda will be refined at the January 1971 session of the preparatory committee.

Other Intergovernmental Bodies

NATO Committee on Challenges of Modern Society (CCMS)—An early expression of the U.S. growing concern with environmental problems was President Nixon's address to NATO in February 1969 and his proposal in April 1969 for the establishment of a NATO Committee on the Challenges of Modern Society. This new committee is designed to consider specific problems of the human environment. It has already underway eight pilot studies, and in five of them two or more of the member countries collaborate. The studies are on (1) disaster assistance (United States and Italy), (2) air pollution (United States, Turkey, and Germany), (3) road safety (United States and Germany), (4) open-water pollution (Belgium, Portugal, Canada, and France), (5) inland water pollution (Canada, France, United States, and Belgium), (6) scientific knowledge and decision-making (Germany), (7) motivation in a modern industrial society (United Kingdom), and (8) environment in the strategy of regional development (France).

Organization for Economic Cooperation and Development—The OECD, an assembly of the industrialized nations of Western Europe and North America, with Japan, has active programs on water resources management, air pollution, and pesticides. It is also organizing an environmental division which would study, among other things, these questions:

- Who should pay for the control of pollution, and who should pay for the damage caused by pollutants that escape into the environment?
- What is the level of acceptable exposure to various pollutants?

- Are there levels of pollutants in the environment which, if reached on a worldwide basis, will give rise to catastrophic changes?

Organization of African Unity—The OAU has directed attention to environmental problems and planning through the African Convention on the Conservation of Nature and Natural Resources, signed by representatives of 38 African nations at the OAU Summit Meeting in September 1968. This Convention, developed on the request of the OAU by the IUCN, with cooperation by FAO and UNESCO, is based on broad ecological principles and covers management, utilization, and preservation of natural resources including soil, water, vegetation, and fauna, and also includes aspects of research, education, administration, and legislation.

Organization of American States—Through the OAS the Latin American Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was prepared in 1940, and subsequently ratified by the United States and 9 other American nations. The OAS has recently updated the Convention annex lists of threatened species, and is developing appropriate research programs which bear on the articles of the convention.

Council of Europe—This assemblage of European nations is making a commitment to environmental quality through its development of the European Conservation Year, initiated in January 1970. Each participating nation has developed its own major conservation program, and the Council serves as a point of liaison and coordination. The programs range from public education in pollution control to programs of basic ecological research.

Bilateral Cooperation

The United States is cooperating bilaterally with Japan, Germany, France, the Soviet Union, and Canada in joint research and information sharing.

With Japan the United States has arrangements for the exchange of scientific and technological information on air pollution, water pollution, toxic microorganisms, wind and seismic damage, and undersea technology. The United States-German program concerns coal dust, water pollution, air pollution control, urban planning, and noise abatement. The United States-Soviet Exchange Agreement covers ocean-

ography, urban transportation, air and water pollution, and other environmental problems.

Cooperation between the United States and Canada on environmental problems has a long history. Their joint attention is now focused on the Great Lakes, St. Lawrence River water boundary, and on the Arctic region. United States-Canada agreements on the Great Lakes go back to the Boundary Waters Treaty of 1906. The Great Lakes is the largest fresh water body in the world. Most of the population of Canada and much of that of the United States lives near its borders, and pollution of the Great Lakes concerns both nations. The intergovernmental body chiefly responsible is the International Joint Commission of the United States and Canada. The IJC has developed an interim report on pollution of Lake Erie and other waters. On June 23, a ministerial meeting was held in Ottawa to discuss the IJC recommendations and future cooperation between the United States and Canada on Great Lakes pollution. That conference agreed on a number of specific proposals of the IJC and laid the foundations for a working group and further ministerial meetings. A final report is expected by the end of this year.

The Arctic region, a "last frontier" of natural resources in the Northern Hemisphere, is an area of growing importance in United States-Canadian consideration of environmental problems. Bordering international waters, it is important to the development of the United States and the North American continent in part because it affords the shortest distance between Eurasia and North America and in part because of its mineral resources.

The Arctic Ocean makes the United States a neighbor to five nations—U.S.S.R., Norway, Denmark, Canada, and Iceland. Still other nations share concern over exploration, settlement, and exploitation of the Arctic region. Environmental quality there is a new opportunity for cooperation among all these nations.

Nongovernmental Organizations

The International Council of Scientific Unions initiated the International Biological Program, a nongovernmental international scientific research project covering the biological aspects of the world's physical environment. The 5-year action program started in 1967 now involves scientists from more than 60 countries.

The International Union for Conservation of Nature and Natural Resources (IUCN) was founded in 1948. It comprises 29 nations and several hundred nonpolitical organizations from about 80 countries and maintains headquarters in Morges, Switzerland. The Union seeks to initiate and promote scientifically based action to preserve the natural environment, life forms, and resources. It works through commissions on ecology, species survival, national parks, education, and environmental policy and administration. The IUCN has consultative status with the United Nations and various regional international groups.

AREAS FOR FURTHER INITIATIVE

The United States should provide increasing leadership in environmental management affairs and lend support to the efforts of other nations and international agencies. The Council is now identifying new possibilities where the participation of other countries is necessary or where exchange of information and experience will buttress the environmental efforts of all nations.

Monitoring the World

The International Geophysical Year (1957–58) was a milestone in developing new knowledge on the physical and dynamic properties of the earth, including the composition and character of the oceans and the atmosphere. It helped provide fundamental baseline data on the global environment. The International Biological Program (IBP) is now developing a proposal for a global environmental monitoring system, which will consider ecological systems and their reaction to man's management of the global environment. Efforts are underway to identify pollutants in the atmosphere and ocean where critical situations may soon occur. Extensive study is required to determine what monitoring systems are needed, their costs, and organization.

Saving Endangered Life

The activities of man on earth have made extinct many forms of animal life. The rate of extermination has closely followed the rate of the world's human population growth. During recorded times the rate of extermination of mammals alone has accelerated from roughly

one species each half century to one a year. About 40 percent of the known exterminations have occurred since 1900. Various international arrangements now seem necessary to keep the annual harvest of various endangered fish and animal life within their natural reproduction rates. There are a number of existing international treaties to do this, particularly those concerning fisheries, but many threats to existence continue unabated, among them the continued depletion of whale and other marine animal populations. Other threatened species with an international range, such as the polar bear, require tighter international protection.

The IUCN has moved to preserve examples of natural environment, life forms, and resources. The United States has also initiated legislative action to this end.

National Parks and the World Heritage

National Parks and historic sites provide permanent protection to the cultural, historical, scientific, and natural heritage of individual nations. There are many areas of extraordinary historic or natural value which may be considered part of a world heritage. The United States, which began its National Parks programs in 1872, has developed wide experience in park planning and management. The Council believes that the United States, drawing on this background, could and should give technical assistance to encourage other countries to take similar actions on their areas of natural and historic significance.

Such technical assistance, because it is designed to foster a world heritage, need not be limited to the countries in which the Agency for International Development has economic development programs. Nor need it be necessarily subject to economic criteria. The Council recommends that the Department of the Interior be given such additional authority as may be necessary to enable it to extend technical assistance in this area and in the closely allied areas of wildlife management. In carrying out such a program, it should consult with AID.

The Council further recommends that the United States undertake an initiative through the United Nations to encourage the establishment, on an international scale, of systems for the protection of the world's unique natural and historical areas. Rapidly rising population pressures, together with rapid and cheap transportation, make it mandatory that the nations act quickly. Such an initiative by the United States would be particularly appropriate in connection with the celebration of our National Park centennial in 1972 and the Second World

Conference on National Parks cosponsored by the Department of the Interior and IUCN.

Cooperation Under the Sea

Extraction of oil and natural gas from beneath the seabed is proceeding rapidly in many coastal waters, and techniques for drilling in deeper waters are being developed. Dredging or other forms of mining the deep seabed for mineral ores may become economically feasible.

Such exploitation of the ocean floor raises questions of rights and ownership as well as many problems of potential damage to the ocean environment. The United Nations is aware of these matters and has organized the U.N. Seabed Committee to make recommendations.

Unless environmental quality controls, resource conservation, and research go hand in hand with development, the use of the ocean floor could become another classic case of the tragedy of the commons—the single interest of each nation would run contrary to the collective interest of all.

President Nixon on May 23 outlined a proposal for sharing the responsibility for and the revenues from undersea resources among all nations, large and small, landlocked and coastal. He urged provisions for adequate environmental protection. The Council recommends that an international regime, developed to manage the seabed areas beyond the limits of national jurisdiction, include safeguards for the prevention of environmental damage.

Ocean Resources

A U.N. resolution, supported by the United States, has called for worldwide collaborative programs of oceanographic resource surveys to extend through the decade of the 1970's. Last October, this Nation outlined specific proposals for the International Decade of Ocean Exploration. The proposed activities address problems of worldwide concern which can be solved most swiftly and economically through multinational, cooperative efforts. They include:

- Preserving the quality of the marine environment through a better understanding of oceanic processes and living organisms;
- Improving environmental forecasting to reduce hazards to life and property; and

- Developing a global ocean monitoring system to assist in preventing harmful, irreversible manmade and natural modifications of the environment.

The Environment and International Development

International development programs, such as those supported by the Agency for International Development (AID) and the World Bank, have in the past primarily emphasized economic benefits without giving adequate consideration to the long-term ecological damage. In several cases pesticides have destroyed normal biological controls. Consequent increases of other insect populations have, in turn, led to further use of pesticides. Irrigation projects have led to water logging and salination of soils, sometimes with an actual net loss of arable land in given regions. Some highway construction has encouraged strip settlement with razing of forests, erosion, and destruction of watersheds. Inadvertent ecological damage may accompany otherwise well-intentioned development projects.

The lesson is not that international development programs should be avoided. It is that they should be based on long-range environmental factors as well as on engineering and economic factors.

The Council believes that the United States has a responsibility, when it gives development assistance, to advise the receiving nation of the ecological consequences of particular projects. The Council welcomes the steps AID has already taken in its project planning and review process to pay special attention to environmental factors, including research in areas where the necessary ecological information does not exist.

The Council recommends that the United States take initiatives, both in international discussions and as a participating member of various international development bodies, to gain acceptance of the principle that development programs must include environmental considerations in their planning and implementation.

Organizing Internationally

Building on the sound, already existing base of international cooperation, the United States may wish to consider proposing new institutional arrangements and greater specialization of existing international institutions to deal coherently and systematically with both immediate and long-range problems of the environment. For example,

mechanisms should be studied to draw upon the world's best talent and technological knowledge for such purposes as monitoring the oceans and atmosphere, and serving as an authoritative, impartial center to warn of impending dangers and recommend action. Similarly, regional specialized groups might focus expert attention on such urgent problems of the less developed countries as urbanization, health, and water supply. Whatever form new initiatives take, the United States should be prepared to offer imaginative and vigorous support.

XI

Citizen Participation

A CHORUS of concern for the environment is sweeping the country. Private citizens, civic organizations, and communities everywhere are organizing and speaking out. Their concern is not tied only to their own local issues. It reaches to regional, national, and international environmental problems. It embraces pollution of the earth's air and water, noise and waste and the threatened disappearance of whole species of plant and animal life. Yet the focal point of the citizen's concern is best seen in the environment he sees *deteriorating firsthand—his own community.*

Parks have been bisected by highways, marshes drained and paved for industrial development, streams run underground, and shade trees ripped out of the city to make way for noisy, multilane expressways. Until recently, the average citizen regretted the destruction of his environment but accepted it as the necessary price of "progress." Now he has begun to ask if this kind of progress is really desirable, whether it can be achieved differently, and whether it is really worth the sacrifice of natural areas and assets.

The citizen's interest in saving and improving the environment is far from new. But in the past year or so, its center of gravity has shifted to a total "environmental" concept more suitable to an urban society. Fishermen, hunters, naturalists, and professional outdoors-

men, joined by a handful of scientists, hikers, and birdwatchers were the first to work for environmental causes. These early conservationists developed the concept of wildlife sanctuaries. They convinced legislators to institute hunting and fishing licenses to help pay for wildlife protection. Often the early conservationists worked against great odds to protect scenic and wilderness resources from destruction. If it were not for them, Yellowstone's natural geysers, the Grand Canyon, the California redwoods, the Everglades, and many other irreplaceable natural treasures might well have been permanently damaged.

Today the environment is a key concern of a wide variety of citizens, and they bring a new set of attitudes with them. They often speak a different language from the longtime professional conservationists, although the two are allies. Many of the newcomers are urban; yet they understand the intricacies of natural processes. Many of the new "conservationists" are in their teens and twenties; yet they tend to see urban problems as at least as important environmentally as the preservation of natural areas and natural resources. Often they choose more direct, active ways to express their views than traditional conservationists.

Citizen participation in environmental protection is being championed at the highest levels of government. In May 1969, the President named Laurance S. Rockefeller Chairman of the 15-member Citizens Advisory Committee on Environmental Quality. The Committee's task is to advise the President of the citizen viewpoint and to recommend roles which citizen groups can play in the national environmental effort. The committee has issued a progress report with proposals for action on such diverse items as urban recreation, solid waste, environmental education, and Federal licensing power. It has prepared a comprehensive citizen's guide titled "Community Action for Environmental Quality," giving information on programs and suggestions for individual participation in community action.

The National Environmental Policy Act of 1969 notes the importance of the individual citizen's role in enhancing the quality of the environment. The Act says: "The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment" (title I, sec. 101(c)). Section 102(c) of the act makes available to the public the statements which all Federal agencies must submit detailing the impacts that their recommendations or proposals for legislation may have on the environment. Section 102(f) requires Federal agencies to make available to individuals advice and informa-

tion useful in restoring, maintaining, and enhancing the quality of the environment.

LOCAL ORGANIZATIONS

Local citizen groups usually form in the face of a specific threat to the local environment. Groups have banded together to fight pollution in Lake Erie, land filling in San Francisco Bay, smog in Los Angeles, and the damming of the flood plains and wetlands of the Neponset River in Boston Harbor. Citizen organizations have worked against offensive smoke stacks in Winston Salem, N.C., and Butte, Mont. Groups in Baltimore, Washington, and San Antonio have blocked or changed highway development plans. Others have succeeded in keeping a freeway from going through the historic Vieux Carré section of New Orleans.

The urban environment has received special attention. In the New York metropolitan area alone, nearly 200 organizations are mobilized to deal with the environment. One, the Open Space Institute, which grew out of the temporary Open Space Action Committee, seeks to save natural lands and waters within the New York region from further development or subdivision. In Los Angeles, the Watts Labor and Community Action Committee has developed an urban recreation program to help develop "pocket parks" and to conduct cleanup campaigns. Local chapters of national organizations have often helped attract citizen attention to local environmental concerns.

THE CONSERVATION COMMISSIONS OF THE NORTHEAST

The growth of local conservation commissions in the Northeast, particularly in New England, has strengthened the citizen's hand in environmental decisionmaking. This movement may point to more effective citizen participation in other areas of the country as well. The conservation commission is a mechanism of local government for promoting direct civic involvement in setting and achieving local environmental goals. A commission typically consists of five to nine citizen members appointed by the mayor, city council, or other governing body of the community.

The commission movement began in Massachusetts, where it fits easily into the active local governmental tradition of the New England town meeting. Since the passage in 1957 of the enabling act, 276 towns and cities of the Commonwealth, representing nearly 80 percent of all its towns and cities and two-thirds of its land areas, have started conservation commissions. Through State and Federal matching funds, Massachusetts communities are now able to acquire and protect valuable land. The 101 commissions in Connecticut, representing about 60 percent of the State's communities, cooperate with the public schools to build educational parks. About 70 percent of municipal governments in Rhode Island have conservation commissions. In Maine, despite problems with the initial enabling law, many coastal communities have established conservation commissions which citizens hope will save sections of the Maine coast from inappropriate industrial development and attendant pollution. In 1968, a year after passage of enabling legislation, more than 50 New Jersey communities had commissions at work; 75 are at work now; 100 are expected to exist before the end of 1970.

By mid-1970, variations on the Massachusetts model were operating in about 600 local jurisdictions in the seven coastal States from Maine to New Jersey.

REGIONAL AND STATEWIDE ACTIVITY: THE CONSERVATION COUNCILS

Local and regional citizen organizations have united into State and regional conservation councils, or "organizations of organizations." A central council gives the varied local member organizations a common meeting ground and also acts as a clearinghouse of information about action at the State level for constituent organizations.

More than 34 States have at least one conservation council. At least six States have two, and Michigan has four. The number of constituent member organizations within any one council usually ranges from 20 to 60, with three councils having over 100 member organizations.

The councils have set for themselves a variety of goals and functions. Some stress education and the dissemination of information to members and the general public. Others have developed legislative programs and plans for political action, and a few have hired lobbyists to present their point of view to State legislators. Some have sought tax

exempt status, but the majority have not, preferring to retain the potential of influencing environmental legislation.

Most of these councils rely heavily on services contributed by member organizations and volunteers, including local college students. Some councils have academic and technical consultants who provide engineering and scientific counsel and services. Income for most councils comes from membership dues. A small part of their income, perhaps 10 percent, comes from contributions and gifts. Membership organizations sometimes include business firms and associations and civic organizations. In some instances, charitable foundations provide financial backing for councils with the proper tax status.

A few regional citizen councils place more reliance on geographic than political boundaries. Their activity may center on a regional environmental problem, such as the pollution of a river which passes through several States, or on a particular natural phenomenon, such as the Grand Canyon or the highlands of West Virginia. The Potomac Basin Center, for instance, is concerned with the Potomac River, which is bounded by four States and the District of Columbia.

The strength of the regional council concept is illustrated by the Rocky Mountain Center on Environment (ROMCOE). This council focuses on the Rocky Mountains, which span eight States, a vast area with common climatic, economic, cultural, and historic characteristics. ROMCOE thus serves citizens with common environmental problems and interests.

NATIONAL ENVIRONMENTAL AND CONSERVATION ORGANIZATIONS

Over a dozen organizations with large memberships of citizens from all parts of the Nation exist to inform, guide, or represent their members in a wide variety of environmental and conservation matters. These include the National Wildlife Federation, the National Audubon Society, the Izaak Walton League of America, The National Recreation and Park Association, and Sierra Club, the National Parks Association, and the Wilderness Society. Another dozen or more with similar goals have memberships mostly of professionals in recreation or conservation fields. Other national organizations with broad interests—the League of Women Voters, the National Association of Counties, the Garden Club of America, the United

Auto Workers and the AFL-CIO—carry on substantial national environmental programs. Newer organizations, such as Friends of the Earth and Zero Population Growth, seek direct, active involvement in environmental controversies. Students are seeking a national voice in the environment through several action organizations.

Some national organizations have changed their traditional modes of operation and expanded their level of activity on environmental issues. They seek members who take active roles in local environmental controversies. Some organizations have separated their political and educational programs into two distinct but related entities for tax purposes—for instance, Friends of the Earth and the John Muir Institute; the League of Women Voters and the League of Women Voters Education Fund; and the Sierra Club and the Sierra Club Foundation.

The newer organizations, and several of the older ones, launch publicity campaigns to attract attention to environmental problems. The attention which Sierra Club books, exhibits, and newspaper advertisements attract has helped to more than double the club's membership in 2½ years—from 40,000 members in 1968 to nearly 100,000 today. The Sierra Club, which was founded in 1892 by John Muir, has evolved from a western outing club with few public environmental programs to an active organization that provides vigorous leadership in protecting natural places and processes, including recourse to the courts. Friends of the Earth, founded in 1969, a new organization attempting to influence legislation on a wide range of interests, also has brought several legal actions.

The Wilderness Society, in addition to providing national leadership, has concentrated on training local leaders, who then assume major local responsibility for identifying wilderness areas and organizing campaigns to set them aside and protect them through legislation. By training leaders, the Wilderness Society is able to decentralize its efforts and rely upon the large numbers of citizens across the country who are willing to give substantial amounts of time to help add to the extensive National Wilderness System contemplated by the Wilderness Act of 1964. Many other groups also rely on effective and active local chapters which assume a good deal of autonomy.

The Conservation Foundation, a non-profit research, education, and information organization, has brought together professionals and citizen leaders for conferences to explore such subjects as as environmental law and the ecological effects of foreign assistance programs.

The United Auto Workers have started a pilot air and water pollu-

tion prevention project in the "downriver" area of Wayne County, Mich., for families of Detroit factory workers. The AFL–CIO has joined in a number of efforts, including the "Citizen's Crusade for Clean Water," and has published a number of essays for union leadership on various environmental problems.

April 22, 1970, was Earth Day, nationwide. Organized by students, it was a day of lectures, meetings, teach-ins, and a variety of other events that drew an estimated 20 million citizens across the Nation. A staff of 25 students and hundreds of volunteers worked in Washington for 6 months to coordinate an Environmental Teach-in on Earth Day, which eventually involved an estimated 2,000 campuses, 10,000 high schools, and 2,000 communities nationwide. Colleges invited speakers representing government, industry, and educational institutions to discuss their responsibilities to the environment. In response to frequent exhortations to "work within the system," many activities were politically or institutionally oriented: one university group planned a full summer program examining congressional voting records on environmental issues; students in the Boston area collected 8,000 signatures on a petition supporting an environmental "bill of rights."

Environmental Action, a coordinating student organization, now continues activities that grew out of Earth Day. It publishes a biweekly newsletter, has issued a paperback book, "Earth Day: The Beginning," and has organized regional conferences so that Earth Day participants can evaluate the April 22 activities and plan future action.

The Department of the Interior's Task Force on Environmental Education and Youth Activities has helped establish a new national student organization—Student Council on Pollution and Environment (SCOPE). Through SCOPE's regional councils, student representatives make recommendations on policy, programs, and practices and act as an early warning system for environmental problems. Although only recently organized, SCOPE has already held two national meetings and convened several regional sessions.

Land Protection Through Private Purchases and Trusts

Private land trusts, regional groups, national conservation organizations and universities have for many years preserved areas of great scenic and natural value. The Nature Conservancy is the major private land-acquiring organization. It has about 20,000 citizen members and

has protected over 400 separate areas in more than 40 States—a total of just under 190,000 acres. The Conservancy's program is growing rapidly; it acquired 40,000 acres in 1969 and another 40,000 in the first half of 1970. Since its founding in 1950, the Conservancy has grown from a loosely knit, meagerly financed, nonprofit group to a large organization. It relies on the expert advice of scientists and outdoorsmen in purchasing land or setting up land trusts involving thousands of acres and millions of dollars. Many of the areas saved would have been lost to private development if the Nature Conservancy had not intervened.

The Conservancy still owns and manages about one-third of the areas it has saved. It makes these areas available for public enjoyment or scientific research consistent with the preservation of the natural resource. Land which the Conservancy acquires is often conveyed to institutions, agencies, and sometimes the Federal Government. The Conservancy carefully writes provisions into the contracts to insure that the areas conveyed can never be used for purposes other than preservation. "Reverter" clauses provide that the land be returned to the Conservancy if commercial development or other incompatible uses occur.

Ducks Unlimited, a non-profit organization of approximately 40,000 members, has helped to acquire and rehabilitate significant amounts of wetlands on the Canadian prairie breeding grounds—thus helping to improve conditions for our North American waterfowl.

Citizen Groups in the Courts

Environmental organizations have begun to try to protect the environment through the courts. Redress through the judicial system, a relatively new tactic for citizens trying to restore the environment, has been encouraged by a series of recent Federal court cases which have held that citizens' groups now have the right to appear in court to seek legal remedies. Major cases include challenges to the sale of DDT, to the oil pipeline now proposed for arctic Alaska, to timbering in wilderness areas in Colorado, Michigan, and West Virginia, and to a proposed power generation station and a proposed freeway along the Hudson River.

Citizen's actions are also being brought to preserve open space and wilderness, to challenge highway route locations, and to abate various pollutants, including auto exhausts, factory effluents, pesticides, and municipal sewage. Actions are also being brought to secure full public

hearings from administrative agencies or simply to get administrative agencies to move more rapidly and effectively and to keep the environment in mind in projected activities. In two recent cases involving DDT, citizens obtained court orders which required the Federal Government to act immediately to prohibit the sale of DDT or to give detailed reasons why the pesticide should remain on the market.

Suits initiated by citizens have begun to cite the National Environmental Policy Act of 1969, and its requirement for environmental impact statements, as noted earlier in this report (chapter II). The Act has already been cited in at least 16 cases and in 6 administrative hearings. In a Federal district court in Texas, a citizens' group cited the act to challenge successfully a Farmers Home Administration loan for the construction of a golf course in a nesting area of an endangered species of bird. In the Federal District Court for the District of Columbia, citizens successfully cited the Act in enjoining Federal permission to build a haul road across the Arctic tundra of Alaska in connection with the construction of an oil pipeline. Many other actions, not always by citizens' groups, rely on the protective language of the National Environment Policy Act.

Several public interest law firms specializing in environmental law recently have joined the limited number of private practitioners previously at work on environmental problems. Some large law firms donate part of their time and legal talents for work on environmental and urban problems. The Environmental Defense Fund and the Natural Resources Defense Council provide legal assistance when needed on behalf of environmental protection. Both the American Bar Association and the American Trial Lawyers Association have established committees to follow the growing interest of the bar in the development of environmental law. Environmental organizations have been formed at more than 50 law schools. And the Council on Environmental Quality has named a special advisory group of attorneys to advise it on legal issues.

Other Professional Responses

Besides lawyers, a number of other professionals find that their training is in demand by citizens' groups seeking expertise in solving complex environmental problems. Ecologists and other scientists from university faculties are in constant demand to advise or give expert testimony. Landscape architects and urban planners have design skills

that are now being used to do a better job of building in harmony with the environment. The American Institute of Architects has established design concept teams that utilize varied design skills for creative solutions to specific local problems.

National Environmental Coalitions

Occasionally national environmental organizations will join other interested citizens to form a temporary, nationwide coalition to take a position or an action on an important environmental issue. One coalition of diverse citizen groups and conservation organizations formed to protect the Florida Everglades from changes in its water level and from the construction of a jetport nearby. Another coalition mounted a successful effort against the Timber Supply Bill of 1970, which would have permitted more extensive logging in National Forests. Still another, the Citizen's Crusade for Clean Water urged Congress to appropriate a larger amount than first planned for the construction of sewage treatment facilities.

The Natural Resources Council of America has, since 1949, provided many of the functions of a permanent national conservation coalition. It has concentrated, however, on coordinating pending legislation and administrative programs and on assisting member organizations in finding reliable sources of scientific information about resources. The Council has provided a basis for improving mutual understanding among member organizations of each other's objectives.

The coalitions show the ability of civic organizations to launch successful environmental campaigns. They also show that the common interests of a wide variety of conservation, environmental, and other civic organizations are much greater than their differences.

XII

Environmental Education

WHEN IT BEGAN to dawn on people that the environment was worsening, that blight was creeping across our land, that the air was polluted and the waters running with waste, one of the first questioning glances was toward education. Our educational systems were caught off guard by the decline in environmental quality. They were no more ready to cope with the decay than any other part of society. Now in the face of the challenge the systems must be broadened to include new perceptions of environmental education.

What do we mean by "environmental education"? Nobody is certain. It has never been adequately defined. Education at least should help the student understand how the natural world works, not just its parts, but the relationships of one to another. He must appreciate not only man's dependence on and contribution to ecosystems, but the ways and degrees by which modern man alters them. As history cannot be adequately seen just as a series of acts, dates, battles, and names, but as the fabric of our past in relationship to our present, so environment cannot be seen but as a web of relationships.

This need not necessarily mean that ecology should replace any particular course of study or that education should be devoted entirely to ecology. But it does mean that there is a need for interdisciplinary education to cope with the interrelated nature of the environment. It is clear that man does not know enough about the environment around him and what he is doing to it.

He has been a sorcerer's apprentice. He has loosed forces he only partly understands and can only partly cope with. It is not enough that experts know—and even they know precious little—but it is mandatory that the people who must live in the environment learn more about the forces that now move in sometimes dangerous ways upon it. Environmental education therefore is a key to making this a livable world.

That means, at the minimum, a fuller understanding of how the natural world works and how man is changing it. A better idea of how our economic systems and political institutions influence the choices that set off chain reactions within our environment, and a shift in personal values to make us willing to pay the price of controlling pollution, will both be necessary.

The Council is not ready yet to suggest how these needs must be woven into America's educational system. The picture is beset with too many conflicting, but legitimate, positions. They should be thoroughly debated.

Environmental education is not only "conservation education." Nor is it only the sum of the antipollution concerns that have recently captured public imagination. An "environmentally literate" individual is one who understands that he is part of a system composed of people, culture, and his physical and natural surroundings. He knows that man's acts can change his relationships to this system. He appreciates the human ability in some degree to control, preserve, and destroy the environment. He accepts responsibility for the condition of his environment. But that does not mean that he knows what to do about it.

A mere scientific study of earth's life support systems is inadequate. Environmental decisions are also based on economic and political factors, social pressures, and cultural values. Many Americans live most of their lives in cities. So it is essential that environmental education be relevant to them. That means that it must stress social and behavioral sciences. It should deal with what the student's environment is and might be. More colleges must begin to weave environmental content into science, technology, law, government, and education courses. And for the long run, perhaps more important than any of these actions, pre-school, elementary, and secondary school students must be exposed to environmental learning. That exposure involves curriculum development, teacher training, and organizational reform of a type and on a scale that do not now exist.

EDUCATION THAT CANNOT WAIT

Intelligent environmental action, however, cannot await the emergence of a new generation whose environmental literacy is the product of education from kindergarten through 12th grade and beyond. Therefore, major attempts are underway to educate and motivate the present adult population, primarily through the mass media and community projects, focusing on local problems.

During the past year every broadcasting network and major newspaper and magazine has written on environmental problems. To assure a sustained educational effort through the media, the U.S. Office of Education, Department of Health, Education, and Welfare, awarded funds to the Corporation for Public Broadcasting to establish an Environment Center. The center will provide television programs and radio materials designed to increase public awareness of environmental problems. It will help prepare teachers for environmental education and train others for careers in environmental management industries.

Environment-oriented education projects are appearing in greater numbers in schools and communities throughout the country. The examples that follow illustrate the diversity of these programs but should not necessarily be considered models.

Oak Ridge Associated Universities (ORAU), in Tennessee, plans to develop several mobile environmental laboratories in 40-foot tractor-trailers manned by trained teacher-demonstrators. These laboratories will set up in supermarket parking lots and near museums and other public places throughout the Nation. Mobile environmental education classrooms—slightly smaller vans to circulate among schools—will operate continually out of ORAU throughout the school year. The mobile labs and classrooms will stress dramatic demonstrations of some of the more subtle problems of environmental contamination and what can be done to improve environmental quality.

Historically, private organizations such as the Sierra Club, the Izaak Walton League, the Conservation Foundation, the National Audubon Society, the American Forestry Association, the National Wildlife Federation, the National Recreation and Park Assocation, the Wilderness Society, and the Massachusetts Audubon Society have led in prodding public environmental awareness. Museums and parks have been regular staging grounds for special education programs. These and other groups should continue to be enlisted in the environmental education efforts of schools, colleges, and communities.

Higher Environmental Education

New forms of instruction have evolved in several colleges and universities to broaden understanding of the environment and human relationships to it. These have ranged from injecting environmental concepts into traditional subject areas to establishing whole institutions that are multidisciplinary or problem-solving in orientation and approach. Heavy emphasis also has been placed on learning through direct observation and participation.

Environmental law is a rapidly developing field of education from the high school level through the law schools and into the practicing law institutes. Some law schools are adding environmental law to their curriculums and are making it the subject of advanced seminars. Environmental litigation, new and proposed legislation, law review articles, and other materials on the subject are spurring bar associations to form environmental law committees and to hold institutes for their members. Environmental law courses which involve students in litigation are also of growing interest in adult education and citizen study and action groups.

New courses dealing with man and his environment are being established in colleges and universities throughout the country, and old courses are being remodeled to emphasize man's relation to the world in which he lives. Some of the courses bear familiar names—as Ecology 1 or Biology 101. But many carry more intriguing titles: Biology and Society, Social Responsibility of Scientists, History of Environmental Perception, and Social Impact of the Biological Sciences.

In 1969, the University of Wisconsin at Green Bay started a full academic program focused on ecology. In recognition that environmental education cuts across conventional boundaries of academic disciplines, the four colleges within the university complex are organized around themes rather than disciplines. The central themes are: environmental sciences, community sciences, human biology, and creative communication.

Innovation in the Schools

At the elementary and secondary levels, the trend is toward weaving new material into established courses and using the environment itself and community resources to teach youngsters what they need to know.

In South Carolina a State-sponsored, 6-year project has produced eight curriculum guides for teachers, grades 1–12, in science, social studies, home economics, and outdoor education. The guides consist

of over 400 lessons which any teacher can use to introduce, develop, and expand environmental concepts.

The National Park Service's National Environmental Education Development (NEED) program, partially funded by the National Park Foundation, tries to relate the individual child to his own environment through a simple set of five basic ecological principles. The NEED program has produced teacher guides and student materials for grades 3 to 8 and eventually will cover kindergarten through 12th grade. Each lesson involves development of a major ecological theme, the perception of how the principle works, and its meaning to the individual. Pivotal to the use of the NEED materials is the development by the National Park Service of National Environmental Study Areas (NESA). The NESA program is a nationwide, environmental education, joint endeavor with local communities. It uses NEED materials together with the regular school curricula to develop an awareness and understanding of the total environment, the student's relationship to it, and a sense of responsibility for it. NESA's may be natural, historical, or cultural. The majority of them eventually will probably be located within or close to urban areas. The NEED program emphasizes the idea that environment is everything and everywhere and that urban environs are proper places for its study. But the field trips which are a part of the NEED program give many city-bound school children their first taste of another environment as well.

New York City's Center for Urban Education has launched Planning for Change, a civic action program that involves upper elementary-grade children in environmental improvement projects. The Conservation and Environmental Science Center at Brown's Mills, N.J., is operated by a consortium of more than 60 school districts. Established with Elementary and Secondary Education Act, title III, funds from the U.S. Office of Education, it has developed curriculum guides and college-sponsored courses. It also aims to produce new material for environmental education in urban, suburban, rural, and marine settings. The center also conducts 1-day field study programs and week-long resident programs.

The Audubon Naturalist Society and the Logan Community School in the District of Columbia together developed a continuing program on environmental awareness and ecological concepts for fifth and sixth graders. That program takes a natural area to compare and contrast with the urban environment. The Philadelphia Parkway Program, a

year-round experimental high school project, uses the total city environment as the classroom and the life of the city as the curriculum. This model has recently been adopted by the city of Chicago. Washington, D.C., and San Francisco have developed similar projects, scheduled to begin this fall.

National conservation and environmental organizations conduct myriad educational efforts aimed at both the classroom and the public. The Conservation Foundation has produced educational films. And it publishes the monthly "CF Letter," a roundup of environmental issues. The National Wildlife Federation issues "Conservation News" and puts out educational materials under its "Ranger Rick" program. The National Audubon Society runs ecological workshops for school teachers. And in consort with the New York City Schools, it has launched a study series titled "A Place to Live" for fourth, fifth, and sixth grade students living in an urban environment.

Several national organizations keep close track of what the Federal Government is doing in the environmental area. The Natural Resources Council of America puts out "Legislative News Service" and "Executive News Service." The Sierra Club publishes a bulletin of current information on events in Washington.

Conferences and workshops are becoming commonplace. The National Recreation and Park Association is teaching park interpretation to park guides—from the point of view of public understanding and involvement. The Conservation Foundation has conducted, and the League of Women Voters Education Fund plans to conduct, air quality workshops to help local leaders assess air quality standards proposed in their States. These workshops have been cosponsored by a battery of civic, health, and religious organizations, many of them new to environmental forums.

Each of the national goals outlined in the National Environmental Policy Act has an educational component from which specific environmental educational policies can be derived. Eventually these national goals must be translated into regional, State, community, and local environmental education objectives.

The responsibility for environmental renewal and restored ecological balance is a task for the total society. If the goal of improved environmental quality is to be reached, the bulk of the population must improve its understanding of the ecological system and how man's actions affect it.

TRAINING ENVIRONMENTAL MANPOWER

Equipping the Nation for intelligent and effective environmental management will require specific skills. As we begin to solve the most immediate environmental problems, manpower training efforts must be vastly accelerated. Government and private groups in the next decade will spend billions of dollars for physical facilities. Plants, laboratories, and research stations dealing with the environment are now understaffed, and projections show that this personnel shortage will worsen. Technicians will be needed, in far greater numbers than are now being trained, to cope with problems of water supply, waste water treatment, solid waste management, and air pollution control.

Efforts are underway to train additional technicians, particularly the disadvantaged, with emphasis on moving them quickly into the job stream. There is need for new programs to train technicians who have fundamental technical skills and can easily adapt to constantly emerging job categories. It may be possible, for example, to modify, coordinate, or merge some of the present specialized technician programs into broader environmental technician programs. Community and junior colleges are especially suited to provide innovative training for environmental technicians.

The most urgent future environmental manpower need is for waste water treatment plant operators and technicians. The Federal Water Quality Administration (FWQA) estimates that jobs for 28,000 new waste water treatment plant operators and technicians will open up over the next 5 years. And 36,500 operators and technicians must be retrained to higher skills. FWQA-assisted projects trained 981 operators in 15 States and in Puerto Rico in 1969. Approximately 2,800 operators in 30 States will be trained during 1970. FWQA also is working with the Department of Defense to attract returning servicemen to the pollution control field through DOD's "Project Transition." A pilot program will train approximately 300 servicemen as treatment operators.

FWQA also manages a program of grants and fellowships for training professional and scientific manpower. Training grants in 1970 will support 693 trainees, most of whom are working toward master's degrees. Research fellowships are also awarded in work toward Ph. D. degrees. Approximately 100 students are supported each year in this way. Finally, FWQA provides special short-term courses—more than 50 courses—just last year, reaching some 1,300 persons.

To meet some of the most critical immediate manpower needs, the Department of Health, Education, and Welfare (HEW) and the Department of Labor are helping to set up special pre-admit community college programs and postsecondary technical school programs on the environment. Manpower Development and Training Act (MDTA) funds have been earmarked for these programs which will train disadvantaged youths for careers as environmental technicians. HEW's Office of Education has committed MDTA funds for workshops to help community colleges and local vocational and technical schools develop curriculum and projects for environmental manpower training. The Office of Education and the Department of Labor are recruiting disadvantaged, unemployed young adults and enrolling them in the special community college programs.

HEW's Environmental Health Service (EHS) is considering an environmental manpower planning system. Work on the proposal is underway now in concert with several other Federal agencies—the Environmental Control Administration and the National Air Pollution Control Administration, both of EHS; the Federal Water Quality Administration in the Department of the Interior; the Department of Housing and Urban Development; the National Science Foundation; and the Department of Transportation. The proposed system will lay a common framework for evaluating and stimulating efforts of the several agencies as they relate to State, local, and private sector planning.

EHS will develop a "Dictionary of Occupational Definitions" and a "Guide to the Development of Staffing Patterns and Manning Charts." Other steps are: development of national estimates of environmental manpower supply, vacancies, needs, and production; collection of data on staffing levels necessary to attain a determined level of environmental quality; and production of workable models for predicting manpower demand and supply.

Public Health Service agencies support a mix of environmental education programs in colleges and universities and conduct an array of technical short courses and seminars for community leaders. The programs aim to prepare specialists and generalists for prevention and control of environmental hazards and for research in environmental sciences.

The National Air Pollution Control Administration is developing manpower regionally. It envisions 12 centers in or near major metropolitan areas. At each site a university consortium will be developed

to improve the quality and quantity of training and research. The consortia will expand the involvement of the participating universities in air pollution control by deepening their interrelationships in cooperative research and curriculum development.

XIII

Present and Future Environmental Needs

THIS REPORT has looked closely at particular environmental problems. It has looked at what is being done now to combat them. And it has looked at what might be done in the days, months, and years ahead. The agenda for urgent action is long. Much has already been done, but much more must still be done with current management tools wielded by existing institutions. Moreover, the pace of change in programs underway promises, over the next few years, to brake even further what has seemed a headlong careening toward environmental decay.

The pressing need for tomorrow is to know much more than we do today. We lack scientific data about how natural forces work on our environment and how pollutants alter our natural world. We lack experience in innovating solutions. We lack tools to tell us whether our environment is improving or deteriorating. And most of all, we lack an agreed upon basic concept from which to look at environmental problems and then to solve them.

NEEDED—A CONCEPTUAL FRAMEWORK

A problem is said to exist when our view of what conditions are does not square with our view of what they should be. Problems, in short, are products of our values. People agree—for example, that a river should not be polluted. And when they see that it is, water pollution becomes a problem. But some of the values dealt with in this report are not unanimously agreed upon. The chapter on land use is critical of urban sprawl; yet many Americans choose to live in dwellings which abet such sprawl. This uncertainty about what values are relevant to environmental questions and how widely or strongly they are held throws up a major obstacle to conceiving environmental problems. How much value do Americans place on the natural environment as against the man-made environment of cities? How much do people value esthetics? Do they agree about what is esthetically desirable? These and a host of similar questions must be raised when trying to align priorities for coping with environmental decline.

Our ignorance of the interrelationship of separate pollution problems is a handicap in devising control strategies. Is pollution directly related to population or to land use or to resources? If so, how? Indeed, does it do any good to talk about pollution in general, or must we deal with a series of particular pollution problems—radiation, pesticides, solid waste? A systems approach is needed, but what kind of system? The pollution system, the materials and resources use system, the land use system, the water resources or atmospheric system? In this report the Council has suggested tentative answers to some of these questions. But much more thought is necessary before we can be confident that we have the intellectual tools necessary to delineate accurately the problems and long-range strategies for action.

Experience will help resolve some of the conceptual problems. We already know what problems are most pressing. Clearly we need stronger institutions and financing. We need to examine alternative approaches to pollution control. We need better monitoring and research. And we need to establish priorities and comprehensive policies.

NEEDED—STRONGER INSTITUTIONS

Most of the burden for dealing with environmental problems falls to governments at all levels. And the Nation's ability to strengthen these institutions is central to the struggle for environmental quality. To make them stronger, fundamental changes are necessary at Federal, State, and local levels of government. Chapter II of this report treats in detail the President's proposed improvements in the Federal Government for better environmental policy development and management. Although these changes will not be the final answer, they do lay the base for a comprehensive and coordinated Federal attack on environmental problems.

States play a key role in environmental management because of their geographic scope and broad legal powers. Many have reorganized to focus comprehensively on environmental problems. Many are helping municipalities build sewage treatment plants; some are planning statewide treatment authorities to construct and operate plants. And California has led the Nation in trying to curb automobile air pollution since the 1950's. In land use control many States are carving out larger responsibilities for land use decisions of regional scope.

In many respects local government, of all the levels, most needs institutional improvement. It has suffered from fragmentation, from skyrocketing demands and costs for public services, and from generally inelastic tax sources. The financial burden of environmental improvement staggers local governments. Most of the costs of water pollution control, both capital and operating expenses, come from their budgets. In some cities, efforts to deal with combined sewer overflows raise almost insuperable financial and technical hardships. Solid waste disposal is a major expense for most local governments, and the costs grow as disposal techniques are upgraded, as land grows scarcer, and as wages spiral. On top of its financial headaches, local government is caught in a tangled web of overlapping and conflicting jurisdictions that hamstring solutions to land use and air pollution.

Existing institutions must be made better and, in some cases, new institutions created to deal with the environment. Occasionally more

funds, personnel, and public support are all that is necessary. Other cases call for a more fundamental restructuring. This may mean extending geographic coverage and operational capabilities. Air and water pollution, for example, do not respect political boundaries, so institutions covering entire watersheds or airsheds may be necessary to cope with them. Important aspects of land use planning, review, and control may need to be shifted to regional or State levels as the only way to tie land use needs together over wide areas. And new forms of land use criteria may be necessary to reverse the current myopia of local government zoning.

Many environmental problems cross not only local, state, and regional boundaries, but international boundaries as well. Control of pollution of the seas and the atmosphere requires new forms of international cooperation—for monitoring, research, and regulation.

NEEDED—FINANCIAL REFORM

Financing for environmental quality is in need of dramatic overhaul. Liquid and solid waste collection and disposal by local governments represent an indispensible service—not unlike electricity and water. Yet rarely do the users of these services, industry and homeowners, bear the full costs of operation and amortization. Rather, financially beleaguered local governments subsidize these services. The current method of financing, therefore, is not only inequitable; it encourages a greater accumulation of waste by industries because they do not bear the full costs of disposal. It deprives local governments of needed funds to operate and maintain waste disposal facilities properly. In short, it contributes to the sorry performance of facilities in the United States in treating sewage and disposing of solid wastes. If future demands for environmental improvement are to be funded adequately, better methods of financing must be developed.

NEEDED—POLLUTION CONTROL CURBS

This report discusses many tools for curbing pollution. Most have been regulatory. For centuries authority to regulate has been wielded to a limited extent—more broadly by the middle of the 20th century.

But there is considerable debate whether regulation represents the best course of action. Economic incentives have won increasing support as a pollution control weapon. Charges or taxes on the volume of pollutants—say, 10 cents a pound on oxygen-demanding material—are another lever that might spur industry to reduce wastes. The charge system, some say, would not only be more economic but also more effective compared to the traditionally cumbersome enforcement process.

In this report the Council urges stricter and more systematic enforcement of air and water standards. That cannot be done, however, without better monitoring and data—as well as clear-cut, enforcement policies that will leave no doubt of responsibilities on the part of the private sector.

The Council believes that economic incentives offer promise, especially if backed up by regulatory power. It believes that they should be selectively demonstrated. And it believes that effluent or emission charges should be evaluated as a supplementary method of stimulating abatement measures.

NEEDED—MONITORING AND RESEARCH

Effective strategy for national environmental quality requires a foundation of information on the current status of the environment, on changes and trends in its condition, and on what these changes mean to man. Without such information, we can only react to environmental problems after they become serious enough for us to see. But we cannot develop a long-term strategy to prevent them, to anticipate them, and to deal with them before they become serious. For example, we became aware of the mercury problem only after it had become critical in some areas and had probably done environmental damage. Yet we still do not know the extent or significance of that damage. Our attack on the problem can now be but a cure or a cleanup. It has already happened. However, if we had possessed an adequate environmental early warning system, we would have been able to anticipate mercury pollution and take early action to stop it at its sources.

We do not know what low-level exposure to most pollutants does to man's health over the long term. Nor do we know how people react to changes in their environment. The challenge to the social sciences is to develop entirely new gauges to measure environmental stress.

What do crowding, urban noise, and automation do to man? These are critical questions. We do not understand enough about the interactions of different environmental forces such as urbanization, land use, and pollution. We do not even understand many of the natural processes that play critical roles in environmental well being—such as changes in world climate.

To obtain such information, a comprehensive program is required. It involves nationwide environmental monitoring, collection, analysis, and—finally—effective use of the information. In the case of some pollution, such monitoring should be international.

The first step is to identify the environmental parameters—things in the environment which are or should be measured. These range from substances such as DDT, sulfur dioxide, and lead to percentages of open space in the cities, visitor use of parks, and survival of species. Once identified, the parameters must be monitored—measured on a regular, repeated, continuing basis. In this way, baselines of the present status can be determined and changes from that base detected.

Environmental indices can be developed from these data. Indices are data aggregated to provide a picture of some aspect of environmental quality—for example, the quality of air as it affects human health. They are not unlike the cost of living index by which economists measure the status of the economy and by which housewives measure their budgets. Some environmental indices—and the parameters on which they are based—are easily identified and measured. For example, conditions that clearly affect human health in air or drinking water can be easily detected. Other indices and parameters are based on value judgments and are much more difficult to deal with. The quality of National Parks and scenic beauty are examples. To develop indices, the information from monitoring must be collected, translated into a usable form, and analyzed. Good indices do two important things. They inform the general public of the quality of the environment, and they inform the government and other decisionmakers who can take action. Good indices show the current environmental quality on a national or local scale and whether this condition is improving or degrading.

At present no nationwide environmental monitoring and information system exists. Federal, State, and local agencies now collect a variety of data. Many of these data, however, are obtained for limited program purposes or for scientific understanding. They are fragmentary and not comparable on a nationwide basis. Although it may be possible to use some of these in the comprehensive system which is

needed, at present they do not provide the type of information or coverage necessary to evaluate the condition of the Nation's environment or to chart changes in its quality and trace their causes.

Therefore, a major national objective must be to develop a comprehensive nationwide system of environmental monitoring, information, and analysis. The Council has initiated a study of the nature and requirements for the early development of such a system. However, even after we have developed a system, we must then have additional knowledge to enable us to understand and interpret the data we get. We are not yet in a position to understand the significance of the monitoring results to man and to natural systems. More research is needed on how the environmental systems operate and on the impact of man on the environment and its impact on him. Consequently, augmenting such research must take a high national priority.

NEEDED—A SYSTEM FOR PRIORITIES

It is difficult, given the current state of environmental knowledge, to set long-term priorities for the future. Relevant measures of environmental quality are often not available or, if available, are inadequate. These difficulties are compounded by great regional differences. For the present we can use our limited current data to identify pressing problems for immediate attention. In the future, the difficult task of deciding the Nation's environmental priorities, however, must be faced. Resources for combating environmental blight and decay are limited. Choices will have to be made on which problems have first claim on these resources. Four main criteria should determine this priority:

- The intrinsic importance of the problems—the harm caused by failing to solve them.
- The rate at which the problems are going to increase in magnitude and intensity over the next few years
- The irreversibility of the damage if immediate action is not taken
- The measure of the benefits to society compared to the cost of taking action.

The process of setting priorities is difficult. There is deep conflict over which problems are most important. And the inertia of on-going activities is a major obstacle. There are conflicts between the needs of

industry and the needs of the environment. And the public yearning for more conveniences clashes often with the best interests of the ecology. Nor will the priorities of the Federal Government always coincide with those of State and local governments. The Federal priorities will be broad and national. States and localities, however, will often give higher priority to other aspects of environmental quality. As long as these other levels of government at least meet national standards, the imposition of higher standards in some areas is welcome. Whatever the divergences, diligent application of priorities will be necessary to make any real progress toward a high quality environment.

NEEDED—COMPREHENSIVE POLICIES

As priorities are developed, policies must be devised to translate them into action. These policies may consist of a mix of activities aimed at a particular goal. Dealing with many environmental problems will require a battery of economic incentives, regulations, research, and assistance programs. In some areas, policies cannot be developed until more information is available. In other areas, they can and should be developed now.

For example, the need for a national energy policy is clear. As the demand for power increases rapidly, new power facilities have to be built. Power plants will pollute the air with oxides of sulfur and nitrogen, the water with heat, and the landscape with mammoth towers and obtrusive power lines.

This environmental harm cannot be wholly averted now, but it can be limited. For the short term, the design and siting of power generating facilities and transmission lines must be better planned and controlled. But for the longer run, a national energy policy should be developed. It would require a comprehensive analysis of energy resources and actual needs. It would provide for wise use of fuels, both conserving them for the future and lessening environmental damage. For example, wider use of nuclear fuel, natural gas, or low sulfur coal and oil would lower sulfur oxide levels in critical areas.

As national transportation policies are shaped, air pollution is one among several critical environmental factors that must be considered. Although air pollution can be abated by enforcing emission standards, control devices for individual vehicles and other technological solu-

tions may not be enough in the long run to keep air pollution from worsening as population and the number of automobiles continue to increase in the cities. One part of a transportation policy should be the continued examination of alternative means of curbing auto emissions, such as the development and use of systems combining the flexibility of the individual automobile with the speed of modern mass transportation.

Control over land use, a critical need of the seventies, is lodged for the most part in local governments. And often local solutions are piecemeal and haphazard. The local property tax favors the single-family residence on a large lot over types of housing less wasteful of land. Planning often fails to take into account the impact of development on the natural surroundings and often is not heeded by local governments. All these factors together lead to a series of local zoning decisions and regulatory action that perpetuate urban sprawl.

The State role in land use control has traditionally been small because most of the authority has been delegated to local governments. And direct Federal control over local land use is smaller still. However, the Federal Government can influence how land is used through planning and capital grants. Under existing programs the Federal Government, by its actions, could spur more modern land use methods. It could encourage cluster zoning and timed development. It could identify natural areas for preservation and encourage channeling of future growth in more rational patterns.

The problems of land use are complicated and diffuse. And the challenge is to center all the capabilities of all levels of government in a coordinated attack on them. The problems and the challenge together argue for a national land use policy.

Population growth and economic growth are potential wellsprings of environmental decay. They increase the demands upon limited natural resources. The U.S. population will continue to grow for the next few decades. But environmental quality is difficult to achieve if population growth continues. The President has appointed a commission on Population Growth and the American Future, headed by John D. Rockefeller III, which will explore the policy implications of future population growth.

The development of knowledge will doubtless indicate many new areas in which national policies are appropriate. And as these policies are developed, specific programs for implementation must then be formulated.

CONCLUSIONS

The year 1970 represents a pivotal year in our battle for a clean environment. The Nation is committing resources at all levels of government and in the private sector. Public support is at an all-time high. And the President's proposal for consolidation of anti-pollution programs, coupled with the Council's policy advisory and coordinating role, provide an opportunity to look at environmental quality in new ways.

This report emphasizes the need to move aggressively now to deal with problems that can be dealt with within existing knowledge and by existing institutions. For the long term, we need much more knowledge of values; the scope and nature of environmental problems; status and trends in the environment; the workings of natural processes; and the effects of pollutants on man, animals, vegetation, and materials. As we gain this knowledge, we will need to develop the institutions and financing mechanisms, the priorities, the policies, and finally, the programs for implementation. Without such a systematic approach, the current piecemeal, unrelated efforts will achieve only partial and unsatisfactory progress in meeting environmental problems of tomorrow.

This report emphasizes that changes in one part of the environment inevitably trigger changes in other parts. These complex interactions of environmental processes must be looked at as a whole. While keeping in mind the indivisibility of the environment and its intricate interrelationships, it is also necessary that some segments be treated separately when attacking environmental decay. Water pollution caused by a specific source may affect an entire ecosystem. But enforcement action must be taken against the particular source, not against the ecosystem. The major portion of this report has dealt separately with interrelated environmental problems, but only because of the inadequacy of our current framework for considering the environment and the need to focus attention on particular problem areas.

The National Environmental Policy Act of 1969 clearly stresses the necessity of approaching environmental problems as a totality. The act requires that Federal decision making incorporate environmental values along with technical and economic values; that both short- and long-term effects be given careful consideration; and that irreversible actions and commitments be carefully weighed.

National environmental goals must be developed and pursued in the realization that the human environment is global in nature, and that international cooperation must be a principal ingredient to effective environmental management.

All levels of government should function in two distinct ways: Within their geographic scope and needs, they must consider and plan for the environment as an interrelated system. But at the same time they must make specific decisions and take specific actions to remedy environmental problems. These two levels apply to action by individual citizens and private institutions as well. Our view of the environment and its value is changing and will continue to change. But these changes have effect only as they relate to specific choices by local communities, by particular industries, and by individuals. People in the end shape the environment. If a better environment is passed down to future generations, it will be because of the values and actions of people—all of us—today.

4.2b The Second Annual Report of the Council on Environmental Quality, August 1971, pp. 3–265

the past year—federal and international activity

If 1970 was, as the Council said in its First Annual Report, "the year of the environment," then 1971 may be known as the environmental year of action. As the Council's First Annual Report recognized, 1970 marked a beginning of unprecedented awareness of and concern with environmental quality in our Nation.

Since then, Federal, State, and local governments, international organizations, industry, and citizens all have moved vigorously to restore and protect the environment. Much was done in the last half of 1970. And so far in 1971 the tempo and scope of activity have quickened.

A key first step in all sectors of activity has been simply to organize for action. Without effective organization, a sustained and coherent approach to identifying problems, setting standards, and enforcing them is impossible. Without it, research and monitoring and the development and effective use of control technology are haphazard and the political processes are frustrated. Organization has been critical not only for government on all levels, but for industry and citizens as well.

As more effective organizations have begun to operate, the activities they were designed to facilitate have proceeded apace. Citizens have voted for environmental improvement—and have given their time to it. Regulatory agencies have accelerated the tempo of their activities. Industries increasingly have committed themselves financially to comply with pollution control stand-

ards. And international institutions have entered more forcefully into the arena of environmental action.

This chapter and the next two discuss in a necessarily selective fashion examples of what has been done in the past year. In some instances it is too soon to know whether this activity truly represents improvement. Indeed, in a field so vast and complex as environmental quality, there will be false starts. Some well-intentioned efforts will produce unanticipated and unwanted results. But rather than fail to act at all until every uncertainty is resolved—a time when action may be too late—the Nation has clearly demonstrated it intends to move forward now, with the best knowledge at its command.

federal government developments

Since our last report, the resources of the Federal Government have been significantly mobilized on behalf of environmental quality. The Federal organizational structure for dealing with environmental problems has been reshaped. Further reforms have been proposed. Federal environmental programs have been strengthened, and innovative legislation has been sent to the Congress. Federal agency awareness of environmental problems has been heightened significantly since the impact statement requirements of the National Environmental Policy Act [1] took effect.

reorganization

environmental protection agency—The Environmental Protection Agency (EPA) was officially born on December 2, 1970. It consolidated into one agency the major Federal programs dealing with air pollution, water pollution, solid waste disposal, pesticides regulation, and environmental radiation. The President named then-Assistant Attorney General, William D. Ruckelshaus, EPA's first Administrator.

The Agency has made a rapid start. It announced a series of water pollution enforcement actions within 3 weeks after its formation. In the following few months, it made major moves to implement the Clean Air Act and to cancel pesticide registrations for DDT, aldrin, dieldrin, and Mirex. Internally, EPA quickly organized itself to cope functionally with related environmental programs (see Figure 1), which was an important reason for its establishment. Three of the five Assistant Administrators have line responsibility for the major functional areas—planning and management, enforcement, and research and monitoring. A fourth Assistant Administrator supervises the air and water program offices. And the fifth supervises the pesticide, radiation, and

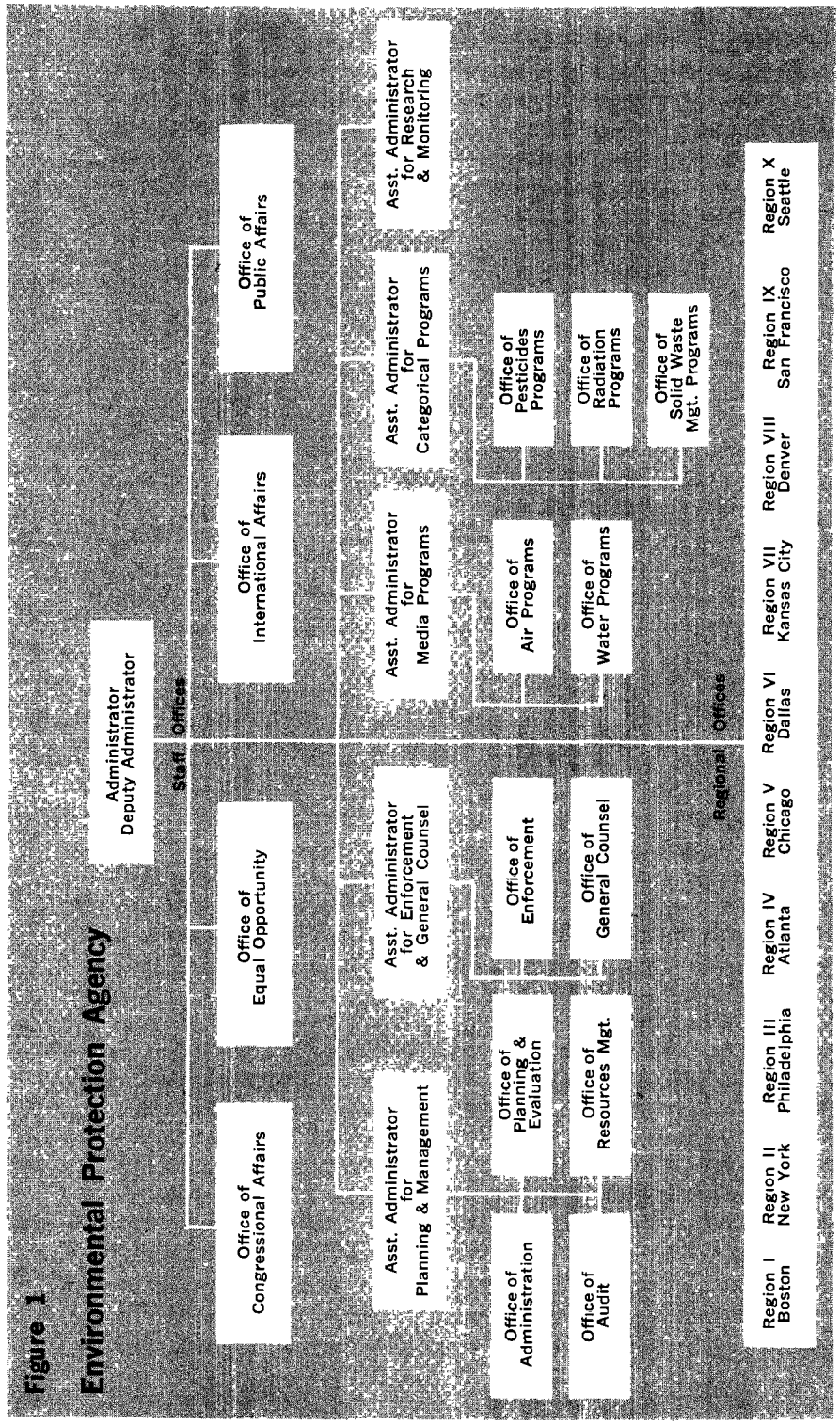


Figure 1
Environmental Protection Agency
Administrator
Deputy Administrator
Staff Offices
Office of Congressional Affairs
Office of Equal Opportunity
Office of International Affairs
Office of Public Affairs
Asst. Administrator for Planning & Management
Asst. Administrator for Enforcement & General Counsel
Asst. Administrator for Media Programs
Asst. Administrator for Categorical Programs
Asst. Administrator for Research & Monitoring
Office of Administration
Office of Planning & Evaluation
Office of Enforcement
Office of Air Programs
Office of Pesticides Programs
Office of Audit
Office of Resources Mgt.
Office of General Counsel
Office of Water Programs
Office of Radiation Programs
Office of Solid Waste Mgt. Programs
Regional Offices
Region I Boston
Region II New York
Region III Philadelphia
Region IV Atlanta
Region V Chicago
Region VI Dallas
Region VII Kansas City
Region VIII Denver
Region IX San Francisco
Region X Seattle

solid waste programs. EPA's 10 regional directors report directly to the Administrator.

Organization by itself, however, cannot make programs work. Because they also require adequate resources, the Administration has recommended a major increase in EPA funding and personnel. The fiscal year 1972 budget requests $2.45 billion for EPA—an almost 90 percent increase over the 1971 level—and a manpower hike of 1,655 authorized positions over the current 7,192. Two billion dollars of the proposed 1972 funds would be grants to communities for building waste treatment plants.

Although EPA and the Council on Environmental Quality work closely, there are significant differences between the two. The Council is a small, staff agency in the Executive Office of the President. Its responsibility is to provide policy advice to the President and to review and coordinate the environmental impact and environmental control activities of all Federal agencies. EPA is an operating line agency. Its responsibility is to administer and conduct Federal pollution control programs. While EPA's activities focus on pollution control, the Council's concern is with the whole spectrum of environmental matters, including parks and wilderness preservation, wildlife, natural resources, and land use.

national oceanic and atmospheric administration—The National Oceanic and Atmospheric Administration (NOAA) is the second major organizational innovation of 1970. This new agency, within the Department of Commerce, consolidates the major Federal oceanic and atmospheric research and monitoring programs. Both the Weather Bureau and the Coast and Geodetic Survey now operate within NOAA.

Dr. Robert M. White, former Director of the Environmental Science Services Administration in the Department of Commerce, is NOAA's first Administrator. The agency monitors the impact of pollutants on the marine environment; describes changes in the oceans, estuaries, and the atmosphere; and establishes ecological base line data and models.

department of natural resources—a proposal—EPA and NOAA significantly improve the Government's ability to deal with environmental problems. But the Federal ability to cope with natural resources problems—including energy, water, land management, and recreation resources—is still scattered among several agencies. To deal with that problem, the President's Advisory Council on Executive Organization recommended a Department of Natural Resources. On March 25, 1971, the President sent to the Congress legislation to create such a department.[2]

The Department would consist of five parts: land and recreation; water resources; energy and mineral resources; oceanic, atmospheric, and earth sciences; and Indian and territorial affairs (see Figure 2).

Figure 2
Proposed Department of Natural Resources
Secretary
Deputy Secretary
General Counsel
Under Secretary for Policy
Under Secretary for Management
Assistant Secretary for Research & Development
Administrator for Land and Recreation Resources
Manage Federal Lands Including Forests
Lease Federally Owned Minerals
Prepare Nationwide Recreation Plan
Manage National Parks Wildlife Refuges and Fish Hatcheries
Conduct Research and Development
Administrator for Water Resources
Develop Water Resources Survey, Plan, Construct and Operate Water Resource Projects
Market Electric Power
Administer Grants to States and Localities
Conduct and Support Research and Development
Administrator for Energy and Mineral Resources
Assess Resources
Operate Uranium Raw Materials and Enrichment Program
Conduct and Support Research and Development
Oversee Mine Health and Safety
Administrator for Oceanic, Atmospheric, and Earth Sciences
Observe, Record, and Analyze Atmospheric, Oceanic, and Terrestrial Data
Forecast Weather and Other Physical Phenomena
Conduct Surveys and Mapping Activities
Assist State and Localities Through Grants and Cooperative Programs
Conduct Research and Development
Administrator for Indian and Territorial Affairs
Conduct Programs for Betterment, and Protect the Rights of
—Indians
—Alaska Natives
—Territorial People
Manage and Develop Assets in Trust
Regional Directors

The Department would embrace most of the agencies now in the Department of the Interior; the Forest Service and the Soil Conservation Service from the Department of Agriculture; the civil works planning functions of the Army Corps of Engineers; the civilian power functions of the Atomic Energy Commission; and the National Oceanic and Atmospheric Administration from the Department of Commerce.

congressional organization—The Congress also is seeking to focus and coordinate its responsibilities for environmental programs. Both the House and the Senate passed joint resolutions to create a Joint Committee on the Environment.[3] An equal number of Senators and Representatives would sit on the Committee. It would not have legislative authority, but it would be empowered to study the impact of environmental and technological changes. And it would pursue methods for upgrading environmental quality. Its responsibilities would be analogous to those of the Joint Economic Committee. Differences in the House and Senate versions of the resolution may require a conference to negotiate a single version for final passage.

The Congress also reorganized and expanded existing committees to give more explicit attention to the environment. Two House and four Senate committees have added "environment" to their official titles, in most cases simply identifying more specifically their preexisting jurisdiction. In addition, three new environmental subcommittees were created: the Subcommittee on Environmental Science and Technology of the Senate Committee on Public Works; the Subcommittee on Environment of the House Committee on Interior and Insular Affairs; and the Subcommittee on Environment Problems Affecting Small Business of the House Select Committee on Small Business.

environmental programs

air quality—implementation of 1970 clean air amendments—The Federal air quality program changed dramatically when the Clean Air Amendments of 1970 became law.[4] They embody both recommendations contained in the President's 1970 Message on the Environment and proposals from the Congress. The Act requires EPA to establish national air quality standards as well as national standards for significant new pollution sources and for all facilities emitting hazardous substances. It also establishes a framework for the States to set emission standards for existing sources in order to achieve the national air quality standards. The State implementation plans are subject to Federal approval. If a State plan is unacceptable, the Federal Government is empowered to promulgate a plan of its own which will take precedence. The 1970 Act also provides more effective procedures for Federal enforcement.

The 1970 Amendments require stringent national emission standards for new automobiles—a 90 percent reduction from existing levels of hydrocarbons and carbon monoxide by 1975 and a 90 percent reduction of nitrogen oxides by 1976. EPA has issued emission regulations to implement these requirements.[4a] The Amendments authorize EPA to set emission standards for air pollution from airplanes, authorize citizen suits to enforce the provisions of the Act, and strengthen controls over pollution from Federal facilities.

EPA has set national air quality standards for particulate matter, sulfur oxides, carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen oxides.[5] By January 30, 1972, State plans to implement these standards must be submitted to EPA, which has mounted a major effort to help the States prepare the plans. Regulations prescribing the content of the plans have been published.[6]

The EPA Administrator has published an initial list of five categories of stationary sources of pollution for which performance standards, requiring use of the best adequately demonstrated control technology in new facilities, will be established.[7] The five categories are nitric acid plants, contact sulfuric acid plants, portland cement plants, large incinerators, and fossil fuel steam generators. Asbestos, mercury, and beryllium have been designated as hazardous air pollutants for which Federal emission standards, applicable to all sources, will be promulgated.[8] Additional sources and pollutants may be designated as additional information is developed.

Pursuant to the Clean Air Amendments of 1970, the President issued on June 30, 1971, Executive Order 11602, which provides for facilities involved in convictions under the Clean Air Act for noncompliance with standards to be barred from entering procurement or other contracts with the Federal Government and from receiving Federal financial aid (see Appendix I).

enforcement—While Federal enforcement of emission and performance standards under the 1970 Amendments must await final promulgation of the standards, EPA continues to exercise its limited enforcement authority under preexisting provisions of the Clean Air Act. One case which has received considerable public attention involves the Union Carbide Corp. plant in Marietta, Ohio. The plant has been the subject of an enforcement conference that began in 1967. In November 1970, Union Carbide was given until the end of the year to submit an acceptable timetable for complying with conference recommendations. However, EPA rejected the company's several plans. Union Carbide then stated that the proposed EPA timetable could be achieved only by closing part of the plant and laying off 625 workers. After further negotiations, the company determined that it could

comply without laying off any workers. A new compliance schedule agreed to by Union Carbide calls for the plant to cut its emissions 70 percent by April 1972.

proposed lead tax and sulfur charge—Measured by weight of pollutants emitted, the automobile continues to be the greatest single source of air pollution. The primary focus of past controls has been to reduce emissions by making changes in new automobiles. In the last 2 years, attention has turned to the gasoline used by cars—particularly to the lead added to gasoline to increase octane and eliminate "knock." Lead in gasoline is a potential health hazard when emitted into the air in automotive exhaust. In addition, it interferes with devices that will very likely be used to control other automotive pollutants in order to meet the stringent 1975–76 emission standards.

The Clean Air Amendments of 1970 contain authority requested by the President to regulate polluting constituents of automotive fuels such as lead. In addition, the President proposed a tax on the lead in gasoline to encourage motorists to buy low-lead or unleaded gasoline by making their prices competitive with that of leaded gasoline. Without the tax, leaded gasoline is cheaper to produce and hence is less costly to the consumer than unleaded gasoline of comparable octane rating. The tax would help to insure that low-lead or unleaded gasoline is available in sufficient quantities now for automobiles whose octane requirements permit its use and in larger quantities when automotive pollution control devices requiring such gasoline are available to meet the 1975 emission standards. Also, in October 1970, the President announced that Federal vehicles, whenever possible, will use low-lead or unleaded gasoline.

The proposed lead tax is an economic lever to force pollution control. An even bolder attempt to accomplish the same end is the President's 1971 proposal to impose a charge on sulfur oxides emissions. The clean air emission charge would be levied on sulfur emitted into the atmosphere from combustion or distillation of fossil fuels. The charge is intended to stimulate development and use of sulfur oxides control technology and fuel cleaning technology and to encourage use of low-sulfur fuels. The charge would complement, not replace, regulation of sulfur oxides emissions under the Clean Air Act. The Council on Environmental Quality and the Treasury Department together are preparing a detailed proposal for the Congress.

water quality—the refuse act: permits and enforcement—On December 23, 1970, the President announced a new program to control water pollution from industrial sources through the permit authority in the Refuse Act of 1899.[9] The Refuse Act outlaws discharges and deposits into navigable waters without a permit. The Secretary of the Army may issue a permit only when the Corps of Engineers determines that anchorage and navigation

will not be impaired. Knowing violation of the Refuse Act is a misdemeanor, subject to a $2,500 fine or 6 months' imprisonment. Violators also are subject to civil suits for injunctive relief.

The program initiated by the President makes a permit mandatory for all industrial discharges into navigable waters of the United States.[10] Violators of water quality standards—including standards imposed by EPA when Federal-State or State standards do not apply or are clearly deficient—are ineligible for permits and liable to enforcement proceedings. All dischargers were required to file basic information on their discharges by July 1, 1971, with an October 1, 1971, deadline for certain more detailed or difficult to obtain information.

To obtain a permit, an industrial discharger must disclose what effluent he intends to discharge and how much of it. Permits require periodic followup disclosures.[11] This is a key advantage of the permit system. It will provide a much more accurate index of the nature and extent of industrial pollution than we now have. In return, industry will obtain more explicit guidance on waste treatment requirements.

There has been no moratorium on use of the Refuse Act to enforce water quality standards while the permit program is being initiated. The Administration has announced that the filing of a permit application will not preclude an enforcement action against the applicant. Indeed, since the permit program was announced, enforcement activity under the Refuse Act has continued to increase.

During the first 11 months of fiscal year 1971, approximately 159 criminal actions were initiated under the Refuse Act, compared with 129 criminal actions in the entire fiscal year 1970. In contrast, an average of only 43 criminal prosecutions per year was initiated under the Act in fiscal years 1964–69. Most criminal actions during the past year have resulted in convictions and assessment of fines. In one case alone, a violator was fined $125,000; in another, $25,000.

More important, however, than the increased use of the Refuse Act for criminal prosecutions has been the use of civil suits under the Act to secure injunctions to halt discharges of harmful material. The first civil injunction action ever initiated under the Refuse Act was filed in 1970 against the Florida Light & Power Co. to abate the discharge of heated water into Biscayne Bay. During fiscal year 1971, more than 50 additional civil suits were filed to enjoin objectionable discharges.

Fourteen civil actions were concluded favorably by court-approved settlements in fiscal year 1971. In addition, interim stipulations were entered in 9 of the 10 cases brought under the Act against facilities discharging mercury. In the 10th case, the plant was shut down. The stipulations and plant shutdown resulted in a total reduction in mercury discharged from these

facilities from 139 pounds to 2 pounds daily. Final disposition of these cases awaits EPA's review of the defendants' plans for further reductions in mercury discharges.

Other civil suits have produced impressive results. The ITT Rayonier pulp processing plant in the State of Washington agreed to construct, at a cost of about $22 million, a waste treatment plant recommended by EPA. A General Motors automobile assembly plant in New York agreed to install large treatment tanks at a cost of over $2 million. In a number of cases involving relatively small manufacturing establishments, complete relief has been secured immediately.

The Refuse Act is an important mechanism for enforcing water quality standards because it permits swifter action against polluters than is possible under the enforcement provisions of the Federal Water Pollution Control Act (FWPCA) itself.[12] Because it prohibits discharges into navigable waters in the absence of a permit and gives the Secretary of the Army broad discretion in establishing permit conditions, the Refuse Act could remedy some deficiencies in the nature and scope of standards adopted pursuant to the FWPCA. For example, standards for nonmunicipal discharges could be extended to all navigable waters and could be stated in terms of precise effluent limitations tailored to meet ambient water quality requirements.

However, because the FWPCA is the most recent and explicit congressional action with respect to water quality, the Administration has asked the Congress to make major improvements in the Federal water quality program through that Act. In the meantime, the permit and enforcement program under the Refuse Act is being used primarily to enforce existing water quality standards.

other enforcement—The present FWPCA provides two limited and cumbersome enforcement mechanisms for pollution abatement by the Federal Government.[13] The first is a three-step procedure consisting of a conference of Federal, State, and interstate water quality agency representatives; a public hearing; and finally, court action.

The conference may be called at State or Federal initiative. However, there must be a State request if the pollution causes only intrastate effects unless the pollution causes economic injury to shellfish producers. The enforcement conference is a mechanism for bringing to light complex and longstanding pollution situations.

Two new enforcement conferences have been called since EPA was established. The first covered the interstate waters of Long Island Sound in Connecticut and New York, and the second covered the navigable waters of Galveston Bay and its tributaries in Texas.

EPA has reconvened five conferences, two of which received wide attention. The four-State Lake Michigan conference, first convened in 1968, focused on the need to protect Lake Michigan from waste heat discharges. The EPA Administrator recommended strict temperature standards for the Lake. After considering proposals of the State and Federal conferees, the Administrator issued a conference summary recommending closed cycle cooling systems for new waste heat discharges and deadlines for plants now in operation to install abatement facilities. In the Lake Superior enforcement conference, first convened in 1969, the remaining difficult issue is the discharge of taconite tailings into the Lake from a Reserve Mining Co. facility in Minnesota.

The second enforcement procedure under the FWPCA, also applicable primarily to interstate pollution, calls for notification both to the violator of water quality standards and to interested parties, followed by court action if necessary. Under the present law, 180 days must elapse after a notice of violation is issued before court action may be initiated. This gives violators the opportunity to comply voluntarily. EPA recently issued a violation notice to Reserve Mining Co. because of its failure to present an acceptable abatement plan to the Lake Superior enforcement conference.

One of the EPA Administrator's first official acts was to issue violation notices to three major cities—Atlanta, Cleveland, and Detroit. By the end of the 180-day period, EPA announced agreements with each of the three cities and with the States involved for joint Federal-State-local financing of the needed waste treatment facilities construction. Of the total estimated cost of $1.2 billion, more than $1 billion will go to reducing pollution of Lake Erie by Cleveland and Detroit.

The Outer Continental Shelf Lands Act [14] was invoked in 10 cases during the past year against major oil companies for their failure to implement required subsurface safety measures on oil wells in the Gulf of Mexico. The cases have been concluded with the collection of more than $2.3 million in criminal fines.

federal funding—The major part of Federal funds for water pollution control goes to municipalities to help finance construction of sewage treatment plants. For fiscal year 1971, the President proposed and the Congress appropriated $1 billion for waste treatment grants. EPA estimates that an additional $12 billion must be spent over the next 3 years for municipal waste treatment needs. To meet this need, the Administration has requested an authorization of $6 billion—$2 billion each for this and the following 2 fiscal years—to provide the needed Federal share of the $12 billion program.

proposed legislation—The President has asked the Congress to amend the FWPCA to provide needed reforms: effluent standards

tied to water quality requirements, mandatory use of best available treatment technology in new industrial facilities, and stringent Federal toxic discharge standards.[15] The Administration's proposed legislation would also extend Federal-State water quality standards, now applicable only to interstate waters, to almost all waters. Moreover, it would authorize legal actions by private citizens to enforce standards. The Administration's proposal would provide for broader Federal enforcement authority, streamlined enforcement procedures, and more stringent fines. The enforcement proposals are similar to provisions in the Clean Air Amendments of 1970.

The President also has proposed legislation to deal with the potentially serious problem of ocean dumping. The legislation would prohibit dumping any wastes originating in the United States into estuaries, the Great Lakes, coastal waters, or the oceans without an EPA permit. A permit would also be required for dumping wastes from any source into waters of the contiguous zone—or into waters within the jurisdiction of the United States. The EPA Administrator would be empowered to ban all ocean dumping of certain materials and to designate safe disposal sites for others. The legislation is based on a report that the Council on Environmental Quality submitted to the President in October.

Administration legislation also calls for establishing an Environmental Financing Authority to aid localities in funding bond issues for municipal waste treatment plants [17] and an increased State grant program to assist State agencies in improving their water quality programs.[18]

cleanup of federal facilities—Although air and water pollution caused by Federal facilities is still a problem, significant progress is being made. In fiscal year 1971, the Federal Government appropriated $113 million to eliminate such pollution, and the President has asked Congress for $250 million in fiscal year 1972. This compares to an average annual appropriation of only $52 million for the previous 3 years. The combined total of $363 million for fiscal years 1971 and 1972 alone contrasts strikingly with the $359 million estimate made in 1970 for the cost in fiscal years 1971, 1972, and 1973 of having remedial measures completed or underway at all Federal facilities by the end of 1972.

While progress is being made in cleaning up Federal facilities, some individual facilities are still major polluters. Many of these are on military installations. As in the case of industrial pollution control, management attitude is a critical ingredient in complying with environmental standards. Budget requests and appropriations alone do not guarantee success if agency management does not give high priority to the effort. The President's Executive Order on pollution from Federal facilities contains an im-

portant limitation on agency discretion: Funds appropriated for pollution abatement may not be used by agency heads for other purposes.[19]

pesticide control—The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) [20] requires that all pesticides shipped in interstate commerce be registered with EPA. EPA may cancel a registration when the label of the product, if complied with, is inadequate to prevent injury to "man and other vertebrate animals, vegetation, and useful invertebrate animals." [21] Suspension of a pesticide registration, which, unlike cancellation, stops interstate shipment immediately, can be initiated only when the product presents an "imminent hazard."

In January 1971, a Federal court of appeals decision [22] departed significantly from the prevailing interpretation of the registration cancellation provisions in FIFRA. The court declared that "Congress intended any substantial question of safety to trigger the issuance of cancellation notices" [23] so that interested parties can participate in hearings on the question of cancellation. Pursuant to the court's directive, EPA issued notices of cancellation of all registrations for pesticides containing DDT.[24] In March, EPA initiated cancellation proceedings on all registrations for aldrin, dieldrin, and Mirex. Because FIFRA provides a long and complex appeals process for parties adversely affected by cancellation orders, a final decision on DDT and the other pesticides may not be made until early in 1972. EPA has determined that none of the pesticides proposed for cancellation poses an "imminent hazard" warranting immediate suspension of their registrations.[25]

Comprehensive pesticide control legislation to replace FIFRA, the Federal Environmental Pesticide Control Act of 1971, has been proposed by the President.[26] The bill is designed to prevent misuse of pesticides by controlling their application, which FIFRA does not do. Under FIFRA, control over use is achieved only to the extent that users read, understand, and follow the instructions that must be placed on the labels of pesticide containers.

Under the Administration bill, a pesticide registered by EPA would be classified "for general use," "for restricted use," or "for use by permit only." Pesticides designated for restricted use could be used only by trained applicators. Pesticides designated for use by permit only would need approval of a trained consultant before application. Applicators and consultants would be licensed by the States, and the Federal Government would provide part of the funds to train them.

Other provisions of the bill include: authority to permit experimental registration of pesticides; streamlining the process of appeals from registration, cancellation, and suspension deci-

sions of EPA; and authority for the Administrator to stop the sale of a pesticide if it violates the Act. Registration and inspection of establishments manufacturing or processing pesticides would be mandatory. And the Administrator would be authorized to regulate pesticide storage and disposal.

solid wastes—In October 1970, the Resource Recovery Act of 1970 [27] became law. The Act puts an important new emphasis on recycling, a goal which the President articulated in his 1970 Message on the Environment. It authorizes funds for demonstration grants for recycling systems and for studies of methods to encourage resource recovery. It requires EPA to publish guidelines for construction and operation of solid waste systems. The guidelines will be binding on Federal agency operations and on federally funded demonstration projects. The Act authorizes grants and contracts for training solid waste disposal personnel. And it directs EPA to submit to the Congress a comprehensive plan for a national network of disposal sites for hazardous wastes. It also creates a National Commission on Materials Policy to conduct a broad study on materials availability, use, and disposal. The Commission will report to the Congress by June 30, 1973.

The Administration has been exploring ways to use Federal purchasing power to encourage recycling. The first major step in this direction was taken by the General Services Administration (GSA). GSA changed its procurement specifications to require that paper purchased by the Federal Government contain a specified minimum percentage of recycled material. The Council and EPA are examining with GSA and other Federal agencies other areas in which the Government can wield its purchasing power to encourage recycling.

EPA's Office of Solid Waste Management Programs launched "Mission 5,000" in July 1970. This is a drive to close 5,000 of the approximately 15,000 open dumps in the United States. EPA's goal is to replace them with better methods of disposal, such as sanitary landfills, by mid-1972. The program thus far has resulted in closing 1,000 dumps.

The Council on Environmental Quality is currently conducting a major study of solid waste recycling in cooperation with EPA and other Federal agencies. Primary emphasis is on present economic constraints against recycling and on incentives to encourage further recycling.

radiation—When EPA assumed the functions of the interagency Federal Radiation Council—and with it responsibility for setting generally applicable environmental radiation standards—a comprehensive review of existing radiation standards was underway. EPA, in cooperation with the Department of Health, Education, and Welfare, the Atomic Energy Commission (AEC), and other Federal agencies, has continued the review through a contract

with the National Academy of Sciences. The review is scheduled for completion in 1972.

Under the reorganization plan establishing the Environmental Protection Agency, EPA assumed Federal authority to set generally applicable environmental radiation standards. The AEC retains authority to implement and enforce EPA standards in the regulation of radioactive materials and nuclear facilities.[28]

In December 1970, the AEC adopted in its regulations design and operating requirements for nuclear power reactors to keep radioactivity in reactor effluents as low as practicable.[29] The Commission has since proposed numerical guides on design objectives and limiting conditions of operation to quantify the "low as practicable" requirement.[30] Conformance with the proposed guides would generally keep human exposure to radioactivity from nuclear power reactors to less than 5 percent of ordinary exposure from natural sources, such as cosmic rays and radioactive rocks, and to 1 percent or less of the overall limits on exposures from all sources, other than medical procedures and natural background, under present environmental standards.

toxic substances—The Administration has sent to the Congress a proposed Toxic Substances Control Act. [31] Based on a recently published CEQ study, the proposed legislation, would provide several major, new authorities to control the large and rapidly increasing number of harmful and potentially harmful chemicals and chemical substances that are commercially used and that eventually enter the environment. The EPA Administrator would be empowered to restrict or prohibit the use or distribution of a chemical substance if necessary to protect health or the environment. If the Administrator found that a substance created an imminent hazard, he could ask the courts to restrain its use or distribution immediately. The Administrator would be authorized to issue standards for tests to be performed—and for results to be achieved from such tests—for various classes and uses of new substances. And he could request information from manufacturers concerning potentially toxic substances including their chemical composition, production level, uses, and the results of tests of their effects.

The need for such legislation was dramatized by several incidents involving toxic substances during the past year. The mercury problem might have been recognized much earlier had the Toxic Substances Control Act been law. In December, at the urging of the Surgeon General and EPA, the detergent industry voluntarily agreed to stop use of NTA (nitrilotriacetic acid) in detergents, pending the outcome of further tests on its health effects. The Federal Government presently has very limited legal authority to halt the use of hazardous materials, even in such widely used products as detergents. The proposed Toxic Substances Control Act would greatly expand that authority.

One limitation in determining the effects of potentially toxic substances has been inadequate facilities for tests to determine the effects of long-term exposures to low levels of such substances. An important step has been taken to relieve this situation. Part of the Pine Bluff Arsenal in Arkansas, previously a facility for development of biochemical warfare materials, has been converted into a National Toxicology Center for testing potentially toxic substances. The Center, a joint Food and Drug Administration-EPA facility, will test low doses of a substance on a large number of animals, determining effects undetectable from tests conducted on a smaller number of animals.

federal environmental research—Research and development is an essential part of most environmental programs. It provides information needed both to understand environmental problems and to solve them. During the past year, the trend toward increased Federal research and development activity continued. A recently completed study by the Federal Council for Science and Technology shows that Federal budget outlays for environmental quality research and development climbed from $542 million in fiscal year 1969 to $606 million in fiscal year 1970 and to $719 million in fiscal year 1971. These figures are based on a somewhat restricted definition of research and development and thus are smaller than the comparable figures compiled by the Office of Management and Budget (see Appendix K).

Environmental research and development is generally devoted to three areas: the effects of environmental insults, ecological relationships and natural processes, and pollution control technology. Sometimes research covers more than one of these areas. For example, EPA plans a project for St. Louis, Mo., where the total air pollution problem of a single city would be studied in depth. An integrated effort involving Federal and State agencies, universities, and other groups would explore the chemical, meteorological, and biological ramifications of air quality.

With respect to the effects of environmental insults, primary attention has been devoted to determine the adverse health effects of pollutants. Health effects research usually involves testing particular substances or combinations of substances on laboratory animals. Often it also involves epidemiological studies which examine the occurrence of certain effects in human populations and attempt to correlate the distribution of these occurrences with the prevalence and concentration of particular pollutants. A report on the health effects of environmental pollution has been prepared by EPA and the Department of Health, Education, and Welfare and will be sent to the Congress shortly.

Our understanding of natural processes in the atmosphere, oceans, and elsewhere has advanced remarkably over the past few years. Mathematical models have been developed for predict-

ing a variety of phenomena, including the distribution of pollutants both in the atmosphere and in rivers. During the past year, increased attention has been devoted to the use of earth satellites for monitoring and predicting environmental changes.

Research on methods of controlling pollution range from investigations on sterilizing insect pests—in order to facilitate reductions in the use of chemical pesticides—to development of a nonpolluting automobile. In many cases, research may have both economic and environmental implications. Thus, the President's Energy Message of June 4, 1971, announced an accelerated program for developing methods to convert coal into a gaseous form which, if economically feasible, would provide both an expanded economic use for the Nation's most abundant fossil fuel and great promise for reducing air pollution from sulfur oxides emissions.

As human activities more rapidly change the whole face of the earth, awareness of the pervasiveness and magnitude of these changes has created a recognition of the need to save at least samples of the full range of natural environments. These sample areas can serve as base lines against which man-caused changes can be compared. For example, they can provide information on the background levels of various potentially toxic substances, such a mercury, against which the levels and effects of these substances in areas heavily impacted by man can be judged. They can provide natural laboratories which, in some cases, are the only places where studies can be carried out to understand the operation of certain ecosystems.

In recognition of the importance of preserving a variety of natural areas, a Federal program for Research Natural Areas has been established. The aim of the program is to be certain that the Federal land managing agencies, in cooperation with the States, universities, and other private and public institutions, preserve examples of all of the many and diverse natural environments in the United States. The Council's First Annual Report noted that 336 Research Natural Areas had been classified and established. This number has been increased to nearly 600, and a unified policy for acquisition, management, and use of these areas is being developed to assure that the areas will be treated consistently by the various agencies concerned. Federal lands, of course, do not cover all the major ecosystems. Consequently, in association with the Federal effort, a program to identify and inventory the Research Natural Areas on State and private lands is going forward under the direction of the U.S. International Biological Program.

land use—toward a national land use policy—Land use decisions are an important determinant of environmental quality. Although planning and control of land use are largely the responsibility of local goverments, the impacts of these activities

often reach statewide, regionwide, or nationwide. Purely local regulation often frustrates environmental quality objectives.

To encourage State control of land use issues transcending local importance, the President has proposed a National Land Use Policy bill.[32] It would provide $100 million over 5 years to aid States in assuming land use regulatory authority over areas of critical environmental concern—wetlands and flood plains, lands around key facilities such as major airports and highway interchanges, large-scale development, lands surrounding new communities, and land and development of regional benefit. Chapter 2 describes recent State actions to assume more control over important land use issues.

The Secretary of the Interior has proposed legislation to the Congress to establish a land use policy and management program for the 450 million acres of the public domain. The guiding principle of this policy would be to protect the quality of the environment of these lands, to require restoration of the land as a condition of use, to give first priority to the protection of environmentally "critical areas," and to keep these lands in Federal ownership for perpetuity, permitting disposal only in very limited circumstances under specific statutory criteria.

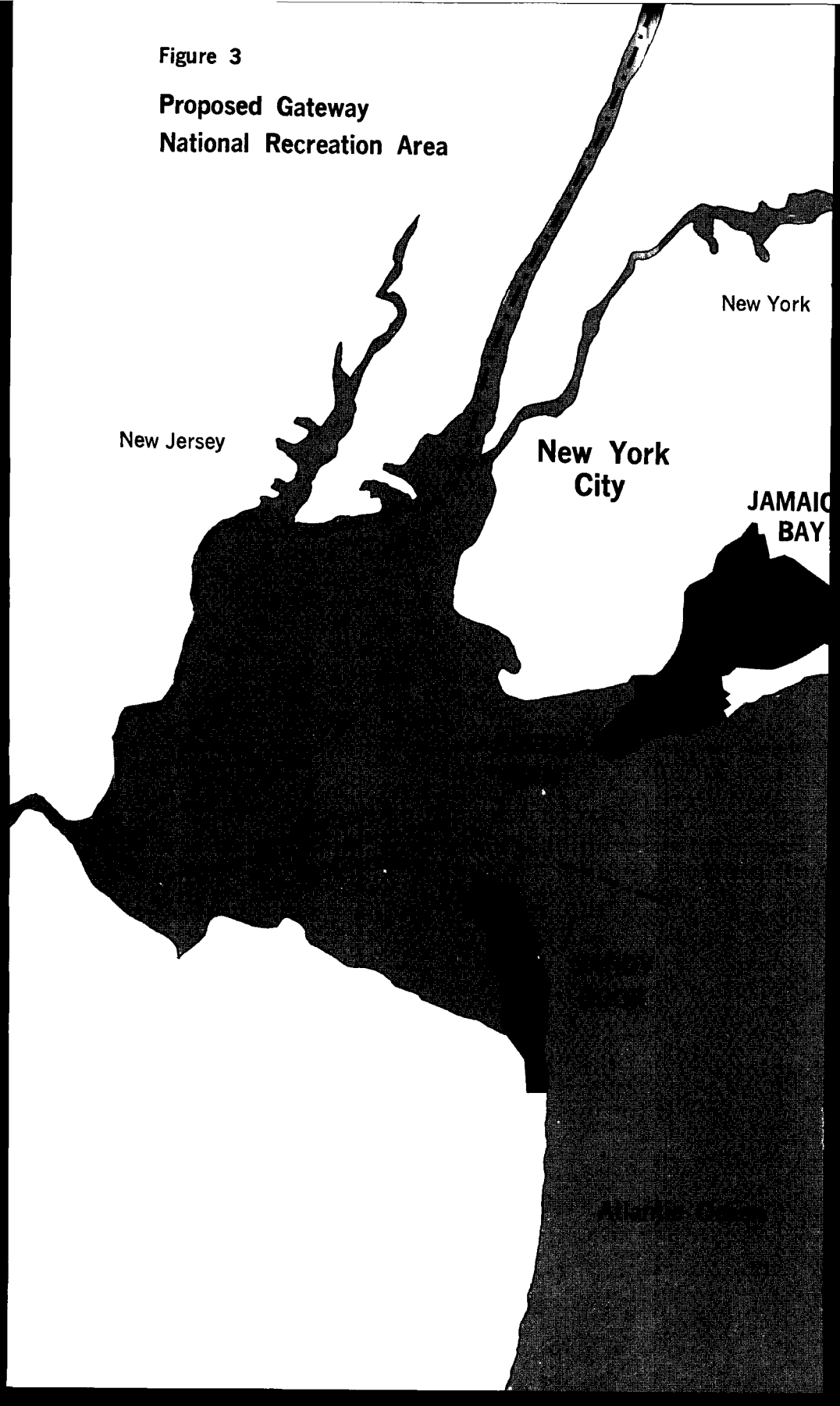
parks and wilderness areas—The Federal Government has taken several actions to add to the amount of land used for parks—particularly in or near urban areas, where the need is great but the supply is short. Under his "Legacy of Parks" program, the President requested a 1972 appropriation of $200 million for the Department of Housing and Urban Development (HUD) Open Space Lands Program. That is nearly three times the 1971 funding level. The HUD Program will give special emphasis to developing vacant or abandoned properties in the inner city. Its highest priority will go to projects in low-income areas.

The President's budget request for the Department of the Interior Land and Water Conservation Fund is for the full $380 million authorized by the Congress. Proposed legislative amendments would channel a greater share of money from the Fund into populous States. The Fund is used both to finance Federal park and other land purchases and to aid State and local governments in acquiring and developing recreation areas.

To further the "Legacy of Parks" program, the President submitted to the Congress, in May 1971, a bill to establish a Gateway National Recreation Area in the States of New York and New Jersey.[33] The area would be a federally managed national recreation area made up of three units—Jamaica Bay and Breezy Point in New York and Sandy Hook in New Jersey. Together, they contain about 7,000 acres of land and 16,000 acres of important marsh and submerged land. The proposal would open to New York City metropolitan area's more than 14 million people a 9,000-acre wildlife preserve, a 460-acre park, and the Nation's

Figure 3

Proposed Gateway National Recreation Area



oldest operating lighthouse, as well as an ocean beach, sand dunes, and a bay for game fishing. A ferry shuttle system linked to existing mass transit lines would provide access for millions of persons who do not own automobiles and otherwise would not be able to reach the area.

During the past year, the President asked the Congress to add 14 areas, totaling 1.8 million acres, to the country's Wilderness System, with new emphasis on the Eastern States.[34] He also resubmitted to the Congress proposals for 13 other wilderness projects covering 1.3 million acres.[35] Efforts are now underway to catch up on the significant backlog of wilderness designations.

In addition, a number of Federal properties were declared surplus by the President's Property Review Board. Among them are properties in Nassau County, N.Y.; Fort Worth and Duncanville, Tex.; Bremerton, Wash.; Parma, Ohio; Cheyenne, Wyo.; and Redondo Beach and Alameda County, Calif. This declaration permits their transfer to States and localities for parks and recreation. The President has pledged to release additional underused Federal properties, particularly in urban areas, to State and local governments for recreation purposes. The Property Review Board, established last year, has already identified 60 Federal properties with high potential for park use.

siting powerplants and protecting mined lands—Other land use problems addressed in the President's environmental program include powerplant siting and strip and underground mining. The proposed Power Plant Siting Act of 1971 [36] would require long-range planning by all electric utilities. Continuous 10-year projections of power needs and additional facilities required for power generation and transmission would be mandatory. Advance review of tentative plant sites would be held 5 years prior to beginning construction. The reviewing agency could reject any such sites as environmentally undesirable. Finally, a preconstruction review would require each utility to apply for certification of a bulk powerplant or major transmission line two years before it is built. The Act would provide a sound framework for protecting environmental values while guaranteeing an adequate supply of electric power.

The proposed Mined Area Protection Act [37] would insure adequate State regulation of surface and underground mining. The Secretary of the Interior would issue guidelines, and the States would be given 2 years to develop and enact mining regulation laws consistent with the guidelines. If a State failed to do this or if a State failed to enforce its own approved laws, the Secretary could establish and enforce Federal regulations.

land controversies—Land use problems surfaced in two major controversies in the past year. Construction by a private consortium of an oil pipeline across Alaska was delayed by the De-

partment of the Interior, which withheld a right-of-way permit across Federal lands, pending detailed examination of the environmental effects of the pipeline. The pipeline proposal raised a number of questions about effects on the Arctic tundra and on wildlife in Alaska and about damage from pipeline leaks or from vessel spills when the oil is en route to refineries. A final environmental impact statement on the pipeline is expected from the Department of the Interior this summer.

The second controversy involved the construction of a barge canal across northern Florida. Although construction by the Corps of Engineers was about one-third completed, the President ordered that the project be stopped because it threatened to destroy the unique scenic area, a major wildlife habitat, and a large sport fish population. Other adverse effects, such as pest infestation and water pollution, were also feared. The Council is working with the Corps of Engineers to develop measures for restoring the already affected area.

preserving historic buildings—In Executive Order 11593, the President directed all Federal agencies to evaluate their properties to determine which possess historic, archeological, or architectural significance (see Appendix H). He directed agency heads to develop procedures to assure that federally owned historic properties are preserved and maintained under standards prescribed by the Secretary of the Interior.

The Executive Order was issued pursuant to authority of the National Environmental Policy Act [38] and the Historic Preservation Act.[39] The Historic Preservation Act established a National Register of Historic Places, in which properties of historic, archeological, or architectural significance are recorded. The Act provides that prior to any proposed Federal action affecting a recorded property, the Federal agency concerned must refer the matter to the Advisory Council on Historic Preservation, a body made up of Federal agency representatives and of private citizens appointed by the President. The Advisory Council renders opinions on the desirability of such proposals and often recommends modifications to Federal projects to protect historic sites.

Properties are listed in the National Register on the basis of State nominations. Since 1968, listings in the Register have increased dramatically, with the current rate of increase at approximately 100 sites or districts per month. The Federal Government controls an estimated 2,000 historic sites not yet recorded on the Register, many of which are located at old military and naval installations. Until July 1973, when evaluation of these properties is completed, properties that appear to possess historic characteristics will be treated as though they were on the National Register, and any action to alter, transfer, or dispose of such properties will be referred to the Advisory Council on Historic Preservation.

Executive Order 11593 is part of a broader program to preserve historic properties. Legislative proposals submitted by the President include a measure designed to facilitate preservation of historic properties transferred to State and local governments at no cost by the Federal Government.[40] This measure provides that State or local governments agreeing to preserve historic properties transferred to them by the Federal Government may permit the properties to be used commercially, thereby enhancing their economic viability and offsetting their restoration expenses. Additional Presidential proposals would provide Federal insurance for the improvement of privately owned historic properties and tax incentives for their rehabilitation.[41]

congressional action—Congress turned its attention to environmental issues as never before this year—a significant indication of the intensity of general public concern with these issues. Of the 695 bills signed into law during the 91st Congress, 121 were identified as "environment oriented" by the Congressional Research Service of the Libary of Congress. This number includes 11 appropriations bills and bills relating primarily to other subjects, such as agriculture, disaster relief, and economic development. It includes 37 parks and recreation bills and 23 water resource development bills. There were only two bills each in the categories of air pollution, water pollution, solid wastes, population, and land use planning. But the importance of measures such as the Clean Air Amendments of 1970,[42] the Resource Recovery Act,[43] and the Water Quality Improvement Act,[44] all enacted in 1970, illustrate the danger of attaching undue significance to the quantity of legislation.

in the senate—Thus far in the 92d Congress, attention to environmental matters has remained high. As of July 25, 1971, the Senate had passed three environmental bills—appropriating money for water resources planning,[45] limiting public exposure to sonic booms,[46] and requiring radiotelephone bridge-to-bridge communication between certain vessels in inland waters to reduce collisions and mishaps.[47] It had also passed two joint resolutions—one to establish a Joint (congressional) Committee on the Environment [48] and one to authorize additional appropriations for the Department of Housing and Urban Development for open space acquisition grants.[49] Hearings were held on environmental bills covering subjects ranging from pesticides and hazardous chemicals to legal actions by citizens, land use policy, ocean dumping, and water quality.

in the house—During the same period, the House of Representatives passed six environmental measures. They include bills concerned with environmental data,[50] a National Advisory Committee on the Oceans and Atmosphere,[51] penalties for shooting certain birds,[52] bridge-to-bridge communication between vessels

in inland waters,[53] and funds for water resources planning.[54] The House also passed a joint resolution to establish a Joint (congressional) Committee on the Environment.[55] Hearings were held on a number of bills. In addition to the subjects covered in Senate hearings, the House hearings considered subjects such as drinking water supplies and powerplant siting.

factfinding—In addition to its hearings on proposed laws, the Congress has held a number of factfinding hearings to review executive branch activities. These hearings have dealt with subjects such as implementation of section 102 of the National Environmental Policy Act by Federal agencies, the economic impact of pollution control, initiation of a permit program for water pollution control under the Refuse Act, stream channelization, eagle deaths in Wyoming, clearcutting of timber on Federal lands, and coal-fired powerplants in the Southwest.

environmental impact statements: a new ingredient in federal decisionmaking—Section 102(2)(C) of the National Environmental Policy Act (NEPA) [56]—the Act which created the Council—requires that any agency of the Federal Government proposing legislation or planning to undertake an action "significantly affecting the quality of the human environment" file an impact statement with the Council. The statements describe the legislation or action, its impact, and the alternatives considered. Before filing, the statements must be circulated by that agency to the public and to appropriate Federal, State, and local environmental agencies. Comments received on the draft statement become a part of the public record along with the final statement, which should reflect the comments. Section 309 of the Clean Air Act [57] gives the Administrator of EPA independent responsibility for reviewing and commenting on the environmental impact of proposed Federal activities or legislation relating to his authorities. This provision overlaps but expands the Administrator's responsibilities under NEPA for commenting on Federal proposals.

As of June 30, 1971, draft or final environmental impact statements on 1,380 actions had been received by the Council. The number of statements has increased rapidly, although a disproportionately large number has involved highway projects, some of which involve relatively minor impacts. The Council believes, nevertheless, that many Federal actions which significantly affect the environment are not being reported in environmental statements. Some major Federal departments have filed fewer than five statements during the past 18 months.

NEPA and its environmental impact analysis requirement are influencing the Government decisionmaking process. The Department of Transportation, the Army Corps of Engineers, the Department of the Interior, the Federal Power Commission, the Atomic Energy Commission, and the Department of Defense are

among the agencies most heavily affected by the Act's requirements. Over 20 agencies have established internal procedures for preparing impact statements. Some agencies for the first time have explicitly incorporated environmental considerations into their decisions. A recent example is the Interstate Commerce Commission. It has recognized that it should conduct environmental impact analyses before making freight rate and carrier certification decisions that can either promote or stifle recycling of "secondary" or waste materials.[58] The Securities and Exchange Commission is requiring that information on pollution violations be made part of stock offerings to the public.

Federal agencies have taken, modified, and avoided actions on the basis of the NEPA environmental analysis. For example, the Corps of Engineers refused to grant some dredge and fill permits in order to protect ecological and esthetic values. The Corps also has suspended some water resource projects pending congressional consideration of the environmental impacts. The Coast Guard has denied several bridge construction permits to avoid adverse environmental consequences. The Forest Service switched from clearcutting to selective cutting in a National Forest, the Department of Transportation reconsidered several proposed Interstate Highway routes, and the Department of Defense amended plans for munitions disposal.

The impact of NEPA and of the section 102 requirement has been reenforced by court decisions, some of which are discussed in Chapter 5.

Yet much more remains to be done to insure that all agencies fully and objectively consider the environment in their actions—not just in connection with specific projects but also in relation to basic policies and program structures. Lack of environmentally trained personnel and the difficulty of changing established decisionmaking patterns are still problems. Too often, the environmental statement is written to justify decisions already made, rather than to provide a mechanism for critical review. Consideration of alternatives often is inadequate. And the ultimate agency alternative—taking no action at all because of the environment—has rarely been considered. Some agencies or their components define their mission in a narrow sense, which excludes adequate consideration of environmental protection. NEPA was intended to elevate environmental considerations to full partnership with technological and economic factors in Governmet decisionmaking. But it still is not working entirely that way.

Questions have surfaced concerning issues such as the extent to which actions authorized and underway prior to enactment of the Act should be subject to environmental statements. Some agencies have been troubled by the potential of a detailed process of public analysis and review to delay Federal actions and to burden Federal officials with increased paperwork.

The Council has helped resolve some of these problems—in its interim guidelines of April 30, 1970,[59] and later in its guidelines of April 23, 1971 (see Appendix G). However, it has not been possible to anticipate all the specific problems which various Federal activities will raise. The responsibility for detailing the way in which each agency will comply with the Act ultimately rests with the agency itself.

In assessing the experience with the impact statements, it is important to recognize the unique and unprecedented nature of the requirement. Federal agencies accustomed to a role of advocacy on behalf of their activities are now required by law to engage in public self-criticism. They must detail adverse impacts and candidly assess alternatives. In fact, many of the less satisfying statements have been prepared by agencies overcautious about minor actions. Some agencies, strongly criticized during the early months under the Act, have since developed improved procedures.

council on environmental quality—During its first full year, the Council has undertaken a wide variety of activities. Some have resulted in a visible product, such as proposed legislation or a published report. But much of the Council's time and effort are devoted to coordinating Federal activities and providing policy advice to the President.

CEQ was responsible for shaping the President's 1971 environmental legislative program, with assistance from many agencies. This program, which the President submitted to the Congress in February, contained 18 major proposals covering almost the entire spectrum of environmental concerns. Many of these proposals have been described in this chapter. The Council also played a key role in developing the Refuse Act permit program.

Two Council reports were published during the year: *Ocean Dumping—A National Policy*, which resulted in the proposed Marine Protection Act of 1971, and *Toxic Substances*, which was based on the staff work done by the Council in preparing the proposed Toxic Substances Control Act of 1971.

The primary mechanism that the Council has used to review environmental impacts of Federal projects is the environmental impact statements submitted by Federal agencies. The Council issued revised guidelines for section 102 statements on April 23, 1971 (see Appendix G). These guidelines require that the draft environmental statements be made available to the public at least 90 days prior to an administrative action (actions other than proposals or reports on legislation). Final environmental statements, with agency comments, must be made public at least 30 days prior to action. When public hearings are held on a proposed Federal action, the guidelines require that a draft statement be available 15 days before the hearing. These new guide-

lines give interested citizen groups and others more time to review and comment on the environmental impact statements.

The Council notifies the public and the Congress of the statements that have been filed in several ways: in its monthly bulletin, the *102 Monitor*; in biweekly lists in *Environmental Pollution and Control*, a bulletin of the National Technical Information Service of the Department of Commerce; in State and local clearinghouses in States affected by a proposed action; through the Legislative Reference Service of the Library of Congress; and in lists published in the *Congressional Record*. Public interest in section 102 statements has been high. One indication is that the Council's *102 Monitor*, first published in February of 1971, has over 2,000 subscribers, many of them public interest and educational organizations.

worldwide developments

As last year's report said, the environment knows no international borders. The same earth, sea, and sky are common to all nations and political ideologies. President Nixon said in transmitting his 1970 Report to the Congress on Foreign Policy for the 1970's: "We know that we must act as one world in restoring the world's environment, before pollution of the seas and skies overwhelms every nation."

In the past year citizens of many nations awoke to the international nature of their common concern—a polluted environment. Fish throughout the world were becoming contaminated with mercury. Toxic metals and air pollutants were filtering across national boundaries. Many nations realized they needed to upgrade their domestic environmental programs. Other nations sought new comprehensive policymaking and administrative weapons to deal more effectively with environmental decay.

Australia, Canada, France, Germany, Great Britain, India, Japan, Kenya, New Zealand, Singapore, Switzerland, and the United States all have either implemented or planned reorganization of their environmental protection programs. Great Britain has a new cabinet-level Ministry charged with environmental protection, national land use planning, housing, and transportation. Japan has added its first new cabinet position in 100 years. The new Minister will head an environmental agency to implement new and comprehensive laws relating to air, water, and marine pollution.

In the United States, the Council on Environmental Quality has taken an active role in the international field. The Council's activities are closely linked to the work of the Department of State and to the activities of the Environmental Protection Agency, the Department of the Interior, and other agencies.

One of the most significant developments during the past year has been a clearer delineation of the roles major international institutions are playing in environmental matters. The Environmental Committee of the Organization for Economic Cooperation and Development is conducting significant work on the international economic effects of member countries' environmental policies with a view to minimizing potential distortions of foreign trade. NATO's Committee on Challenges of Modern Society is concentrating on special problems of industrialized societies—such as how to develop low pollution motor vehicles. The Intergovernmental Maritime Consultative Organization is active in the area of marine pollution with special emphasis on how to prevent oil spills. The Economic Commission for Europe is serving as a valuable forum for information exchange between Eastern and Western nations on pollution control. The United Nations Secretariat is working to prepare for the 1972 U.N. Conference on the Human Environment, and is actively encouraging the participation of developing nations in the Conference. These organizations and others are developing special qualifications and programs to deal with particular environmental problems on the international level.

bilateral programs

united states and canada—The past year has seen major accomplishments by the United States and Canadian Governments working together to restore the quality of the Great Lakes—a vital asset for a large segment of the population on both sides of the boundary. The stark implications of continued deterioration of the Lakes emerged fully in early 1970, when the International Joint Commission (IJC) issued a carefully researched interim report which became the basis for its final recommendations of December 1970.

President Nixon charged the Council on Environmental Quality to work with Canada on the problem. Ministers of both countries met in June 1970 and agreed to set up a Joint Working Group. The Group began to study ten major problem areas in the fall, and by April 1971, issued a report containing its recommendations. It urged the two Federal Governments to agree to adopt common water quality objectives for the Great Lakes, to agree to programs for attaining the objectives, and to give the IJC authority to monitor these efforts.

At the second meeting of Ministers, on June 10, 1971, the two Governments agreed to adopt the report of the Joint Working Group and to complete a Great Lakes Water Quality Agreement embodying the recommendations by the end of the year. The Agreement will specify measures to control Great Lakes pollution by 1975. In the meantime, close contact continues through

the IJC on such problem areas as the St. Croix River in Maine and the Skagit River in the State of Washington.

united states and japan—The United States and Japan have exchanged environmental information for many years under the United States-Japan Cooperative Program on Natural Resources. In 1970, the two nations launched an intensive effort to establish strong joint programs dealing with air and water quality. Struck by the dramatic convergence of serious air pollution incidents in late July and early August in Japan and along the eastern seaboard of the United States, President Nixon suggested, and Prime Minister Sato agreed, that increased cooperative efforts should be undertaken. Chairman Russell E. Train of the Council on Environmental Quality and Minister of State Sadanori Yamanaka represented their Governments at a conference in Tokyo in October 1970. They identified a number of areas in air and water pollution control and solid waste management in which to pursue joint programs. At a second conference, on June 1–2, 1971, in Washington, the two Governments agreed to exchange information on curbing air pollution from automobiles and on applying advanced technology to sewage treatment.

other joint programs—The United States is in the process of developing bilateral relations on environmental matters with Mexico and Spain. Preliminary talks have been held with the Mexican Government, and environmental protection programs were part of a recently negotiated agreement with Spain. Ongoing bilateral programs with France and Germany on scientific matters now embrace environmental activities. The United States is also actively exploring opportunities for environmental cooperation with Poland, Yugoslavia, and India.

multination programs

nato — Since 1969, following President Nixon's initiative, NATO's Committee on the Challenges of Modern Society (CCMS) has gradually won over skeptics who questioned whether NATO could or should embark upon activities other than mutual defense and political consultation. The range of CCMS activity has embraced such diverse subjects as flood control, reduction of earthquake hazards, and comparative air pollution monitoring in Ankara, Frankfurt, and St. Louis.

An historic turn in the struggle for cleaner oceans was made by the CCMS and the NATO Council in November 1970. The member nations agreed to take steps to eliminate the intentional discharge of oil and oily wastes into the oceans by 1975, if possible—and no later than by the end of the decade. The Intergovernmental Marine Consultative Organization endorsed the undertaking as the basis for an international convention.

CCMS also stimulated the development of a series of agreements to cooperate in developing safe, low-pollution vehicles. These agreements represented a significant pooling of engineering expertise and technology.

A major conference on urban and environmental problems attended by a number of cabinet-level NATO officials convened in Indianapolis in late May. Mayors and urban experts discussed specific cooperative action related to the central problems of the urban environment. Recommendations from the conference will be presented at the fall 1971 CCMS plenary meeting and should lead to further international cooperation in this field.

oecd—The Environmental Committee of the Organization for Economic Cooperation and Development, formed in December 1970, is focusing on international economic implications of domestic environmental quality standards. Action by any one nation on pesticides or toxic substances, for example, might have a significant impact on the economy and trade of other nations. The OECD has set up an early warning system for consultations among governments before such actions are taken. OECD also is seeking ways to harmonize national practices in assigning the costs of environmental improvement in order to minimize possible adverse trade effects. The international economic implications of differing national pollution control standards are also being examined. In addition, studies are underway on the impact of the motor vehicle on the environment and on pollution by the pulp and paper industry.

the prague symposium—The Economic Commission for Europe (ECE) is the sole intergovernmental forum in which only the industrialized countries of Western and Eastern Europe are represented. The ECE's May 1971 Prague Symposium advanced East-West environmental cooperation. The results of the meeting will provide guidance to the newly established Senior Environmental Advisors to ECE Governments, a permanent ECE body which will hold its first meeting in the fall.

imco—The Intergovernmental Maritime Consultative Organization is the principal forum in which the world's maritime nations forge international agreements on the control and abatement of pollution from ships. In recent years, IMCO has developed international conventions on liability of shipowners and on the rights of nations to destroy or tow away stranded vessels that pose oil spill hazards. It has also set limits on the discharge of oil on the high seas. All of these conventions are now before the U.S. Senate for ratification.

In March 1971, after several years of negotiation, the Maritime Safety Committee of IMCO forwarded to the IMCO Assembly recommended limits on tank size of oil tankers. The recommendations seek to reduce the outflow of oil from ships in the

event of collision, grounding, or breaking apart. The IMCO Assembly will meet this fall to vote on the proposal. This measure is especially significant in view of the current trend toward supertankers and increased tank sizes. Also before the Assembly is a recommendation to all governments to set strict specifications on construction of liquified natural gas (LNG) and liquified petroleum gas (LPG) tankers by implementing the proposed Code for the Construction and Equipment of Ships Carrying Dangerous Cargoes in Bulk. LNG and LPG tankers carry their gas cargoes at extremely low temperature and high pressure. Strict construction standards will help lessen the potential for explosions. Besides these recommended actions, IMCO subcommittees are considering measure to limit the risk of collision or stranding, to dispose of bilge and ballast water in ports, and to improve vessel construction.

the 1972 u.n. conference on the human environment—Preparations for the major U.N. Conference on the Human Environment, to be held in Stockholm in June 1972, began in 1969. The Conference Secretary General, Maurice Strong, has generated wide interest in the Conference and has made a particular effort to include developing countries. To identify their interests further, a series of regional conferences will be held in Latin America, Africa, Asia, and the Middle East this fall.

Many nations have submitted possible agenda items to the Secretariat for review in September at the Third Preparatory Committee Meeting. The items centered on six broad topics adopted at the Second Preparatory Committee Meeting in February 1971: planning and management for human settlements; natural resource management; control of pollutants of broad international significance; educational, informational, social, and cultural aspects of environmental issues; development and environment; and the international organizational implications of action proposals.

In the United States, interdepartmental task forces have worked on a number of possible agenda items. Marine pollution, monitoring, information exchange and regional environmental institutes are receiving special attention. Another key agenda item is President Nixon's proposal for the establishment of a World Heritage Trust to preserve important natural, historical, and cultural areas. Intergovernmental working groups will meet on five topics of particular interest—marine pollution, monitoring and surveillance, conservation, soils, and a declaration on the environment—prior to the Stockholm Conference.

The U.N. Conference will be the scene of the first meeting of the developing and the developed nations on the matter of environmental quality. The Conference agenda is being put together with special care to take into consideration the social, economic, and political conditions in the developing

countries. The Conference will attempt to develop methods to achieve environmental quality that will neither inhibit economic development nor impose upon the developing nations the values of the developed countries.

nongovernmental organizations

The International Union for Conservation of Nature and Natural Resources (IUCN) is the only nongovernmental organization concerned solely with environmental matters on an international basis. With membership from over 70 nations, it provides a forum in which environmental problems of developed and developing countries may be approached. It works closely with various U.N. organizations, as well as with regional intergovernmental bodies. Its activities range from the traditional conservation considerations of wildlife and national parks to management of natural resources and environmental considerations in international development.

Last year, the International Council of Scientific Unions established a Special Committee on Problems of the Environment (SCOPE). As one of its first actions, SCOPE is developing a plan for international environmental monitoring.

summary

Federal progress in environmental protection is evident in several broad areas. Organization for action is better. Water quality enforcement is stronger. Standards in areas such as air quality and radiation have been tightened. Pesticides are regulated more stringently. The Nation's financial commitment to environmental improvement has been substantially increased. A broad spectrum of specific proposals has been made both to strengthen existing authorities and programs and to provide needed controls in new areas—such as toxic substances, noise, ocean dumping, power plant siting, mining, and land use policy. The President's commitment to use more Federal money and property to provide urban area recreation opportunities is being carried out. Federal agencies are implementing a major new statutory requirement to analyze the environmental impacts of their actions and, when appropriate, to search for alternatives less harmful to the environment. Within all Federal agencies, greater commitment to the environment is needed to insure more effective implementation of the National Environmental Policy Act and of the statutory and Presidental directives concerning cleanup of pollution in Federal facilities.

Two areas of Federal activity that particularly need increased attention are monitoring of environmental conditions and intergovernmental coordination. (Chapter 7 discusses the need for a much improved system of monitoring and evaluating environ-

mental conditions and trends.) The internal organization of EPA along functional lines and the establishment of NOAA are key first steps for an integrated pollution control monitoring program. Efforts in this area will receive increased attention from EPA, NOAA, and other agencies, such as the Geological Survey, with coordination by the Council on Environmental Quality.

The importance of intergovernmental coordination will become increasingly apparent as new and expanded environmental programs continue to rely primarily on State and local actions within the framework of Federal standards and guidelines. The establishment of EPA provides an important basis for beginning to build more effective and clearly defined Federal-State relations, particularly in view of the increasing movement of States toward consolidating pollution control programs.

There have been a number of important forward steps in international efforts to protect the environment. The United States has initiated active bilateral programs with Canada and Japan and is laying the groundwork for other joint actions. NATO's CCMS has succeeded in examining several specific environmental problem areas in industrial nations and especially in achieving agreement on eliminating intentional marine oil discharges by 1975 if possible, but no later than 1980. IMCO has continued its leadership in combatting marine pollution. OECD has tackled the international economic implications of national environmental policies and programs. ECE has broadened communications between East and West on the environment. The United Nations faces the difficult task of dealing with environmental quality on a global scale in its preparations for the 1972 Conference on the Human Environment.

Many knotty international problems remain to be resolved. For example, what will be the impacts on international trade and competition of national pollution control programs? Are existing international institutions and basic international law adequate to meet environmental demands?

One thing is clear: Environment has become—and must remain—a high national priority in the United States and in an increasing number of other nations.

footnotes

1. 42 U.S.C.A. §4321 *et seq.*
2. S. 1431, H.R. 6959, 92nd Cong., 1st Sess. (1971).
3. S.J. Res. 17, 92nd Cong., 1st Sess. (1971); H.J. Res. 3, 92nd Cong., 1st Sess. (1971).
4. 42 U.S.C.A. §1857 *et seq.*; 49 U.S.C.A. §§1421, 1430; and 50 App. U.S.C.A. §456.

4a. 36 Fed. Reg. 12657 (1971).

5. 36 Fed. Reg. 1503 (1971).
6. 36 Fed. Reg. 6680 (1971) (previous to final issuance).

7. 36 Fed. Reg. 5931 (1971).
8. 36 Fed. Reg. 5931 (1971).
9. 33 U.S.C. §4077.
10. Executive Order No. 11574, 3 C.F.R. 188 (1970).
11. 36 Fed. Reg. 6564 (1971).
12. 33 U.S.C.A. §1160.
13. *Id.*
14. 43 U.S.C. §1334.
15. S. 1014, H.R. 5966, 92nd Cong., 1st Sess. (1971).
16. S. 1238, H.R. 4247, H.R. 4723, 92nd Cong., 1st Sess. (1971).
17. S. 1015, H.R. 5970, 92nd Cong., 1st Sess. (1971).
18. S. 1012, H.R. 5958, 92nd Cong., 1st Sess. (1971).
19. Executive Order No. 11507, 3 C.F.R. 91, 94 (1971).
20. 7 U.S.C. §135 *et seq.*
21. *Id.* §135(z)(2)(d).
22. *Environmental Defense Fund* v. *Ruckelshaus,* 439 F. 2d 584 (D.C. Cir. 1971).
23. *Id.* at 593.
24. Pesticide Regulation Notice No. 71–1 (January 15, 1971) (available from EPA).
25. Standards & Criteria for Suspension, Environmental Protection Agency Policy Statement (March 18, 1971) (available from EPA).
26. S. 745, 92nd Cong., 1st Sess. (1971).
27. 42 U.S.C.A. §3251 *et seq.*
28. President's Reorganization Plan No. 3, 3 C.F.R. 199 (1971).
29. 10 C.F.R. §50.34a (1971).
30. 36 Fed. Reg. 11113 (1971).
31. S. 1478, H.R. 5276, H.R. 5390, 92nd Cong., 1st Sess. (1971).
32. S. 992, H..R 4332, 92nd Cong., 1st Sess. (1971).
33. S. 1842, H.R. 8816, 92nd Cong., 1st Sess. (1971).
34. 7 *Presidential Documents* 694 (1971).
35. 7 *Presidential Documents* 109 (1971).
36. S. 1684, H.R. 5277, H.R. 5389, 92nd Cong., 1st Sess. (1971).
37. S. 993 and H.R. 4704, 92nd Cong., 1st Sess. (1971).
38. 42 U.S.C.A. §4321 *et seq.*
39. 16 U.S.C. §461 *et seq.*
40. S 1152, H.R. 6769, 92nd Cong., 1st Sess. (1971).
41. S. 1207, H.R. 5778, 92nd Cong., 1st Sess. (1971).
42. 42 U.S.C.A. §1857 *et seq.*; 49 U.S.C.A. §§1421, 1430; and 50 App. U.S.C.A. §456.
43. 42 U.S.C.A. §3251 *et seq.*
44. 33 U.S.C.A. §1151 *et seq.*
45. H.R. 6359, 92nd Cong., 1st Sess. (1971).
46. S. 1117, 92nd Cong., 1st Sess. (1971).
47. S. 699, 92nd Cong., 1st Sess. (1971).
48. S.J. Res. 17, 92nd Cong., 1st Sess (1971).
49. S.J. Res. 52, 92nd Cong., 1st Sess. (1971).
50. H.R. 56, 92nd Cong., 1st Sess. (1971).
51. H.R. 2587, 92nd Cong., 1st Sess. (1971).
52. H.R. 5060, 92nd Cong., 1st Sess. (1971).
53. S. 699, 92nd Cong., 1st Sess. (1971).
54. H.R. 6359, 92nd Cong., 1st Sess. (1971).
55. H.J. Res. 3, 92nd Cong., 1st Sess. (1971).
56. 42 U.S.C.A. §4332(2)(C).
57. 42 U.S.C.A. §1857L–7.
58. Notice of Proposed Rulemaking, Implementation of Public Law 91–190, National Environmental Policy Act of 1969 and Related Requirements, I.C.C. No. 55 (May 26, 1971).
59. 35 Fed. Reg. 7390 (1970).

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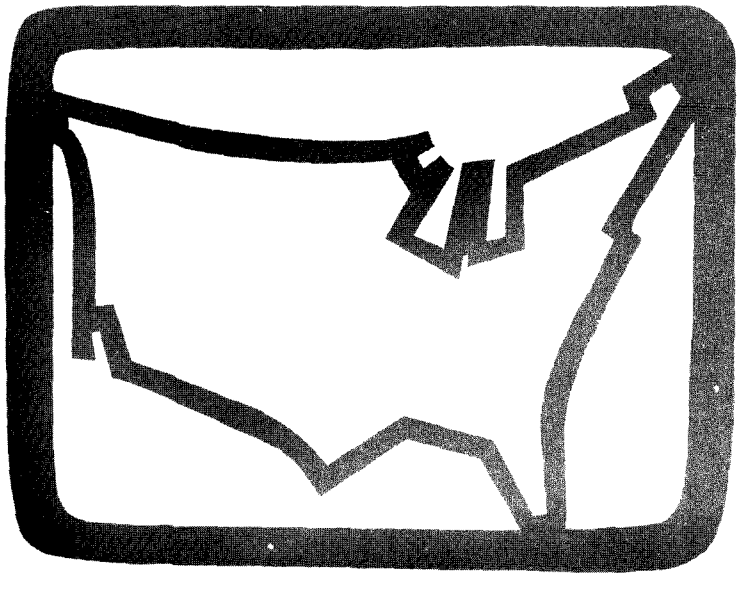


the past year—state and local activities

States and their political subdivisions have traditionally played the lead role in environmental protection. They have led both in curbing pollution and in controlling land use. Although the Federal Government has long been active in preserving wilderness and wildlife and in providing parks—largely because of its immense land-holdings—not until the mid-1950's did it mount a significant water quality program, and not until the early 1960's did it become involved with air pollution. And except for its own land, the Federal Government has not engaged in land use regulation.

But even now with the more direct Federal involvement in environmental protection—to meet increasingly serious problems with ever clearer interstate implication—States continue to play a vital role. State and local governments remain on the front line of essential planning, management, and enforcement.

In our system of government, the States are experimental laboratories for a variety of solutions to common problems. And State innovation frequently sets a precedent for Federal action. For example, California's automotive emission laws,[1] born of acute smog in the Los Angeles basin, set the stage for the National Emission Standards Act of 1965.[2]

Wisconsin's ban on DDT was a harbinger of similar Federal action, commenced in 1969 and expanded in 1971, to cover all uses of DDT. Permit systems for pesticide use in California, Florida, Maryland, and New York established a precedent for the President's proposals for Federal regulation of pesticide use.[3]

Even organizational reform at the Federal level, such as the creation of the Environmental Protection Agency (EPA), also finds precedent at the State level. In 1967, Minnesota created a consolidated Pollution Control Agency.[4] That same year Wisconsin formed an environmental "super department" putting resource management and pollution control activities under a single wing.[5] Through creative new State approaches and national acceptance of the most successful, the Federal system has profited.

Because of limited space and data, this chapter on State and local developments is a selective survey. Examples cited range from interesting and unique innovations to actions representing larger trends. In many areas, unfortunately, data are insufficient to identify trends or representative actions. To cite a particular example is not to endorse the program. Nor should failure to cite a program or accomplishment be viewed as a judgment that it is less important or significant than one which is cited. Some important activities are not reported simply because information was lacking or because an action occurred too late to be covered adequately.

The following discussion accents State rather than local activities because Federal legislation is putting more and more responsibility at the State level in order to encourage comprehensive, regional efforts. For instance, the Federal water quality program traditionally has focused on the States. And State responsibility for air quality has been increased by the 1970 Amendments to the Clean Air Act.[6] Moreover, although local governments are vital to pollution control, the data on local activities are sparse. Finally, in land use regulation, long the almost exclusive province of local governments, there is widespread agreement that increased State involvement is the key to more effective controls.

pollution control

As the Advisory Council on Intergovernmental Relations has stated, the past year evoked from State and local governments "broadened fiscal support for environmental protection, stricter regulations over air and water pollution and solid waste disposal, and the design of innovative programs to control environmentally related problems." Although concrete cleanup results are hard to quantify, the government machinery needed to produce positive results is being improved and in some cases built for the first time.

broadened fiscal support

The States provided more money and manpower for pollution control in the past year. Figure 1 shows how much more—for both air and water pollution control programs; a State-by-State analysis in the appendix to this chapter breaks it down further. However, the figure and detailed tables do not fully depict the adequacy of State efforts. Factors such as population, number and type of pollution sources, past accomplishment, organizational efficiency, and skill of personnel also must be considered.

Despite significant increases, many States still suffer severe shortages of funds and manpower. Inability of States to attract qualified personnel because of very low salary scales—particularly for junior employees—is a major problem.

The money and manpower amounts in Figure 1 reflect spending for control programs—standard setting and enforcement, monitoring, planning, and training. They do not include the very substantial expenditures, primarily at the local level, for pollution control facilities such as waste treatment plants. In 1970, States contributed roughly $280 million in grants and loans to help support municipal construction of sewage treatment facilities. Local expenditures for such projects in 1970 are estimated at $420 million. During the same period, the Federal Government obligated approximately $450 million for projects qualifying for assistance under the Federal Water Pollution Control Act.

In the past year, Florida and Louisiana joined the list of States with programs to help finance construction of waste treatment plants. Twenty-three States, including most of the populous ones, now have such programs. Communities qualify for a "bonus" in Federal grant assistance whenever the State pays 25 percent of the cost.

In 1970, voters strongly supported State involvement in financing pollution control facilities. Data on 1970 bond elections show that voters approved all five bond issues designated by the Investment Bankers Association as "pollution control" issues. These issues totaled more than $1 billion, including Illinois and California issues of $750 million and $250 million, respectively. "Water and sewer" issues, a category that includes most sewage treatment facility bonds, won 90.2 percent approval by dollar volume. This compares with the 60.1 percent approval rate for all bond issues in 1970.

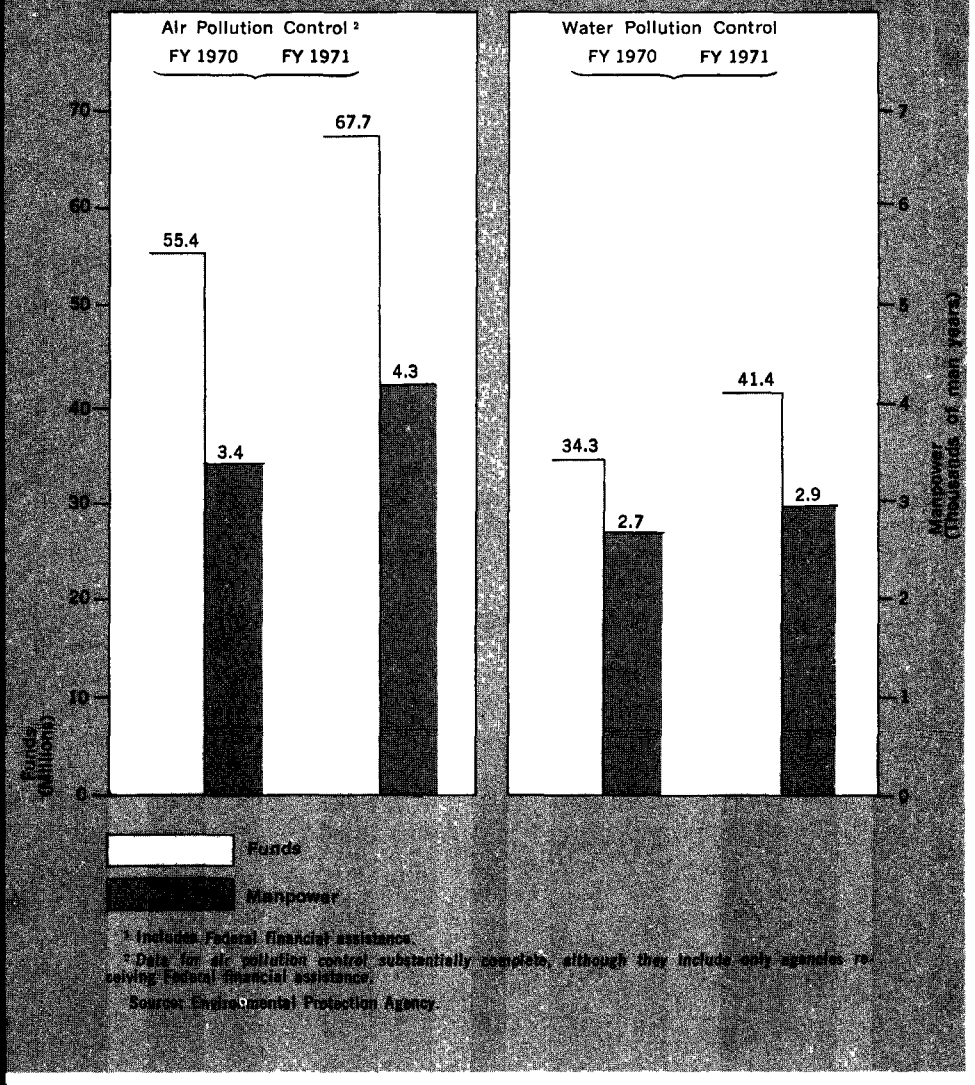
stricter regulation

Many States have tightened pollution control standards or expanded their coverage to new pollutants or activities. Many have intensified antipollution enforcement.

Inadequate data on prior State enforcement activity make it

Figure 1

Funding and Manpower for State and Local Air and Water Pollution Control Agencies [1]



[1] Includes Federal financial assistance.

[2] Data for air pollution control substantially complete, although they include only agencies receiving Federal financial assistance.

Source: Environmental Protection Agency.

difficult to judge the volume or effectiveness of the past year's activities on a comparative basis. However, public clamor for action against violators of pollution control standards has highlighted the weaknesses of many existing State enforcement authorities and prodded States to develop new and better mechanisms.

air quality—A vivid example of limited enforcement authority occurred in Alabama. In July 1970, the Federal Government denied the State's request for $600,000 in financial aid for its air quality program because the State Air Pollution Control Act [7] failed to meet minimum requirements for such aid. Inadequate enforcement provisions were the basic reason. Then, in April 1971, after a 5-day air pollution "episode" in Birmingham, the Alabama Attorney General filed a suit under the State's public nuisance law against 13 major industrial companies requesting that they be given a 6-month deadline to abate their pollution. The Attorney General stated that the Alabama Air Pollution Control Act could not have been invoked since it set no applicable standards. (For a discussion of some of the limitations of State public nuisance law generally, see Chapter 5.)

residential fuel burners and incinerators—New York City's ordinance regulating the use of fuel burners and refuse incinerators in multiple dwellings [8] was upheld by the State's highest court in November.[9] It was challenged by more than 400 apartment house owners. The New York City Administrative Code requires the Air Pollution Commissioner to issue operating certificates for fuel burners and incinerators. Owners must conduct such tests as the Commissioner finds necessary to determine whether the equipment meets the new standards. The law sets standards for sulfur content of fuel and requires owners to install sulfur emission monitoring and recording devices. Once compliance dates have passed, the Commission is empowered to seal any equipment lacking a permit or emitting harmful substances. Following the court decision, the City promptly set deadlines for plans to upgrade substandard facilities. It also warned that it would use the law's enforcement authority in cases of noncompliance.

auto emissions—Under the Federal Clean Air Act, State and local governments retain authority to regulate pollution from automobiles in use.[10] But authority to regulate emissions from new motor vehicles is reserved to the Federal Government. California is an exception. Under section 209(a) of the Federal Clean Air Act, California is eligible for a waiver from EPA permitting it to establish emission standards for new motor vehicles stiffer than Federal standards if needed to meet "compelling and extraordinary conditions" in that State. California, whose regulation of automotive emissions established the precedent for present Federal law, has obtained several waivers since the Federal law

was enacted in 1965. In 1971, waivers were granted by EPA for emission standards and test procedures for various classes of vehicles in the 1972, 1973, and 1975 model years.[11]

A number of State and local governments have "antismoke" laws, which prohibit annoying, visible exhaust from vehicles. Michigan's vehicle code is one example.[12] Although many such laws are rarely enforced, some jurisdictions are moving to strengthen their implementation. For example, officials in Jacksonville and in Dade County, Fla., have announced that they are intensifying enforcement of their recently enacted antismoke laws. On a nationwide basis, however, much more needs to be done to enforce such laws.

Several States are studying the possibility of establishing emission testing and inspection programs. Section 210 of the Clean Air Act authorized Federal grants to assist such programs.

Some cities are curbing the use of surface transportation to help control air quality, and others are actively considering such measures. In New York City, for example, new air pollution emergency procedures embody provisions for closing streets and restricting automobile use. To help meet Federal air quality standards, the City is working with the Tri-State Transportation Commission to develop a master plan for area traffic.

New York recently closed several streets on an experimental basis to explore possibilities for generally limiting the role of the automobile there. The Mayor has ordered a study to determine if one of the experimental streets—Madison Avenue—could be converted into a mall.

indirect pollution controls—In come cases, pollution control requirements may be imposed indirectly, rather than through standards. For example, the Illinois Public Utility Commission, at the urging of the State Attorney General, granted a rate increase to a large electric utility, Commonwealth Edison, on the condition that the utility take several specific pollution abatement actions.[13] If Commonwealth Edison fails to take the actions within the allotted time, the State may reduce the rate increase 50 percent. This is believed to be the first rate regulation in the Nation to contain explicit and extensive environmental quality requirements. The requirements call for the utility to convert to cleaner fuels to protect air quality and to install cooling facilities to prevent thermal water pollution.

water quality—Representatives of the numerous Federal, State, and interstate authorities with water pollution control enforcement responsibilities in the New York City metropolitan area have agreed to pool information and to coordinate enforcement and monitoring. This elementary step should enhance enforcement efforts, which have been hampered by fragmentated data and responsibilities.

Illinois has comprehensive legislative authority for water pollution control enforcement. For example, the new State Environmental Protection Act permits the Illinois Pollution Control Board to force any municipality or sanitary district that has been ordered to abate water pollution to issue general obligation or revenue bonds to finance the needed treatment facilities.[14] This provision is designed to overcome lack of funds and debt limit problems that often forestall construction of necessary sewage treatment works in many communities.

New York's new Department of Environmental Conservation has waged an active battle against water pollution. The Department reduced mercury discharges into New York waters by 97 percent—down to about 2 pounds per day. Under New York's Pure Waters Program, a pioneer program of State financing for waste treatment, 358 municipal sewage treatment plants, costing approximately $2.2 billion, were built or were under construction or design as of March 31, 1971. State funds totaling more than $1 billion have been committed to these projects.

California has also been active in water quality enforcement. The State's new Water Quality Control Act,[15] which took effect on January 1, 1970, arms the State with an arsenal of enforcement powers, including strict fines—up to $6,000 a day—against polluters. Enforcement has been vigorous, with more than 100 direct enforcement actions taken and many waste discharge requirements strengthened.

The San Diego Regional Water Quality Control Board won a citation from the Department of the Interior in October 1970 for its efforts, in conjunction with local authorities, to visibly improve water quality in San Diego. Cleanup measures included establishment of a regional sewage treatment system. The Los Angeles Regional Water Quality Board tightened discharge standards for the Inner Los Angeles Harbor and Dominguez Channel. By late spring of 1970, Inner Harbor water quality had been distinctly improved. Several species of marine life not seen for 25 years returned to the harbor's waters.

ocean dumping—In both San Diego and Los Angeles, major reductions in ocean dumping of wastes contributed to water quality improvement. Several large-volume dumping operations voluntarily curtailed dumping involving materials such as filter cake in San Diego and oil drilling wastes in Los Angeles. Subsequently, the San Diego Board banned ocean dumping within its jurisdiction. Similar action by the San Francisco Board and voluntary reduction of paper mill and oil wastes dumping in Seattle resulted in a total decline in Pacific Coast dumping (excluding dredge spoils) from about 1 million tons in 1968 to about 24,000 tons in 1971.

Both New Jersey and Rhode Island have recently enacted legislation to regulate ocean dumping within their jurisdiction.[16]

In Rhode Island, transportation and dumping of specified types of materials will require a permit from the State environmental agency. In New Jersey, permits for loading and transporting will be used to control dumping.

subsurface disposal—Colorado moved to regulate subsurface disposal of liquid wastes—a practice used increasingly as more stringent surface water quality standards and stricter enforcement reduce the waste disposer's options. With some exceptions, State Water Pollution Control Commission rules prohibit the direct or indirect underground discharge of liquid wastes without a public hearing and a permit.[17] The regulations protect usable waters and authorize the Commission to specify disposal methods. They also require monitoring, evidence of financial responsibility, and engineering and other data. Although some other States also regulate underground disposal, authority often is limited and is unevenly exercised.

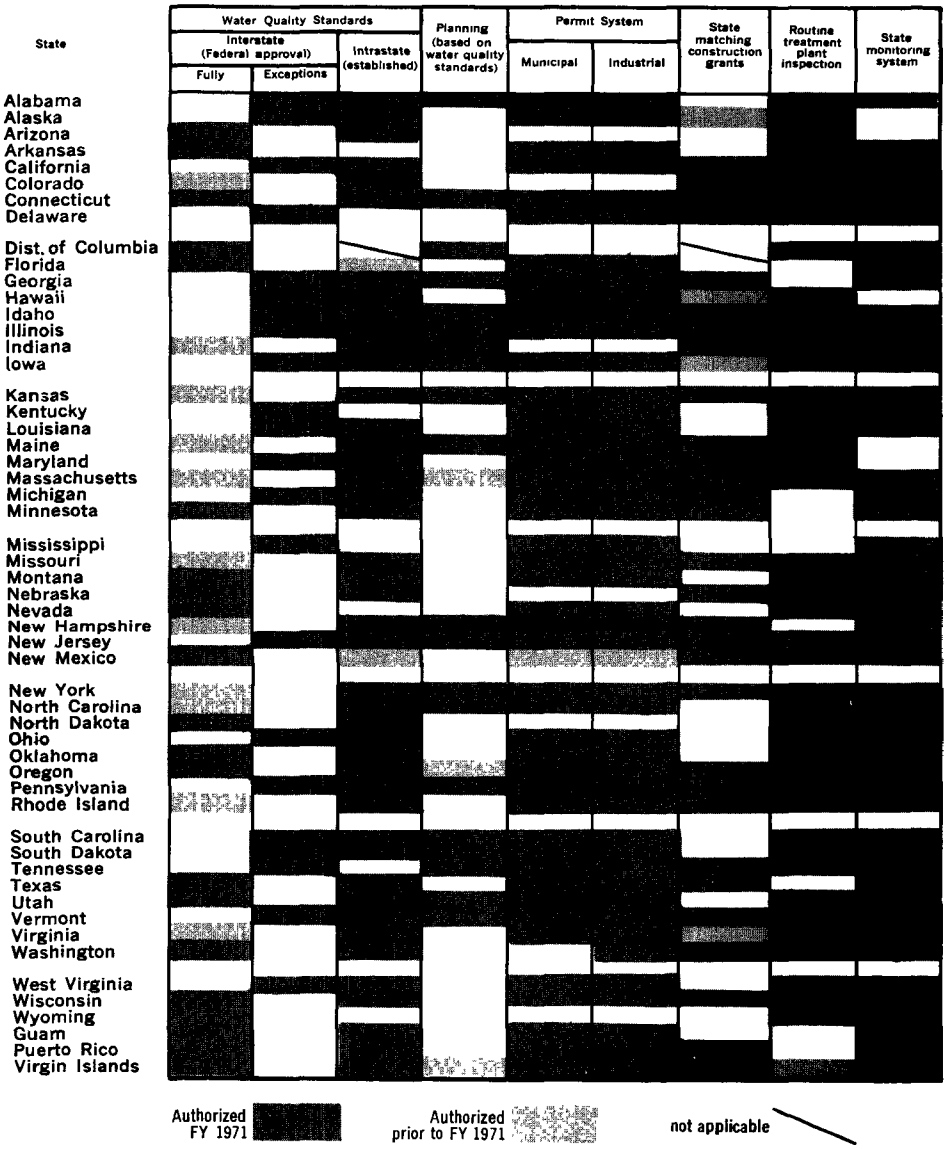
phosphates—At both the State and local levels, one of the most publicized regulatory activities in the past year was enactment of restrictions on phosphate content of detergents. Cities and counties in Florida, Illinois, Maine, Maryland, Michigan, New York, Ohio and Wisconsin have acted to limit phosphates in detergents. Several of these laws have been challenged in court by detergent manufacturers.

Among the States, Connecticut, Florida, Indiana, Maine, Minnesota, and New York have enacted legislation to regulate the phosphate content of detergents.[18] In New York and Connecticut phosphates will be banned from detergents after January 1 and June 30, 1973, respectively. In Indiana, phosphates will be limited to 3 percent by weight on January 1, 1973. These three States have also authorized or required interim reductions. In Maine, phosphates in detergents are limited to 8.7 percent (phosphorus) as of June 1, 1972. Florida provides that after January 1, 1973, no detergent may contain additives—including but not limited to phosphates—found by the State pollution control agency to be harmful to health or the environment. Minnesota legislation authorizes the State pollution control agency to regulate maximum permissible concentrations of any nutrients, such as phosphorus. Many other States and communities are considering phosphates legislation.

Figure 2 and Table 1 show State performance in relation to important air and water quality program elements. In Figure 2, the distinction between standards for interstate and intrastate waters reflects the fact that the Federal Water Pollution Control Act presently applies only to interstate waters.[19] However, the bonus grant provisions in the Act inject a strong incentive to develop intrastate standards. All but seven states now have such standards, as the table shows. The "permit system" category in-

Figure 2

State Water Quality Program Elements, May 1971



Source: Environmental Protection Agency, Office of Water Programs.
[1] Municipal only.
[2] Federal only.
[4] Municipal and State only.

dicates existence of legal authority to issue permits or their equivalent for discharges; it does not show whether permits are issued or how they relate to water quality standards. The "State matching" category refers to legal authorization for a State to help municipalities build sewage treatment facilities by grant or loan. It does not reflect whether such assistance is regularly provided. The "treatment plant inspection" category covers surveillance of the operation and maintenance of all facilities at least once a year. The elements in Table 1 are based on requirements of the Clean Air Act with respect to State implementation plans to be submitted to EPA.

Table 1

State Air Quality Program Elements, January 1971 [1]

Legislative Authority	States with authority	States without authority
Adopt emission standards and promulgate other regulations	54	0
Require information on processes and potential emissions from sources of air pollution	39	15
Issue permits for construction of new sources of air pollution	38	16
Inspect facilities causing pollution	52	2
Require emission information from polluters and make it available to public	20	34
Require monitoring of emissions by polluters	13	41
Issue and enforce compliance orders	51	3
Enjoin standards violators	52	2
Take special, prompt action in case of air pollution emergencies	44	10
Regulate land use and transportation to meet air quality standards	5	49
Inspect automotive pollution control devices	16	38

[1] Includes District of Columbia, Guam, Puerto Rico, and U.S. Virgin Islands. In some cases, figures are approximations based on best available data.

Source: Environmental Protection Agency, Office of Air Programs.

solid waste—Regulation of solid waste management practices, other than for public health protection, is in a rudimentary state. However, statewide and regional solid waste planning is on the rise. And it is leading to increased regulatory activity—such as prohibitions against open dumps and controls over landfill practices.

In New Jersey, the Department of Environmental Protection was empowered to register all solid waste disposal operations, to formulate a statewide waste management plan, and to encourage regional action. It was also empowered to build disposal facilities

on an experimental basis.[20] The State plan, recently issued by the Department, recommends incineration and landfill districts.

A new Kansas law calls for limited State regulation of solid waste management.[21] It creates a Solid Waste Advisory Council to recommend ways to finance solid waste systems and standards to govern the operation of disposal facilities. North Carolina has armed its State Board of Health with new solid wastes research, standard-setting, and inspection responsibilities.[22]

The Solid Waste Disposal Act[23] demands that State solid waste management plans funded under the Act include an inventory of waste disposal facilities and a survey of problems and practices. Under the 1970 Amendments, provision for recycling or recovery of materials from waste must be included whenever possible.[24] Figure 3 shows the progress of State solid waste management plans pursuant to section 207 of the Solid Waste Disposal Act, as amended.

litter—Oregon recently passed legislation dealing with another public-arousing problem—litter by beverage containers.[25] The Oregon law requires a deposit on all beer and soft drink containers, 5 cents on standard-sized bottles and cans and 2 cents on small beer bottles. It also bans detachable tabs on metal cans. The law takes effect in October 1972. Over 40 States are considering similar legislation. In the November 1970 elections, a mandatory deposit was defeated in the State of Washington. Several years ago, Vermont prohibited nonreturnable beer bottles, a measure that was rendered ineffective and later abandoned after the advent of beer cans.

noise—Comprehensive noise pollution control is an area of increasing State and local regulatory activity. Although there are an estimated 1,500 to 2,000 State and local noise control laws, many are limited or unenforceable. However, concern and activity in this area have been renewed. Florida recently enacted legislation authorizing its Department of Air and Water Pollution Control to establish noise standards.[26] North Dakota has taken similar action.[27]

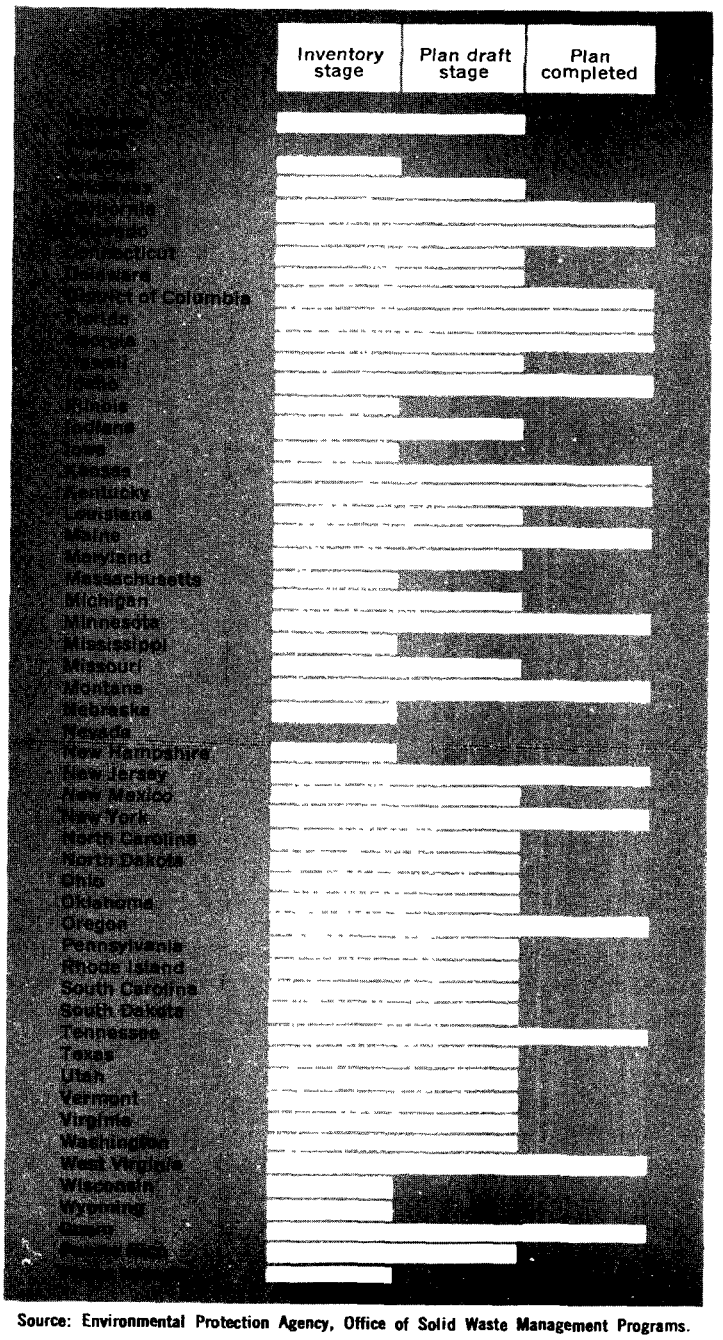
In March, 1971, Chicago adopted a comprehensive noise control ordinance, which became effective on July 1.[28] Under the ordinance, manufacturers must certify that specified types of vehicles and equipment, including construction equipment, sold in the city meets prescribed noise emission standards. Vehicle users are also subject to noise limitations. Noise from buildings and certain noise-generating activities are also regulated.

Chicago has come up with a unique method of enforcing its new noise standards. Mobile teams, equipped with portable sound meters, will cruise the city "listening" for violations and ticketing violators.

New York's Quiet Communities Program embraces research, monitoring, and land use planning. Enforcement of noise stand-

Figure 3

Progress in State Solid Waste Management Plans, June 30, 1971



Source: Environmental Protection Agency, Office of Solid Waste Management Programs.

ards is carried out primarily through local law enforcement agencies.

California,[29] Connecticut,[30] and New York [31] all have legislation establishing maximum decibel noise levels for motor vehicles on public highways. California also regulates noise levels of new motor vehicles.[32] Studies in New York indicate substantial reductions in vehicle noise levels. Most States have laws requiring mufflers on vehicles to prevent excessive noise, but because these laws generally do not establish maximum decibel levels, they are difficult to enforce.

Although many municipal noise ordinances regulate noise from fixed industrial locations, very few regulate the annoying noise from construction activities. Public nuisance laws have rarely been invoked successfully against such noise.

Municipal building codes often contain provisions to minimize noise passing through walls, but many such provisions are inadequate or poorly enforced. There is virtually no regulation of household appliances by State and local governments.

radiation—Legal uncertainty shrouds the future of State regulation of radioactive emissions from nuclear powerplants. Opinions by a Federal district court in Minnesota [33] and by the Illinois Pollution Control Board [34] reached opposite conclusions on whether States are preempted by Federal law from regulating such emissions. The Federal district court held that Federal radiation control authority precludes State regulation. The Illinois Board ruled just the opposite, contending that when public health and safety—traditional State concerns—are involved, a congressional intent to foreclose State regulation must be very explicit. The Board found such an intent to be lacking in the Atomic Energy Act.[35] The ultimate outcome of the two cases, both of which are now on appeal, will significantly influence the future of State nuclear powerplant regulation.

reorganization

States, like the Federal Government, have reorganized themselves to cope with the environment. The trend toward consolidation of State pollution control programs began in the late 1960's. And it has taken a variety of forms. The examples discussed are representative although not necessarily typical.

Prior to the reorganizations discussed below, environmental programs in most States were—and in many other States still are—scattered among several agencies, boards, and commissions. Boards and commissions, manned by government agency representatives, citizens, special interest groups, or all of these, usually wielded considerable influence in setting pollution control policy. Often these entities exercised powers independent of the Governor, and special interest groups sometimes dominated them.

Implementing board-established policy was generally left to one or more agencies. Most often, a State health department contained one or more units responsible for air and water pollution control. In some cases, the water pollution control program was lodged in a separate agency or combined with other water programs, such as water resources management. The State solid waste management program, if any, was usually under a health department arm. Pesticides regulation was a function of the health or agriculture departments—or both. State park, recreation, fish and wildlife, and other resource programs were sometimes grouped together or were sometimes totally separate.

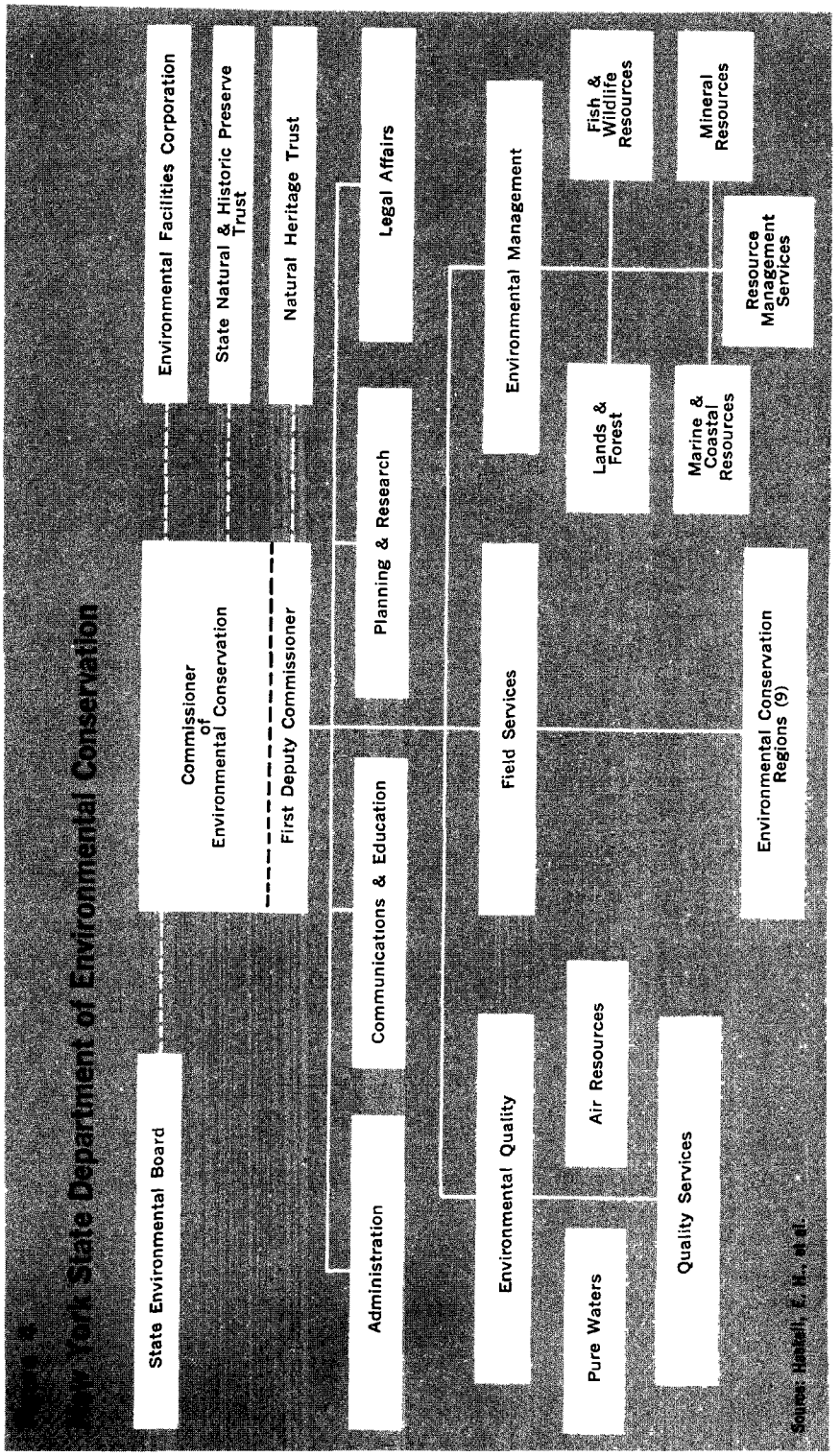
new york—By a statute enacted on Earth Day 1970, and effective July 1, 1970, New York State transferred most of its pollution control and resource management programs—the air, water, and pesticides control programs and the water resource, forest, fish and wildlife, and marine and mineral management programs—to a new Department of Environmental Conservation (DEC).[36] Solid waste disposal regulation, land use planning, and noise pollution control were also put under the Department's general purview, and it is expected that DEC will seek more specific statutory authority in these areas.

DEC is empowered to develop a statewide environmental plan and a statement of goals and strategies, to review all State agency programs affecting the environment, and to formulate guidelines for measuring the environmental values and relationships involved.

Internally, DEC is basically divided into an environmental quality (pollution control) section and an environmental management (resource management) section (see Figure 4).

The act creating the DEC also created a State Environmental Board—made up of citizens and representatives of State agencies—and a citizen Council of Environmental Advisors. The Board, which replaces interagency air and pesticides boards and the Water Resources Commission, will advise the DEC Commissioner. It has veto power over environmental standards, criteria, rules, and regulations proposed by the Commissioner. The citizen Council is an advisory body to the Governor on broad environmental policy. It has specific responsibility for developing guidelines on environmental quality and economic and population growth.

washington—The State of Washington enacted legislation in 1970—less extensive in scope than the New York law—which consolidates environmental protection programs under a Department of Ecology (DOE).[37] Created on July 1, 1970, DOE resulted from an across-the-board effort in the State to overhaul government structures and make them more responsive to the Governor, the legislature, and the public.


New York State Department of Environmental Conservation
State Environmental Board
Commissioner of Environmental Conservation
First Deputy Commissioner
Environmental Facilities Corporation
State Natural & Historic Preserve Trust
Natural Heritage Trust
Administration
Communications & Education
Planning & Research
Legal Affairs
Environmental Quality
Field Services
Environmental Management
Pure Waters
Air Resources
Quality Services
Environmental Conservation Regions (9)
Lands & Forest
Marine & Coastal Resources
Fish & Wildlife Resources
Mineral Resources
Resource Management Services

DOE consolidates the water and air quality, solid waste management, and water resource programs. In contrast to New York's DEC, DOE does not incorporate other resource management programs. Although the Department is basically a pollution control agency, programs such as pesticide control and drinking water quality remain with the Agriculture and Social and Health Services Departments, respectively.

As in some other States that have reorganized environmental programs, a key objective was to create a strong environmental executive directly accountable to the Governor while limiting the number and authority of special interest and interagency boards and commissions that have been a hallmark of State environmental management.

Preexisting citizen or interagency boards such as the Water Resources Advisory Council and the Air Pollution Control Board gave way to an Ecological Commission to advise the DOE director. All nonprocedural rules and regulations proposed by the Director of DOE are reviewed by the Commission. The Commission has veto power over such proposals if five of its seven members disapprove.

The third element in Washington's new pollution control structure is a three-member quasi-judicial Pollution Control Hearings Board. It hears appeals from decisions of the DOE and of local air pollution control authorities.

One of the most significant aspects of DOE is its internal structure. It is structured according to functions, such as standard setting and planning. There is no separate air quality, water quality, water resource, or solid waste component. Instead, there are two functional branches—one for administration and planning and one for public services (see Figure 5).

Illinois—Probably the most innovative State reorganization program was adopted in Illinois. The Illinois Environmental Protection Act of 1970 [38] transferred preexisting authorities and programs and added some new ones to three new functional entities. Resource management programs were not affected. The Pollution Control Board (PCB) sets standards and adjudicates enforcement proceedings. The State Environmental Protection Agency (EPA) identifies and prosecutes alleged violators before the Board, issues permits, and gives technical assistance. The Institute for Environmental Quality (IEQ) conducts long-range policy planning and applied research. (See Figure 6.)

Pollution control programs—air quality, water quality, radiation control, and "land pollution control" (solid wastes)—thus were divided in the reorganization among three organizations. This is an atypical response to common problems that have led various other states to reorganize.

The Illinois reorganizers saw many problems. The State Department of Public Health (DPH) overadvised and overconsulted

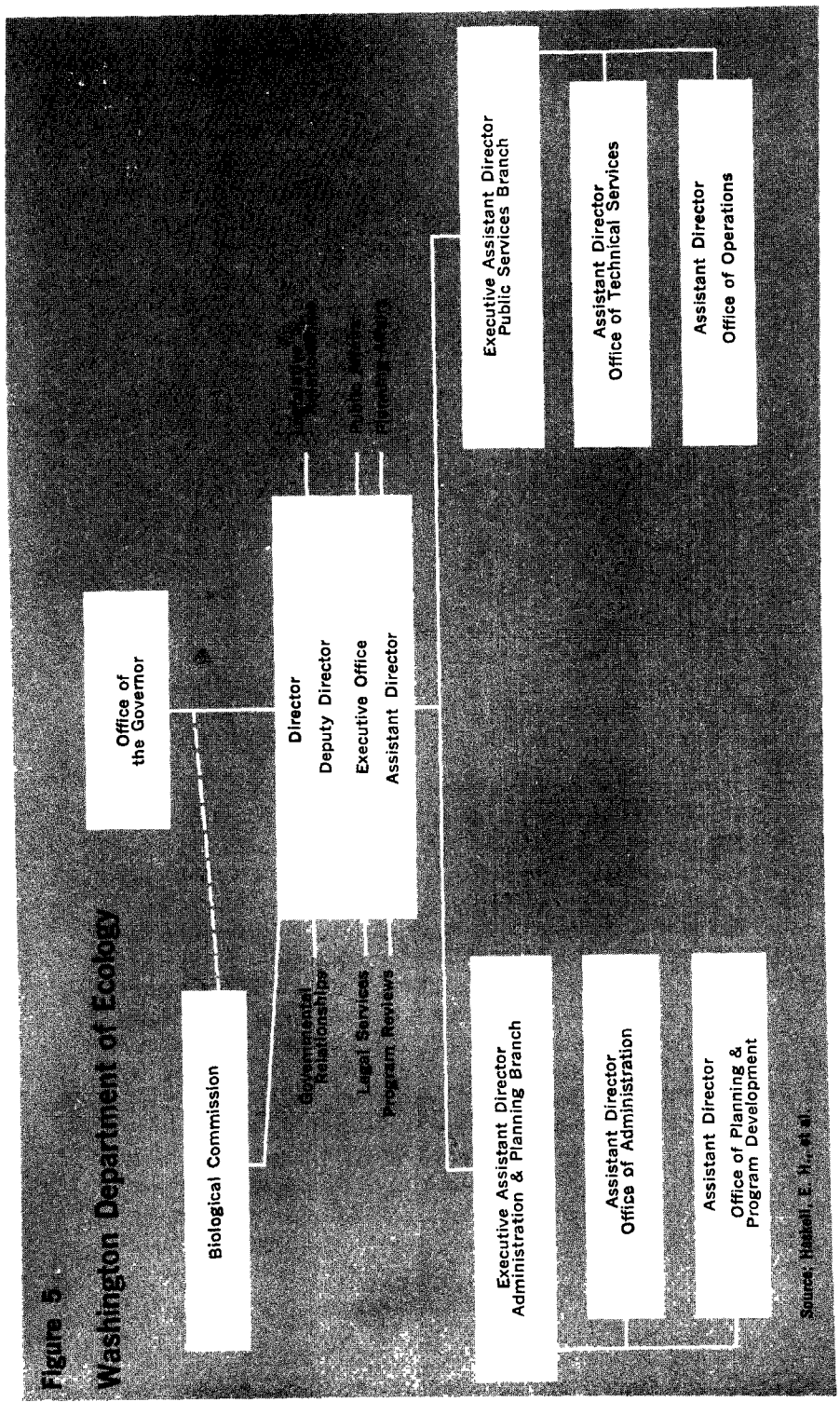


Figure 5
Washington Department of Ecology
Office of the Governor
Biological Commission
Director
Deputy Director
Executive Office
Assistant Director
Executive Assistant Director
Administration & Planning Branch
Executive Assistant Director
Public Services Branch
Assistant Director
Office of Technical Services
Assistant Director
Office of Operations
Assistant Director
Office of Administration
Assistant Director
Office of Planning &
Program Development

with polluters instead of regulating and prosecuting them. Part-time standard-setting boards—such as the Air Pollution Control Board and the Sanitary Water Board—were ineffective; they met infrequently, and some members were associated with polluting constituencies. The air and water quality boards were separate. Finally, the pollution control units within DPH had to compete with other important DPH interests for money.

The framers of the Illinois reorganization plan were guided by principles in large measure different from those followed by other States. First, rather than eliminating or reducing the role of the policymaking board, Illinois professionalized it by giving it a full-time membership with staff. It also gave the board sharply defined, final authority for standard setting and policy development.

Second, Illinois acted upon the theory that some functions, such as prosecution and adjudication, conflict, or at least compete unfavorably, if administered by a single agency. The State also felt that long-range research and planning inevitably suffered when forced to compete for funds within an agency that must respond primarily to immediate crises and pressures. Hence, it created the independent IEQ.

Third, the Illinois approach is grounded in the belief that some duplication of responsibilities promotes a healthy competition that will maximize action against pollution. It assumes that interacting and overlapping organizations, with an involved citizenry, will "check and balance" inadequate or arbitrary action by any one organization. The Illinois Environmental Protection Agency, the Attorney General, and any private citizen all have authority to initiate enforcement proceedings. And citizens as well as the State EPA and IEQ may initiate standard-setting proceedings.

Reorganization of environmental programs such as those in New York, Washington, and Illinois, especially when linked to an expansion or streamlining of pollution control authority, should significantly accelerate substantive progress at the State level. The varying approaches to reorganization—consolidation versus separation of functions and competitive overlap; pollution control alone versus a combination of pollution control and resource management; internal functionalization versus pollutant or media orientation—all will lend valuable comparative experience for future refinement of environmental management efforts.

program innovations

Aside from reorganization, some States have also introduced innovations in 'environmental problem solving. States have pioneered new approaches to citizen involvement, waste management and its financing, pollution charges, and applications of

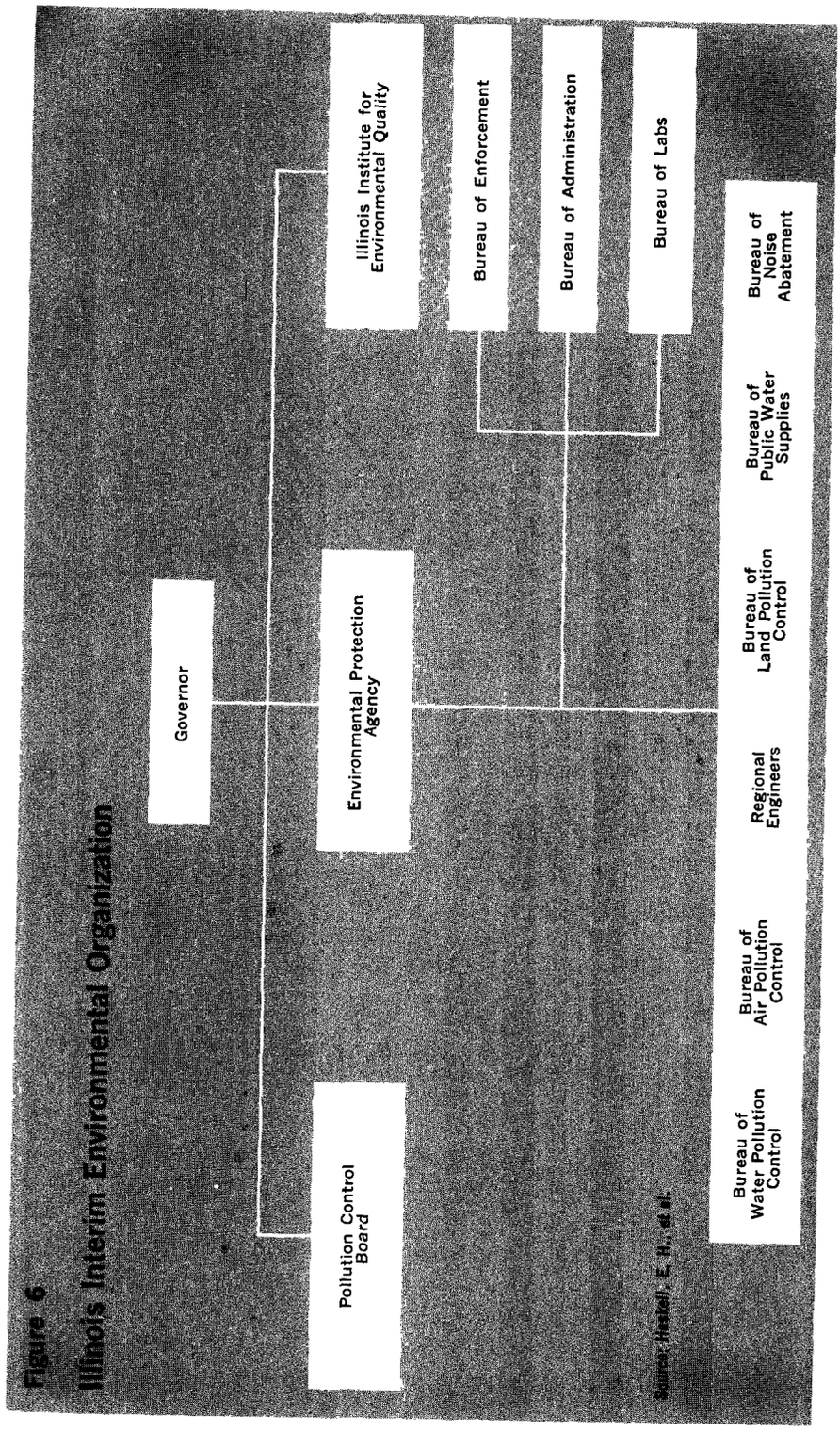


Figure 6
Illinois Interim Environmental Organization
Governor
Pollution Control Board
Environmental Protection Agency
Illinois Institute for Environmental Quality
Bureau of Enforcement
Bureau of Administration
Bureau of Labs
Bureau of Water Pollution Control
Bureau of Air Pollution Control
Regional Engineers
Bureau of Land Pollution Control
Bureau of Public Water Supplies
Bureau of Noise Abatement
Source: Haskell, E. H., et al.

technology. (New State laws, patterned after the National Environmental Policy Act (see Appendix A) and requiring State agencies to weigh the environmental impact of proposed activities, are discussed in Chapter 5.)

citizen involvement—Michigan has given private citizens broad rights to obtain a court injunction or other equitable relief against conduct that will "pollute, impair, or destroy the air, water, or other natural resources or the public trust therein." [39] The new Michigan law covers much more than air and water pollution, but it can be expected to have a particular impact in those areas.

The Michigan law contrasts with the Illinois Environmental Protection Act of 1970,[40] which provides for major citizen involvement in the regulatory processes of State agencies but authorizes a more limited type of citizen enforcement. The Illinois Act gives citizens broad rights to be informed of agency proposals and actions, to examine records, and to participate in agency procedings. The standard-setting agency, for example, must hold a public hearing on any standard or rule proposed by 200 or more citizens—unless it is "plainly" devoid of merit or has been considered within the previous 6 months.[41]

Any Illinois citizen may initiate an adjudicative proceeding before the Pollution Control Board to enforce the Act or standards established pursuant to it. In addition, a recent amendment of the State constitution enables citizens to sue in the State courts to protect their right to a "healthful environment." [42] (Chapter 5 discusses in more detail the Michigan, Illinois, and other State laws giving private citizens access to the courts to protect the environment.)

waste management and its financing—Three States, Maryland, New York, and Ohio, have public corporations empowered to engage in a traditionally local function: financing, constructing, and operating municipal sewage treatment and solid waste disposal facilities. The Maryland and Ohio corporations have similar authority with respect to some industrial facilities, and the New York and Ohio corporations have responsibility for water supply facilities.

maryland—The most recent of these three innovative institutions is the Maryland Environmental Service (MES), created in 1970.[43] MES may finance, design, construct, operate, and maintain solid and liquid waste disposal facilities. It provides research, technical assistance, and planning services on a regional basis. MES may contract with municipalities, other government entities, and private parties to provide these services. When directed to do so by State pollution control officials, it must install or operate abatement facilities for a municipality, firm, or individual that

has failed to comply with an order issued by such officials. Recipients of MES services bear the costs.

MES is expected to effect economies of scale through regionalization of waste treatment and disposal, better financing opportunities than those available to most local jurisdictions (MES is authorized to issue its own bonds), and stricter compliance with water quality standards and solid waste disposal regulations.

MES will draft and seek to implement 5-year plans for the regions that it designates. However, the MES legislation requires approval by local governing bodies in a designated region as a precondition to adoption and implementation of a plan. Only the State General Assembly can override a local veto. Moreover, local governments can veto the location of waste disposal sites and continue to set fees for sewer and refuse services. Once a plan is adopted, an MES district will be established to acquire or construct the necessary facilities.

Some skeptics suggest that the local veto provision will hamstring MES and force it merely to implement local priorities instead of pursuing regional objectives. However, it is quite possible that MES can at least move toward regional waste management by persuading local officials that it will be cheaper and more effective to think regionally. MES must sell itself.

The primary difference between MES and the New York and Ohio public corporations—the New York Environmental Facilities Corporation (NYEFC) and the Ohio Water Development Authority (OWDA)—is that neither NYEFC nor OWDA has statutory authority to take over any facility that is violating standards. None of the three corporations provides grants to municipalities, although in Maryland and New York, municipalities may obtain State grants to help construct sewage treatment facilities. In Ohio, state funds that qualify for Federal grant assistance are provided on a loan basis.

new york—NYEFC, created in 1966 as the Pure Waters Authority, began operations in September 1968 and has authority to finance, construct, and operate municipal air pollution control facilities in addition to its solid and liquid waste management and water supply authorities.[44] Basically the corporation is a service organization to help communities that have assessed their own needs and priorities. Unlike MES, it is not designed to impose regional solutions to waste disposal problems.

As of March 31, 1971, NYEFC had outstanding 14 contracts for sewage treatment financing, 17 contracts for sewage treatment construction, and 20 for operation and maintenance of such facilities. Also outstanding were one construction contract for a water supply facility and one contract for operation and maintenance of a solid waste disposal facility. The Corporation's outstanding obligations totaled more than $28 million, and the total value of its contracts was more than $125 million.

ohio—OWDA, established in 1969,[45] has received as of June 1, 1971, a total of 249 applications for assistance from local governments. It has signed agreements with 81—for projects valued at more than $165 million. Five projects have been completed, and 52 projects, costing a total of more than $119 million, are under construction. Two projects for industry are under construction, and one has been finished.

OWDA, like NYEFC, does not have regional planning responsibilities. But projects that it funds must be consistent with regional waste management plans soon to be completed by the Ohio Department of Natural Resources. OWDA, unlike MES, does not have authority to build a facility in order to remedy a violation of standards. However, under the terms of its contracts, it does have authority to take over the operation of any facility —industrial or municipal—which it has financed or constructed, if standards are being violated.

MES, NYEFC, and OWDA are pioneering institutions, each reflecting to some degree the growing awareness that regional planning and facilities, economies of scale, and large-scale financing are important to effective waste management. As waste management problems become more difficult and public demands for a quality environment more intense, such statewide solutions will become more important.

pollution charges—The "effluent fee" or pollution charge has been a key innovation in financing pollution control at the State level. However, its implementation so far has been limited. Vermont passed a law in 1969 levying a charge on dischargers not in compliance with State water quality standards.[46] The Vermont law provides that after July 1, 1971, a "temporary pollution permit" may be issued to a discharger ineligible for a "discharge permit." A discharge permit is issued only for discharges that will not reduce the quality of receiving waters below applicable standards. To receive a temporary permit and avoid legal action by the Water Resources Board, the discharger must show that he is making a bona fide effort to install or develop control facilities or systems, has no reasonable alternatives, and would suffer hardship if the permit were denied. He must also demonstrate that some public benefit will result from issuance of the permit and that the discharge will not unreasonably degrade water quality.

Any temporary permit issued must contain various conditions specified by statute. One of these is periodic payment of a pollution charge, established by the Board "to approximate in economic terms the damage done to other [public and private] users of the waters." This is designed to give permit holders "the economic incentive . . . to reduce the volume and degrading quality of their discharges" during the limited period of time the permit allows to complete remedial action.

The Vermont effluent fee system deviates most sharply from the basic effluent fee concept, as advocated by welfare economists, in this way: The Vermont charge applies only to dischargers determined to be out of compliance with water quality standards. The basic effluent fee concept generally calls for charges to be levied against all dischargers. The July 1, 1971, deadline for implementing the effluent fee law recently was extended for 1 year by the Vermont Legislature to give firms more time to comply with water quality standards. However, firms not complying by July 1, 1972, will be assessed fees retroactive to July 1, 1971.

Michigan recently enacted legislation establishing an effluent and water quality monitoring fee system. That law requires all manufacturing and other commercial dischargers to pay a fee "for the cost of surveillance of industrial and commercial discharges and receiving waters." [47] The fee, assessed annually by the Water Resources Commission and based on the volume and strength of discharge, may range from a $50 minimum administrative fee to $9,000 per location for discharges in conformance with the Commission's effluent restrictions. The law specifies no maximum fee for unlawful discharges. Thus, it apparently could be applied similarly to the Vermont law.

The new waste treatment and disposal program in Maryland, discussed earlier in this chapter, may also be used to impose an effluent fee. Maryland's new Environmental Service is authorized to charge for its services. The Environmental Service Act would permit MES to structure its charges to reflect the costs of environmental damage caused by pollution.

new applications of technology—A promising example of recent innovation in technological experimentation by State governments and their subdivisions is the Muskegon County Wastewater Management System. With more than $2 million from EPA, the Michigan county has initiated a demonstration project using partially treated municipal sewage, which contains soil conditioners and nutrients, to reclaim barren land for agricultural use. When waste water is sprayed on the land, the soil will remove nutrients and absorb heavy metals, both of which are used by plants. The project is designed, however, to prevent overloading of heavy metals in the soil. A drainage network of tiles and wells will return clean water to the county's aquifers, lakes, and rivers—to augment water supply or stream flows. The concept is not new, but the large-scale application of it is.

A bold project that required the cooperative commitment of the county, the State, the Federal Government, and 13 units of local government, the Muskegon County experiment is an example of increasing and needed efforts to reuse waterborne wastes rather than simply collecting them for unproductive and costly disposal. If the project proves viable for widespread application, it will provide an alternative to the conventional municipal

waste treatment plant. Preliminary evaluation suggests the project will be less costly than expensive tertiary treatment that would still result in wastes being discharged into Lake Michigan.

In a related, subsequent development, the Army Corps of Engineers and the Environmental Protection Agency announced a joint program to develop regional waste water management systems for five of the Nation's largest urban centers. In these areas—Boston (Merrimack Basin), Chicago, Cleveland, Detroit, and San Francisco—the two agencies will jointly study alternative waste water management posibilities in close cooperation with State and local governments. Based on the premise that pollutants are potential resources out of place, these studies will consider alternatives such as the Muskegon County system. Only alternatives capable of achieving established water quality standards and compliance schedules will be considered.

With approval from the Commonwealth of Pennsylvania, under a new law requiring State approval of all waste disposal projects,[48] a new type of sanitary landfill has been put into operation near Tullytown. Designed to protect against water pollution, the site is expected to provide refuse disposal space for a number of communities for 8 to 10 years. To prevent polluted water from the landfill from penetrating to underground water supplies or from running off to nearby streams, a membrane barrier has been installed at the base of the landfill to collect all water which penetrates. Surface water that filters down to the membrane flows to collection points where metals and biological materials are removed. The treated water may be discharged to the streams or returned to the landfill where, under certain conditions, its recirculation promotes rapid stabilization of the wastes. The system is intended to permit reclamation of areas such as swamps or low-lying ground, which otherwise would not be used for refuse disposal because of danger to the water table.

Because public concern for environmental protection has focused largely on pollution control, it is not surprising that much of the State and local environmental activity has focused on this area. States also have been pioneering new land use programs. These range from setting up new regulatory authorities and institutions to paying more attention to increasing parks and protecting natural areas.

regulation of land use

In the past year, State control over critical areas and types of land use has increased. Under the U.S. Constitution, States possess the inherent police powers on which land use regulatory authority depends. However, since zoning rules were first applied in New York City in 1916, land use regulation has been

regarded predominantly as an instrument for controlling urban development. Following the pattern prescribed in the Model Standard Zoning Enabling Act published by the Department of Commerce in 1922, most States have delegated land use regulation to local government.

The traditional local zoning system is ill suited to protect broader regional, State, and national values. Local governments have a limited perspective on and little incentive to protect scenic or ecologically vital areas located partially or even entirely within their borders. Economic pressures often spur development to the detriment of the environment because of local government dependence on property taxes.

Local land use regulation alone, therefore, cannot deal effectively with many of today's environmental problems: protecting lands that have natural or esthetic value to a region; accommodating development that is necessary for a region but may not be desired by local communities; and controlling large-scale development that impacts upon more than one local government. Recent State initiatives in land use regulation are aimed at overcoming these disabilities.

protecting wetlands and other key areas—Several States have assumed control of land use in important geographic areas in order to preserve fragile ecological characteristics from incompatible development. For example, legislation in some States has subjected draining, dredging, filling, and development in coastal wetlands to State regulation.

These laws respond to the fact that continued draining, filling, and consequent disappearance of wetlands destroy important wetland-dependent shellfish, marine life, and waterfowl. At least two-thirds of the marine population spends an essential part of its life cycle in estuarine waters—or depends on species that do. (Statistics on wetlands losses in various States are detailed in Chapter 7.)

Wetlands laws often require a prospective developer to obtain permits from both local and State government prior to development in wetlands. The better laws customarily restrict development activities to those compatible with preservation of wetlands for dependent plants, micro-organisms, fish, and wildlife.

The 1963 Massachusetts wetlands protection law, the first such State law, limited certain kinds of development and set up a permit requirement.[49] Additional wetlands legislation in 1965 authorized the State to issue comprehensive protective orders that are recorded as conservation restrictions against deeds and thus are binding on the property through successive ownerships.[50] These orders, issued prior to any development, specify one or more permissible classes of wetlands use for the property to which they are applicable: unqualified (e.g., recreation, hunting, and grazing of stock); conditional (e.g., roadways, under-

ground utilities, mooring slips); and by special permit only (e.g., excavations for boat channels, beaches, boat launching ramps).

As of the spring of 1971, protective orders were recorded against 18,100 acres of Massachusetts coastal wetlands. Orders were pending against other acreage which, if added to the present total, would cover 40,000 of the approximately 45,000 acres of coastal wetlands in the State. A key advantage of the protective order system is that it determines land capability and compatible uses in advance of actual development and related disputes.

In 1969, California expanded the authority of the San Francisco Bay Conservation and Development Commission (BCDC) to protect the Bay's wetlands and to prevent inappropriate, piecemeal filling of the Bay.[51] BCDC, composed of 27 members representing Federal, State, and local governments and the general public, regulates all dredging and filling in the Bay. It has limited jurisdiction over substantial development within 100 feet of the Bay as well as over proposed filling of salt ponds and other wetlands. BCDC will approve only those developments that are water-related and provide public access to the Bay.

Since 1969, the Commission has processed 13 major permit applications, approving all but one. The approved projects provide two new shipping terminals and more than 2 miles of new public access to the Bay. The project for which a permit was denied would have endangered water quality. BCDC received no applications for major Bay fill projects such as subdivisions or refuse dumps—presumably because the law clearly precludes major Bay shrinkage.

Concern for wetlands protection has led at least two States, Arkansas and Maryland, to establish inventory systems to identify particularly vulnerable areas. The Arkansas Act[52] aims to preserve disappearing wetlands in the eastern part of the State. Related measures seek to save trees growing below the high water mark in navigable streams[53] and to bring the use and disposition of islands formed in such streams under State and local control.[54]

Maryland's inventory program is part of a broader scheme of wetlands protection. The Wetlands Act of 1970 directs the Secretary of the Department of Natural Resources to inventory all private wetlands and to establish their boundaries.[55] The Act also requires a license for dredging or filling and for removing or otherwise altering or polluting private wetlands.

After studying the State's long winding coast, Florida's Coastal Coordinating Council, an advisory board, has recommended protective zones for marshes, mangrove areas, beaches, and other environmentally vulnerable terrain. Certain State-owned estuarine areas are already protected through a system of aquatic

preserves.[56] The State recently added five new preserves, bringing the total to 31.

In June 1971, Delaware enacted a far-reaching Coastal Zoning Act prohibiting new heavy industrial development and strictly regulating all other new industrial development within a 1- to 6-mile strip along the 100-mile Delaware Bay coast and along the State's 25-mile Atlantic coast.[57] The law flatly prohibits additional oil refineries and petrochemical complexes, basic steel manufacturing plants, pulp paper mills, and offshore bulk facilities. It cites garment factories, auto assembly plants, and jewelry and leather goods factories as industries that may continue to locate in the coastal zone, but only by permit. The Delaware law embodies a clear-cut decision to preserve for recreation and tourism—and to reject as a site for major industry —a large area uniquely suited by geography for either purpose. By banning offshore transfer facilities, the State bars the use of Delaware Bay as a major deep water port for supertankers and other large bulk carriers. The law describes transfer facilities as representing a "significant danger of pollution to the Coastal Zone" and as magnets for new, unwanted development and growth.

Although most "area control" land use initiatives have involved coastal wetlands, land-locked Colorado in 1971 called on its State Land Use Commission to define "critical conservation and recreation areas" and recommend them to the legislature for State regulation.[58] Various environmental characteristics, such as ecological vulnerability and scenic quality, qualify Colorado lands to be considered areas for State regulation.

An increasing number of States is becoming concerned about prime agricultural land near urban areas that is rapidly being taken over by housing, industrial, and other development. This concern springs from the desire to prevent urban sprawl and to preserve urban area open space as well as from the desire to preserve prime agricultural lands. New York recently enacted a law that permits the State after 3 years to zone up to 3 million of the State's 5 million acres of farmland into agricultural districts that will be protected from incompatible development.[59] This law goes beyond the preferential assessment laws in a number of States which permit farmers voluntarily to enroll their land as agricultural in order to obtain property tax assessment based on its agricultural value rather than on its often much higher development value. Such laws, often designed to mitigate the economic pressure on farmers to sell land to developers, have had mixed success thus far.

restricting potentially harmful development—Certain kinds of development may concern a State regardless of its proposed location or the character of the land involved. The impact of some development is felt well beyond its immediate vicinity. A power-

plant, for example, may need large volumes of cooling waters, emit air pollutants, and require transmission line corridors. A large airport generates problems of noise and of ground access to the surrounding area. A large recreational area or amusement park can clog nearby communities with heavy traffic from visitors attracted to new surrounding commercial developments—restaurants, motels, or service stations.

Several States have enacted laws to control the siting of new electric powerplants. In 1970, California established long-range planning requirements and a certification procedure.[60] Maryland enacted legislation authorizing the State to purchase powerplant sites in advance of need.[61] Washington created a siting board composed of State agency representatives,[62] and Oregon has set rigid standards for the siting of nuclear powerplants.[63] New York enacted controls over the location of transmission lines.[64]

Many areas around major airports, developed with little land use control, are largely incompatible with the needs and functions of the airport or surrounding communities. The result has been noise complaints, ground traffic congestion, and disorderly development. In 1969, Minnesota came to grips with the problem, implementing an Airport Zoning Act to control development around major airports.[65] The law vested in a Metropolitan Airport Commission responsibility for planning and siting airports in the Minneapolis-St. Paul area. The Commission's comprehensive plans for siting must be approved by a 15-member Metropolitan Council, which has overall metropolitan planning and development authority, before an airport can be built. The Council also formulates guidelines for land use around airport sites. Local governments are required to obtain Council approval for all land use regulations within the vicinity of the airport. Thus, the Metropolitan Council effectively controls both selection of a new airport site and the subsequent use of land around it, based on planning by the Commission.

One of the most innovative State land use initiatives taken in 1970 was in Vermont. Following a decade of burgeoning second-home and ski resort development and facing the prospect of continued growth and development in the years ahead, Vermont moved to protect its land and waters from inappropriate or excessive development.

Legislation was passed in the spring of 1970 establishing a State Environmental Board, an independent regulatory board within the Agency of Environmental Conservation.[66] The Environmental Board is charged with adopting two types of plans to guide and coordinate development within the State: A capability plan will describe land use capabilities and outline planning criteria. A land use plan then will delineate two types of areas—those generally suited for development, subject to conditions assuring compatibility with the environment of the area, and

those not appropriate for development, except under very special circumstances, because of their vulnerable ecological characteristics or their special historic or scenic value.

Prior to adoption, both plans will receive wide publication. Comments will be solicited at public hearings from citizen groups and from planning agencies. Adoption requires approval of the Governor and of the Vermont Legislature.

The Vermont law also establishes district commissions to grant or deny application for the use of sites for development and subdivisions. This permit system is designed to make development compatible with the State land use plan. For example, recognizing the vulnerability to erosion, special waste disposal problems, delicate plant life, and beauty of its mountain areas, the Vermont law requires a State permit for all commercial, industrial, and residential development above 2,500 feet, regardless of acreage or size. At lower elevations, permits are required for development of more than 10 acres, or if there is no local zoning, developments of more than one acre. Housing projects of less than 10 units within a 5-mile radius are exempt. Permit applications must include a complete plan for the layout of the proposed development, statements of costs, financing, and purpose, proposed utilities systems, and adjacent land uses.

Before a permit is granted, a district commission normally holds a public hearing. It must find that the development will not cause undue air or water pollution; that it will have an adequate water supply without siphoning from existing systems; that it will not create heavy pressures on roads, educational facilities, and municipal services; that it will not mar the natural beauty of the area; and that it is consistent with land use plans.

As of April 1, 1971, district commissions had received 234 applications and acted on 177. Ten decisions had been appealed to the Environmental Board. Five had been decided, four were pending, and one had been withdrawn. Several appeals from Board decisions are pending in the Vermont Supreme Court, but none appears to challenge the validity of the statute. The Vermont experience will be watched nationally as one of the most ambitious and sophisticated State efforts in land use regulation.

Another New England State, Maine, also acted in 1970 to control large-scale development. Moved by the threat that development would damage scenic and biologically important coastal sites and realizing that Maine laws provided very little authority over land use, the legislature passed a new Site Location Law.[67] Certain types of commercial or industrial development require a permit from the Environmental Improvement Commission. They include any development on a land area which is in excess of 20 acres, or which involves drilling or excavating natural resources or building structures in excess of 60,000 square feet on a single site. Residential developments

which are in excess of 20 acres, or which would require a pollution permit, have been defined by the Commission as commercial developments requiring permits.

The law provides that anyone proposing such development must file a notice of intent together with a description of the type and location of the development. An applicant must file an extensive informational form and request review of his proposal by a number of State and local agencies, including regional and local planning bodies. When reviewing agencies recommend that conditions be imposed, the Environmental Commission usually complies.

The criteria for granting, denying, or conditioning permits are similar to those in the Vermont law. They include pollution impacts, congestion of facilities, esthetics and natural systems, and suitability of soil. The Commission approves the application only when the criteria are met, with the burden of proof on the applicant.

As in the case of the Vermont law, it is too early to judge the effectiveness of Maine's Site Location Law. Almost all of the more than 90 final Commission decisions rendered have granted permits subject to conditions. However, in the first major controversy faced by the Commission, a proposal to construct a $150 million oil refinery on Sears Island, the permit was denied, on environmental grounds.

facilitating desired development—Maine and Vermont's concern over the environmental consequences of ill-planned or unregulated development caused them to impose controls. Other States have done so out of a concern that restrictive or uncoordinated local land use regulations may interfere with desirable development. New Jersey's regulation of the Hackensack Meadowlands is an example.[68] New Jersey's authority for comprehensive planning and land use regulation in this area, which includes portions of 13 municipalities and contains substantial wetlands, is based on the State's interest in encouraging effective regional development. It is intended that the State commission regulating land use in the Meadowlands will prevent environmental damage. But protection of the environment is not the State's primary objective—development is. An interesting feature of this regulatory system is a tax-sharing mechanism to distribute proceeds from development equitably among the area's municipalities.

Another example is the Massachusetts Zoning Appeals Law.[69] It was enacted in 1970 to permit the State to override local decisions that unduly restrict or exclude development of publicly assisted housing. Because of the severe shortage of housing for low- and moderate-income families in the Boston metropolitan area, the Legislature established a Housing Appeals Committee. It now rules on local decisions that deny permission to develop housing.

Local control over land use is left intact, and local ordinances and regulations remain in force. The statute merely superimposes procedures and standards when a qualified low-income housing developer applies for a permit. If the developer can show that a local denial or condition was not "reasonable and consistent with local needs," the Housing Appeals Committee may order the permit granted.

The key element in the statutory scheme is the definition of "consistent with local needs." Local requirements and regulations are "consistent with local needs" if they are reasonable in light of the regional need for low and moderate income housing.

The second element of the "local needs" standard aims to protect health or safety, preserve open space, promote better site and building design, and apply regulations equally to both subsidized and unsubsidized housing. The statute does not specify the exact weight which the Committee may give to local planning objections. But the effect appears to be that the Committee will overturn the local decision unless the proposed project offends neutrally applied local planning standards.

As of the end of April 1971, only four appeals had reached the Committee. Two were withdrawn and there was no final decision on the others.

Since 1968, the State of New York has sought an end similar to the Massachusetts Zoning Appeals Law through its State Urban Development Corporation, which is empowered—but has not yet acted—to override local zoning and building codes when special housing needs exist.[70] A new building code enacted in Ohio in 1970 for factory produced housing is also designed to facilitate the siting of desirable development.[71]

State laws to encourage housing development, though not strictly environmental in the traditional sense of the term, are important because they demonstrate how States can exercise their authority to assure socially desirable land use that has impact beyond the local level. However, such laws can also stir conflicts between State and local governments. A development socially desirable in one sense may impose costs for public services larger than the local tax revenues that the development will generate. Or development may be resisted because social problems are feared.

Laws curbing development for the sake of the environment also may trigger State-local conflicts when local communities balk at losing tax revenues that new construction would generate. State and local development-limiting regulations often raise the question of how far regulation may legally go before it becomes a "taking" of property—for which compensation is constitutionally required. State and local governments are wrestling with this problem throughout the country. The fear that compensation might be required has prevented much needed regulation

of wetlands and other natural areas. Nonetheless, States are moving ahead, albeit slowly, to build a framework of land use controls compatible with the need for both environmental protection and orderly growth. (For a discussion of recent case law developments, particularly with respect to the "taking" issue, see Chapter 5.)

parks and natural areas

As the pace of our society continues to quicken and as crowding and congestion continue to frustrate Americans who live in urban-suburban complexes, traditional State and local responsibility for natural resource management and public recreation becomes even more vital. Many States and their political subdivisions are moving to plan and develop parklands and to identify and preserve unique natural areas.

A recently completed survey by the National Recreation and Parks Association shows all the national statistical indicators on State park expenditures, employment, and usage up from past years (see Table 2).

Table 2

State Park and Recreation Programs

	1967	1970	Percent increase
	(in millions)		
Expenditures			
Salaries and wages	77	121	57.1
Supplies and equipment	37	59	59.5
Lands	57	72	26.3
Improvements	108	126	16.7
Grants to local agencies	16	16	0.0
Other	NA	8	NA
Total	$295	$402	36.3
Attendance			
Day visitors	355	432	21.7
Overnight visitors	36	51	41.7
Total	391	483	23.5
	(in actual figures)		
Personnel			
Year round	11,477	13,363	16.4
Seasonal	17,774	21,042	18.4
Total	29,254	33,405	17.6
Areas	3,202	3,426	7.0
Total acreage	7,352,322	8,554,940	16.4

NA=Not Applicable.

Source: National Recreation and Park Association.

State park agencies administer over 8.5 million acres of parkland—nearly 1.1 million of it newly acquired in 1970. The total spent on these lands amounted to more than $400 million in 1970, including $72 million for land acquisition, $126 million for capital improvements, and $121 million for salaries and wages. More than 34,000 individuals were employed by State park agencies in 1970—61 percent seasonal or part time.

A significant part of this progress—especially in land acquisition—traces back to the catalytic function performed by grants-in-aid under the State portion of the Federal Land and Water Conservation Fund.[72] Through the life of the program, fiscal year 1965 to fiscal year 1971, more than 700,000 acres have been bought with approximately $158 million in Federal payments, representing half the cost of each project. State, city, and county governments obligated their fiscal year 1971 apportionment under the program at a high rate to acquire roughly 150,000 acres for about $38.3 million.

Grants from the Interior Department's Bureau of Outdoor Recreation to buy special or unique areas included 239 acres at Burton Island for the Delaware Seashore State Park; the Federal share was $971,000. California acquired 320 acres for the Humboldt Redwoods State Park with a $513,000 Federal share. And Florida bought 9,219 acres of Payne's Prairie near Gainesville with a Federal matching grant of $1.05 million.

Beyond the impetus of Federal grants, States have cataloged an impressive record on their own. In Alaska, for example, citizens approved a $2.3 million bond issue for parks, and the State assembly established four new State parks covering a total of more than 1 million acres. The largest of these embraces 459,000 acres. The Louisiana Legislature approved a major bond issue to finance camping facilities and other capital improvements at four existing State parks. The bond issue also funds development of a detailed parks master plan.

Maryland has initiated an open space grants-in-aid program which will provide $86 million for land acquisition and development over the next 5 years.[73] Maryland also recently passed legislation granting property tax exemptions for land held by the Nature Conservancy (see Chapter 3, Citizen Activity) provided it is ultimately intended for public ownership.[74]

Foreshadowing the urban focus of the President's "Legacy of Parks" proposal, Oregon recently established its first sizable State park within a densely populated metropolitan area—the 257-acre Tryon Creek State Park in Portland. Spurred largely by citizen initiative, the park will grow to about 600 acres. In another innovative move, Oregon's legislature, in its 50th biennial assembly, passed a measure which will free $1.3 million in State highway funds for bicycle and hiking trails development.[75]

Pennsylvania's State park system, also sensitive to the need for

parks serving the city dweller, has one urban-oriented park under development and several more planned. Ridley Creek State Park is 45 minutes from downtown Philadelphia and when completed, will serve 25,000 people a day. Although designed to preserve a rural setting, the park will interact in many ways with a number of urban based needs: inner city youth work projects, regular and vocational school programs, and general programs in environmental education.

Another State park in southeastern Pennsylvania—Nolde Forest—will become an "environmental classroom." The entire 656-acre park will be managed to heighten knowledge and understanding of the environment.

Green River Gorge Conservation Area in the State of Washington will also be developed into an outdoor classroom. This natural area is located 20 miles from downtown Seattle, protected from damaging encroachment by steep canyon walls. The State Parks and Recreation Commission will acquire and develop adjacent areas for access and facilities while preserving the spectacular natural character of the gorge itself.

Many States have established scenic river and trail systems. Among them are California, Maine, Maryland, Michigan, Minnesota, Ohio, and Wisconsin. In addition, Alabama, Florida, Georgia, Iowa, Louisiana, Oklahoma, Oregon, Tennessee, Virginia, and West Virginia have set up scenic river systems. Alaska, Colorado, Massachusetts, and Washington have established scenic trails systems.

Oregon has brought portions of the Rogue, Illinois, Owyhee, and John Day Rivers and the entire Minam River into its scenic river system. And the Oregon Scenic Waterways Act of 1970 [76] calls for continuing studies and periodic reports to the Governor identifying and recommending other rivers for scenic designation. Oregon prohibits construction of dams and reservoirs on scenic rivers. It requires private or public owners to give 1 year's notice before mining, cutting trees, or building roads or other structures on riverfront lands.

The Michigan Natural Rivers Act of 1970 [77] establishes a system of wild, scenic, and recreational rivers regulated by the State Natural Resources Commission. The Commission may direct that lands along designated rivers be controlled by zoning and may adopt zoning ordinances if the local governments fail to do so within 1 year. Commission approval is mandatory for bridges, roads, and other buildings along scenic river lands. Florida's system of wild and scenic rivers includes a network of marked canoe trails, which have been publicized by a special brochure.

The encouraging moves noted above reflect one aspect of the larger surge of community concern about environmental quality However, most States and localities need to do more than they

have to add to their park systems and to make them more accessible to and suitable for modern urban society. There also remains a tremendous unmet challenge in protecting natural areas for present and future generations. Unfortunately, aggressive programs are difficult to initiate as competition stiffens for funds. The situation is especially critical for municipalities. But some States, as well, have either cut back their programs to purchase and develop park and natural areas or soon will. The President's "Legacy of Parks" program, if approved by the Congress, would help sustain, and even quicken the pace of, State and local park and open space purchases.

summary

Action at the State and local levels to preserve and enhance the environment has been both varied and impressive. State and local governments are carrying out organizational reforms, increasing their enforcement activities—often with limited statutory authority, increasing the funding and manpower for environmental programs, tightening pollution control standards, and both proposing and enacting a wide range of new legislation.

In many areas of environmental concern, a spectrum of innovative approaches is being tried, while in others—such as regulation of phosphates in detergents—a common formula is widely used. There is a definite trend of increased land use regulation by States, but the form and content of such regulation differ considerably from State to State.

The many successful or promising examples of State and local environmental action belie persistent and fundamental problems: severe fund shortages in many States and in many types of environmental protection activities; glaring manpower deficiencies, often largely attributable to unattractive pay scales; and reluctance or inability of many officials to stand up to polluters and irresponsible land developers.

As the Federal Government develops more adequate data on State and local activities, more precise evaluations can be made of the extent to which these problems are being solved.

footnotes

1. Cal. Health & Safety Code §39052(a). *See also id.* §§39052.5, 39101–39106.
2. 42 U.S.C. §1857f–1 *et seq.*
3. S.745, H.R. 4152, 92nd Cong., 1st Sess. (1971).
4. Minn Stat. Ann §16.01 *et seq.*
5. Wis. Stat. Ann. §15.34 *et seq.*
6. 42 U.S.C.A. §§1857–185a; 49 U.S.C.A. §§1421, 1430; 50 App. U.S.C A. §456.
7. Ala. Code tit. 8, §288 *et seq.*
8. Administrative Code of City of New York, §892–1 0 *et seq.*
9. *Oriental Boulevard Co.* v. *Heller*, 27 N.Y.2d 212, 265 N.E. 2d 72 (1970).

10. 42 U.S.C.A. §§1857f-1, 1857f-6a.
11. 36 Fed. Reg. 8172 (1971).
12. Mich. Stat. Ann. §9.2607.
13. 85 P.U.R.3d 199 (Ill. Commerce Com. Docket No. 55149).
14. Ill. Ann. Stat. ch. 111 1/2, §1001 *et seq.*
15. Cal. Water Code §13000 *et seq.*
16. Ch. 177, [1971] N.J. Laws; H. 1086, [1971] Rhode Island Laws.
17. Colorado Water Pollution Control Commission Rules & Regulations for Subsurface Disposal Systems.
18. Public Act No. 248, [1971] Conn. Laws; Public Act No. 71-35, [1971] Fla. Laws; H. Bill No. 1551, [1971] Ind. Laws; Ch. 323, [1971] Me. Laws; Ch. 896, [1971] Minn. Laws; Ass. Bill No. 6963-A, [1971] New York Laws.
19. 33 U.S.C.A. §1160.
20. N.J. Stat. Ann. §13:1D-1 *et seq.*
21. Ch. 264, [1970] Kansas Laws.
22. N. C. Gen. Stat. §130-166.18.
23. 42 U.S.C. §3251.
24. 42 U.S.C.A. §325(a)(2).
25. Ore. Rev. Stat. §390.805.
26. Ch. 71-36, [1971] Fla. Laws.
27. Ch. 255, [1971] North Dakota Laws.
28. Chicago Municipal Code §§ 17-1.6 to -4.21.
29. Cal. Vel. Code §23130.
30. Conn. Gen. Stats. Ann. §14-80.
31. N.Y. Veh. & Traf. Law §386.
32. Cal. Vel. Code §27160.
33. 320 F. Supp. 172 (D. Minn. 1970), *appeal docketed,* No. 71-1093, 8th Cir., February 22, 1971.
34. Dresden Nuclear Power Station, 2 E.R.C. 1302 (Ill. Pollution Control Board, 1971), *appeals docketed,* No. 56040, Ill. 1st App. Div., June 1, 1971, and No. 71-47, Ill. 3d App. Div., June 2, 1971.
35. 42 U.S.C. §2011 *et seq.*
36. N.Y. Envir Conserv. Law §1 *et seq.*
37. Wash. Rev. Code Ann. §43.21A.010 *et seq.*
38. Ill. Ann. Stat. ch. 111 1/2, §1001 *et seq.*
39. Mich. Stat. Ann. §14.528(202).
40. Ill. Ann. Stat. ch. 111 1/2, §1001 *et seq.*
41. *Id.*
42. Ill. Const. amend. XI, §2, effective January 1, 1972.
43. Md. Ann. Code art. 33B, §1 *et seq.*
44. N.Y. Pub. Auth. §1280 *et seq.*
45. Ohio Rev. Code Ann. §6121.01 *et seq.*
46. Vt. Stat Ann. tit. 10, §912a
47. Mich. Stat. Ann. §3.533.
48. Pa. Stat. Ann. tit. 35, §6001 *et seq.*
49. Mass. Ann. Laws ch. 130, §27A.
50. Mass. Ann. Laws ch. 130, §105.
51. Cal. Gov't Code §66600 *et seq.*
52. 1971 Arkansas Act. No. 297.
53. 1971 Arkansas Act. No. 142.
54. 1971 Arkansas Act No. 297.
55. Md. Ann. Code art. 66C, §718 *et seq*
56. Fla. Stat. Ann. §258.17 *et seq.*
57. Ch. 171, Vol. 58, [1971] Delaware Acts.
58. S. Bill No. 91, [1971] Colorado Laws.
59. Ch. 479, [1971] New York Laws.
60. Cal. Pub. Util. Code §2851 *et seq*
61. Md. Ann. Code art. 66C, §766.

62. Wash. Rev. Code §80.50.010.
63. Orc. Rev. Stat. 609.
64. N.Y. Pub. Serv. Law §120 *et seq.*
65. Minn. Stat. Ann. §360.74.
66. Vt. Stat. Ann. tit. 10, §6021 *et seq.*
67. Me. Rev. Stat. Ann. tit. 38, §481 *et seq.*
68. N.J. Stat. Ann. §13:17-1 *et seq.*
69. Mass. Ann. Laws ch. 40B, §21 *et seq.*
70. N.Y. Unconsol. Laws §6251 *et seq.*
71. Ohio Rev. Code Ann. §124 21 *et seq.*
72. 16 U.S.C. §4601-4 *et seq.*
73. Md. Ann. Code art. 66C, §357B *et seq.*
74. Md. Ann. Code art. 81, §9(54).
75. H. Bill No. 1700, [1971] Oregon Laws.
76. Ore. Rev. Stat. §390.805.
77. Mich Stat. Ann. §11.501 *et seq.*

appendix
funding and manpower for air and water quality agencies

Table A-1

Funding and Manpower for State and Local Air Pollution Control Agencies, 1970–71

(In thousands of dollars)

State	Fiscal year 1970 funding			Fiscal year 1971 budgeted [1]			Fiscal year	
	Federal	State and local [2]	Total	Federal	State and local [2]	Total	1970 man-years	1971 man-years
Alabama	15	156	171	15	169	184	10	12
Alaska	54	21	75	54	23	77	6	6
Arizona	314	243	557	314	382	696	48	47
Arkansas	49	44	93	60	49	109	4	10
California	2,069	7,665	9,734	2,463	10,114	12,577	614	635
Colorado	567	560	1,127	611	636	1,247	71	74
Connecticut	407	272	679	448	484	932	48	56
Delaware	249	148	397	197	172	369	26	31
District of Columbia	213	107	320	234	117	351	21	21
Florida	488	658	1,146	961	734	1,695	90	123
Georgia	316	192	508	358	344	702	35	65
Hawaii	0	73	73	0	205	205	7	14
Idaho	46	37	83	47	38	85	6	2
Illinois	1,391	3,477	4,868	1,255	2,831	4,086	212	291
Indiana	380	454	834	323	580	903	61	71
Iowa	87	86	173	92	180	272	9	29
Kansas	127	61	188	141	94	235	29	31
Kentucky	341	393	734	534	529	1,063	54	76
Louisiana	120	106	226	154	182	336	15	16
Maine	54	27	81	36	18	54	2	6
Maryland	1,307	899	2,206	1,426	910	2,336	124	173
Massachusetts	415	324	739	575	436	1,011	33	61
Michigan	1,336	662	1,998	1,331	956	2,287	59	116
Minnesota	346	231	577	350	369	719	42	46
Mississippi	44	23	67	46	24	70	3	6
Missouri	733	583	1,316	761	598	1,359	104	107
Montana	106	85	191	131	97	228	10	17
Nebraska	30	15	45	90	46	136	3	8
Nevada	148	130	278	159	136	295	22	26
New Hampshire	32	34	66	45	38	83	6	7
New Jersey	788	796	1,584	1,430	1,323	2,753	149	177
New Mexico	78	87	165	217	148	365	11	23
New York	2,332	7,876	10,208	2,629	8,784	11,413	628	720
North Carolina	454	246	700	578	396	974	55	81
North Dakota	15	13	28	15	12	27	3	4
Ohio	730	1,054	1,784	904	1,422	2,326	84	129
Oklahoma	90	84	174	105	114	219	13	21
Oregon	557	420	977	547	524	1,071	55	57
Pennsylvania	1,958	1,641	3,599	2,604	2,424	5,028	204	295
Rhode Island	114	66	180	83	42	125	8	12
South Carolina	224	166	390	295	359	654	23	44
South Dakota	0	0	0	14	7	21	0	3
Tennessee	503	259	762	788	416	1,204	58	100
Texas	1,139	693	1,832	1,475	960	2,435	155	182
Utah	123	80	203	99	122	221	12	17
Vermont	21	15	36	53	26	79	3	6
Virginia	231	146	377	320	306	626	34	42

Table A–1—Continued

Funding and Manpower for State and Local Air Pollution Control Agencies, 1970–71

(In thousands of dollars)

State	Fiscal year 1970 funding			Fiscal year 1971 budgeted [1]			Fiscal year—	
	Federal	State and local [2]	Total	Federal	State and local [2]	Total	1970 man-years	1971 man-years
Washington	1,222	981	2,203	1,212	1,246	2,458	93	85
West Virginia	138	110	248	221	226	447	14	27
Wisconsin	57	34	91	100	137	237	7	14
Wyoming	16	9	25	26	14	40	3	4
Guam	0	0	0	9	7	16	0	1
Puerto Rico	144	108	252	141	104	245	25	25
Virgin Islands	30	16	46	39	20	59	4	4
Total	22,748	32,666	55,414	[3]27,115	[4]40,630	67,745	3,414	[5]4,256

[1] Data represent activities of air quality agencies, not expenditures for pollution control facilities. Most States follow the Federal July–June fiscal year, although some use the calendar year or another 12-month period.

[2] Data for State and local agencies are substantially complete although they include only agencies receiving Federal financial assistance.

[3] 19.15 percent increase over 1970 level.

[4] 24.38 percent increase over 1970 level.

[5] 24.69 percent increase over 1970 level.

Source: Environmental Protection Agency, Office of Air Programs.

Table A-2

Funding and Manpower for State Water Quality Agencies, 1970–71 [1]

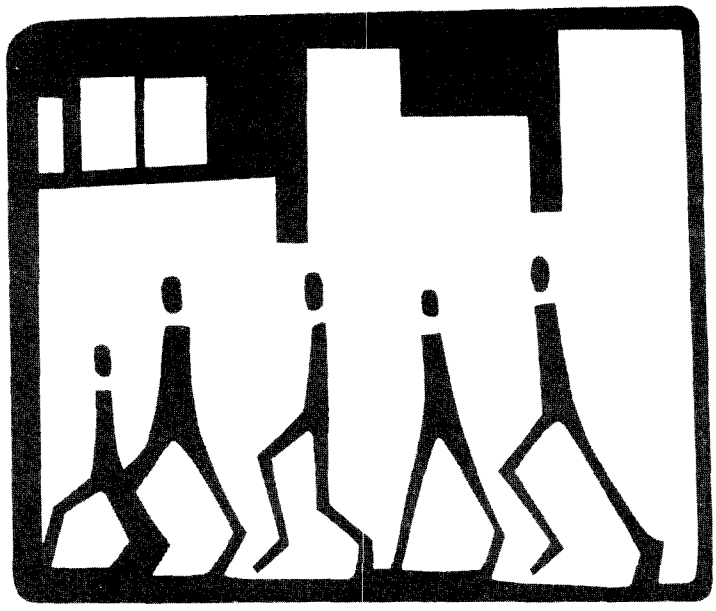
State	Fiscal year 1970 funding			Fiscal year 1971 budgeted			Fiscal year 1970 man-years	Fiscal year 1971 man-years
	Federal	State	Total	Federal	State	Total		
Alabama	185,012	58,068	243,080	180,500	158,750	349,250	21.90	22.20
Alaska	20,100	56,280	76,380	20,000	114,700	134,700	8.20	15.00
Arizona	69,377	59,003	128,380	75,500	88,117	163,617	12.75	11.00
Arkansas	118,169	182,401	300,570	115,700	275,000	390,700	27.30	35.00
California	662,480	2,314,066	2,976,526	661,100	2,801,270	3,462,370	239.00	192.30
Colorado	84,970	141,463	226,433	88,000	220,495	308,495	20.00	21.00
Connecticut	169,311	324,787	494,098	167,400	503,905	671,305	50.80	64.80
Delaware	86,267	217,312	303,579	85,900	202,200	288,100	36.33	33.75
District of Columbia	89,055	271,515	360,570	87,800	579,744	667,544	51.70	63.80
Florida	267,440	462,300	729,740	266,300	658,519	924,819	68.50	72.00
Georgia	223,337	412,894	636,231	218,700	535,544	754,244	38.00	50.00
Hawaii	65,100	114,781	179,881	71,100	184,900	256,000	24.20	31.00
Idaho	42,957	173,467	216,424	44,100	214,000	258,100	9.75	20.30
Illinois	379,097	645,359	1,024,456	428,000	2,327,340	2,755,340	95.00	188.00
Indiana	229,696	346,732	576,428	230,000	484,358	714,358	66.03	56.80
Iowa	123,699	121,309	245,008	121,200	124,580	245,780	15.25	22.75
Kansas	98,724	321,285	420,009	97,600	426,400	524,000	37.75	49.61
Kentucky	171,210	218,059	389,269	165,000	327,546	492,546	33.00	45.80
Louisiana	187,743	266,887	454,630	194,100	321,502	515,602	40.00	49.00
Maine	64,122	371,023	435,145	63,000	397,093	460,093	24.00	29.80
Maryland	143,480	1,135,869	1,279,349	181,300	1,369,830	1,551,130	69.20	82.60
Massachusetts	224,604	413,490	638,094	264,600	457,598	722,198	68.00	58.05
Michigan	358,303	659,392	1,018,195	357,900	992,200	1,350,000	91.00	95.50
Minnesota	156,951	561,430	717,681	155,400	661,965	817,365	60.40	60.00
Mississippi	148,000	123,236	272,235	146,100	72,550	217,650	25.75	25.00
Missouri	198,388	224,496	423,884	196,700	230,634	427,334	31.50	31.50
Montana	33,886	69,117	103,013	39,000	68,668	107,668	7.00	7.00

Nebraska	65,404	77,809	144,313	66,400	117,611	183,451	13,29	41,90			
Nevada	21,405	32,682	54,167	23,767	34,213	57,980	5,50	5,71			
New Hampshire	63,488	900,644	964,032	63,500	517,528	581,028	65,00	66,00			
New Jersey	313,742	856,408	1,170,150	311,900	725,284	1,037,184	77,95	68,90			
New Mexico	90,875	36,943	97,818	62,300	113,000	185,300	11,30	13,60			
New York	871,175	4,348,545	6,020,720	659,400	4,564,632	5,216,632	388,08	300,00			
North Carolina	269,764	438,219	707,383	264,600	509,930	774,530	56,50	97,00			
North Dakota	34,398	30,464	64,862	27,200	27,700	54,900	5,60	5,45			
Ohio	445,000	495,549	940,549	447,300	819,875	1,267,175	67,50	60,00			
Oklahoma	119,156	138,437	257,593	117,600	181,088	298,688	13,80	35,90			
Oregon	436,504	497,780	934,901	96,900	468,835	565,735	38,20	47,60			
Pennsylvania	110,443	1,779,523	2,276,027	488,300	2,085,978	2,574,278	205,00	170,61			
Rhode Island	159,749	163,827	274,270	111,800	187,200	299,200	23,65	32,65			
South Carolina	41,165	200,631	360,380	157,400	365,474	522,874	36,50	42,80			
South Dakota	212,537	58,683	99,848	38,900	66,500	105,600	11,70	7,30			
Tennessee	436,961	108,780	401,317	208,200	123,320	937,520	31,50	37,50			
Texas	54,592	1,796,201	2,233,152	427,000	1,771,339	2,198,339	133,00	145,00			
Utah	43,999	62,466	117,047	55,400	92,052	147,452	11,35	12,67			
Vermont	212,858	216,078	260,077	43,700	239,820	283,520	21,60	23,60			
Virginia	131,037	626,220	838,078	210,300	1,065,740	1,276,240	78,90	100,00			
Washington	111,682	997,205	1,128,242	131,037	1,025,803	1,156,840	73,50	73,50			
West Virginia	196,393	173,790	285,472	111,682	233,870	345,552	28,50	28,60			
Wisconsin	23,786	959,602	1,165,996	193,000	1,402,000	1,595,000	75,00	83,00			
Wyoming	46,719	31,302	55,038	23,600	39,400	63,000	2,60	3,00			
Guam	198,900	43,105	89,824	75,000	39,469	114,469	7,80	10,60			
Puerto Rico	52,725	106,234	305,134	195,000	182,813	377,813	26,50	36,99			
Virgin Islands		35,326	88,050	70,300	35,150	105,450	10,40	10,90			
Total	9,334,796	24,956,011	34,290,807	9,392,806	32,051,045	[1] 41,443,451	2709.11	[2]2934.75			

[1] Data represent activities of water quality agencies, not expenditures for pollution control facilities. Fiscal year refers to the Federal July–June fiscal year.
[2] 20.86 percent increase over 1970 expenditures.
[3] 2.3 percent increase over 1970 level.

Source: Environmental Protection Agency, Office of Water Programs.

3



the past year—private activity

Government can only do so much. The rest is up to the private sector. Our system leaves a lot to its citizens, encouraging them to seek reform directly instead of always turning to government. And even the most stringent regulation of industry will not alone succeed in moving it to meet its social and legal obligations.

This chapter provides a perspective on—and some examples of—actions by both citizens and industry on behalf of a higher quality environment.

industry action

Industry moves the Nation, but while doing so, generates a large share of its total wastes—hence its pollution. Industrial sources account for an estimated one-third of total air pollution from the five major pollutants—sulfur oxides, nitrogen oxides, hydrocarbons, particulates, and carbon monoxide—and for three-fourths of stationary source emissions, which include the most damaging air pollutants.

Industrial operations also heavily pollute the Nation's waters. Manufacturing facilities discharged in 1964, the latest estimate available, wastes with a biochemical oxygen demand (BOD) four to five times larger than that of the entire population of the United States. BOD is a measure of the oxygen needed to de-

compose organic wastes. Estimates for 1970, based on American Water Works Association data, show that industry uses 10 times more water than municipal systems. And the ratio is rising.

Industrial pollution is generally more toxic than municipal pollution. Heavy metals such as mercury and cadmium, arsenic, organic chemical compounds, and other toxic wastes come to our waterways largely from industrial operations.

Industry also generates a large percentage of the Nation's nonagricultural and nonmineral solid wastes. Compared with the 250 million tons of solid waste from residential, commercial, and institutional sources in 1969, industry generated 110 million tons. Industrial wastes often are much more toxic and difficult to dispose of than the mixed wastes of municipalities.

Large-scale reduction in the levels of the most serious pollutants requires an effective and sustained effort by industry. This means not only installing pollution control equipment and other facilities, but developing new technology. It often means major changes in management policies.

innovating with technology

Industrial innovation in manufacturing and marketing has made the United States a world leader in technology and material well-being. But industry now must also use its innovative capabilities to solve pollution problems. For some municipal and industrial pollutants, control technology has yet to be developed. Similarly, advanced technology is needed to reach levels of control not yet achievable for some common pollutants.

A number of technological innovations by industry have already contributed dramatically to our present ability to cope with pollution or soon may do so. The electrostatic precipitator, developed years ago, has made possible virtual elimination of all fly ash and dust emissions from fuel-burning facilities. The Monsanto Co., a large chemical producer, has recently developed a catalytic oxidation process—now being demonstrated at an electric power plant—to remove sulfur oxides from stack gases. General Electric is developing a radically new design for cooling towers that are used to dissipate waterborne waste heat. Its low velocity plume could prevent the localized fog that surrounds most cooling towers.

Pulp and paper mills historically have been major sources of water pollution. St. Regis Paper Co. is pioneering a closed system for water recycling. Black liquor, normally a harmful waste byproduct of paper production, is converted into activated carbon, which is then used to filter wastes out of the paper mill's water effluent. The filtered effluent water is clean enough to be recycled and reused by the mill.

Many firms have undertaken complex research and develop-

ment to provide new solid waste recycling technology. Garret Research & Development, a subsidiary of Occidental Petroleum, is developing a coal liquification process and is experimenting with the same equipment to recycle solid wastes. The potential end products will be saleable metals, low-sulfur heating oil, and a char which may be useful for waste water treatment. Several firms are experimenting with pyrolysis, a form of incineration, as a means for solid waste disposal without air pollution problems.

Despite progress, much remains to be done. Technology to control sulfur oxides and nitrogen oxides emissions is not yet commercially proven. Better technology must be developed to control heavy metals and other toxic substances, many of which only recently have become measurable in the minute quantities in which they exist in the environment. And technology still must be developed to achieve further reductions in automotive emissions. To conserve scarce natural resources and to protect the environment at the same time will require not only new technology but new marketing breakthroughs in solid waste recycling.

Yet in some industries the commitments are still relatively small. Expenditures for all types of research and development by the electric utility industry, which accounts for a large share of several of our most damaging pollutants, were only $41 million in 1969. That is less than one-quarter of 1 percent of their annual revenues and about 60 percent of their annual advertising expenditures. Yet new technology that will be needed by the power industry—sulfur oxides control equipment, the breeder reactor, and underground transmission lines—will cost billions of dollars to perfect. Although the Federal Government and electric utility suppliers are spending large sums of money, it will be necessary for the electric utility industry to provide greater support in the future. On the other hand, the electric power industry is significantly stepping up expenditures for presently available emission control equipment and facilities.

The research and development that is necessary throughout industry will require large expenditures. Table 1 lists one estimate of industrial research and development spending for 1970 and of planned expenditures for 1971. The average planned increase of 25 percent indicates a growing commitment by industry.

use of existing technology

Although control of some pollutants awaits new technology, many pollutants could be curbed drastically by more widespread use of current technology. The Environmental Protection Agency (EPA) estimates that if the best presently available technology were applied to all existing sources of particulate emissions, they would drop by 95 percent.

Table 1

Industry Research and Development Expenditures for Pollution Control, 1970 and 1971

(Dollars in millions)

Industry	Actual 1970	Planned 1971	Percent change 1970–71
Iron and steel	$1.7	$0.8	−53
Nonferrous metals	10.1	13.5	34
Machinery	177.6	186.5	5
Electrical machinery and communications	48.1	63.7	32
Aerospace	181.3	222.0	22
Autos, trucks, and parts	60.1	74.6	24
Other transportation equipment	2.2	2.1	−5
Fabricated metals and ordinance	7.0	11.0	57
Professional and scientific instruments	31.6	32.9	4
Lumber	0.4	1.2	200
Furniture	0.4	1.1	175
Chemicals	53.1	36.1	−32
Paper	8.2	8.3	1
Rubber	3.2	3.1	−3
Stone, clay and glass	15.4	19.1	24
Petroleum products	34.4	43.2	26
Food and kindred products	5.6	7.3	30
Textile mill products	5.0	4.3	−14
Apparel	<5	<5	NA
Other manufacturing	15.7	12.4	−21
All manufacturing	661.1	743.2	12
Nonmanufacturing	80.4	182.6	127
All industry	741.5	925.8	25

Source: McGraw-Hill Publications Co.

The level of industrial spending for pollution control facilities, compared with estimates of needs, is a good measure of industry's progress in meeting pollution control standards. Unfortunately, estimates of both needs and actual expenditures are difficult to obtain. One problem lies in separating expenditures devoted to pollution control from those made for process changes that increase productivity. Also, varying cost estimating practices (particularly with respect to inclusion of operating costs), varying estimates of the rate of return on pollution control investments, diverse interpretations of standards, and varying estimates of the costs of control all make reconciliation of different data difficult. Table 2, from figures by McGraw-Hill, estimates total industrial expenditures for air and water pollution control in 1969 and 1970 and planned investments for 1971.

The estimates in Table 2 show a 50 percent increase in expen-

Table 2

Industry Investment for Air and Water Pollution Control, 1969–71

(Dollars in millions)

Industry	Actual		Planned 1971	Percent change 1969–70	Planned percent change 1970–71
	1969	1970			
Iron and steel	$179	$206	$212	15	3
Nonferrous metals	41	100	152	144	52
Electrical machinery	32	52	58	63	12
Machinery	51	121	169	137	40
Autos, trucks, and parts	68	67	118	22	76
Aerospace	22	15	18	−32	20
Other transportation equipment	15	15	6	0	−60
Fabricated metals	44	53	70	20	32
Instruments	25	25	28	0	12
Stone, clay, and glass	63	64	104	2	62
Other durables	103	135	175	31	30
Total durables	630	853	1,110	35	30
Chemicals	140	169	263	21	56
Paper	143	153	321	7	110
Rubber	9	50	42	456	−16
Petroleum	260	337	507	30	50
Food and kindred products	58	84	151	45	80
Textiles	10	13	25	30	92
Other nondurables	31	60	37	94	−38
Total nondurables	651	866	1,344	33	55
All manufacturing	1,283	1,719	2,454	34	43
Mining	105	115	135	10	17
Railroads	NA	28	28	NA	0
Airlines	NA	21	27	NA	29
Other transportation[1]	0	4	10	—	150
Communications	0	*	*	NA	NA
Electric Utilities	135	406	679	151	68
Gas Utilities	130	110	148	−15	35
Commercial[1]	0	100	158	—	58
All business	1,671	2,502	3,641	50	46

[1] Based on large chain, mail order, and department stores; insurance companies; banks; and other commercial businesses.
* Less than .5.
Source: McGraw-Hill Publications Co.

ditures between 1969 and 1970 and project a 46 percent increase in 1971. A study by the National Industrial Conference Board (NICB), based on a smaller number of industries and a selected sample of firms, shows a 24 percent growth rate. If the McGraw-Hill estimate of 1971 spending is accurate, there is reason for encouragement.

EPA estimates a need for capital investment by manufacturers

in waste water treatment facilities of $3.1 billion over 4 years to clean up their operations. Almost $1 billion must be spent for capital replacement in the same period. Hence, even without inflation, investment by manufacturers for waste treatment should average close to $1 billion a year.

Table 3 puts total investment by manufacturers for water pollution control in 1970 at $870 million. If expenditures increase as projected in Table 2, it appears that industry will meet EPA's estimates of needed investment levels.

Total air pollution control investments were estimated by McGraw-Hill at $1.3 billion for 1970 (see Table 3). In Chapter 4 of this report, CEQ estimates needed industry investment between 1970 and 1975 of approximately $8 billion, or an average of $1.33 billion a year. Although current spending is slightly below the estimated average rate necessary to meet standards, expected increases should bridge this gap.

Another way of looking at progress is to compare industry's estimates of spending with its own estimates of needs, as shown in the McGraw-Hill survey. Industry estimates of needs are based on total investment needed to meet air and water pollution standards in effect as of January 1, 1971. Table 4 indicates these estimates compared to expenditures.

If industry expenditures continued at 1970 levels, it would take more than 7 years, on the average, to meet present air and water pollution standards. If industry spends what it says it will in 1971 and continues at that level, it will take only 5 years. However, both averages understate the time that may be necessary for some industries. And they overstate it for others. For instance, if the iron and steel and nonferrous metals industries do not substantially lift their investment levels, it will take them 12.6 and 10.8 years respectively to meet standards at 1971 spending levels. On the other hand, the textiles industry will only require a little over 3 years to meet its needs at 1971 levels of spending.

Estimates of need and of expenditures for pollution control are sufficiently imprecise that no specific conclusions can be drawn from them. However, two general conclusions seem warranted. First, industrial expenditures appear to have risen dramatically in the last year, and increases in 1971 should be large. Second, however, even higher rates of spending will be required by some industries—if they expect to meet the standards established under current air and water pollution control laws.

management's commitment

Management commitment is clearly a critical factor in abating pollution and enhancing the environment. Consideration of environmental quality can and should be built into decisionmaking processes by industry—whether it be in siting a plant, investing

Table 3

Industry Expenditures for Air and Water Pollution Control, 1970

(In millions of dollars)

Industry	Actual 1970	
	Air	Water
Iron and steel	$86	$120
Nonferrous metals	80	20
Electrical machinery	25	27
Machinery	82	39
Autos, trucks, and parts	45	22
Aerospace	9	6
Other transportation equipment	12	3
Fabricated metals	25	28
Instruments	18	7
Stone, clay, and glass	39	25
Other durables	58	77
Total durables	**479**	**374**
Chemicals	79	90
Paper	59	94
Rubber	32	18
Petroleum	152	185
Food and kindred products	38	46
Textiles	4	9
Other nondurables	4	56
Total nondurables	**368**	**498**
All manufacturing	**847**	**872**
Mining	73	42
Railroads	21	7
Airlines	18	3
Other transportation	3	1
Communications	[2]	[2]
Electric utilities	256	149
Gas utilities	75	35
Commercial [1]	50	50
All business	**1,343**	**1,159**

[1] Based on large chain, mail order, and department stores; insurance companies; banks; and other commercial businesses.
[2] Less than .5.
Source: McGraw-Hill Publications Co.

in abatement facilities, or participating in community environment programs.

Advance environmental impact analysis may be one answer, especially for major actions such as plant sitings and heavy equipment purchases. Industrial impact analysis could follow the model spelled out in section 102 of the National Environmental

Table 4

Industry Requirements and Expenditures, 1970 and 1971 [1]

(In billions of dollars)

Industry	Require-ments	1970 ex-penditures	Planned 1971 ex-penditures
Iron and steel	$2.64	$0.21	$0.21
Nonferrous metals	1.62	.10	.15
Electrical machinery	.21	.05	.06
Machinery	.89	.12	.17
Autos, trucks, and parts	.17	.07	.12
Aerospace	.06	.02	.02
Other transportation equipment	.21	.02	.01
Fabricated metals	.19	.05	.07
Instruments	.10	.03	.03
Stone, clay, and glass	.16	.06	.10
Other durables	.46	.14	.18
Total durables	**6.51**	**.85**	**1.11**
Chemicals	1.00	.17	.26
Paper	1.84	.15	.32
Rubber	.30	.05	.04
Petroleum	2.12	.34	.51
Food and kindred products	.40	.08	.15
Textiles	.11	.01	.03
Other nondurables	.08	.06	.04
Total nondurables	**5.85**	**.87**	**1.35**
All manufacturing	**12.36**	**1.72**	**2.46**
Mining	.74	.12	.14
Railroads	.32	.03	.09
Airlines	.08	.02	.03
Other transportation	.06	[2]	.01
Communications	[3]	[3]	[3]
Electric utilities	3.24	.41	.68
Gas utilities	1.04	.11	.15
Commercial [4]	.32	.10	.16
All business	**18.16**	**2.50**	**3.84**

[1] Figures may not add due to rounding.
[2] Less than .005.
[3] Less than .0005.
[4] Based on large chain, mail order, and department stores; insurance companies; banks; and other commercial businesses.
Source: McGraw-Hill Publications Co.

Policy Act (see Appendix A) which is applicable to proposed Federal agency actions. Such a procedure would help firms consciously to consider the environmental impact of their plans. It could be structured to include valuable input from government agencies and community groups before plans were adopted.

Dow Chemical Co. has already adopted the advance analysis

concept in part with its internal clearance system for new chemicals developed by its research laboratories. The aim is to guarantee the environmental safety of such chemicals before their commercial production and introduction into the environment. The procedure is similar in concept to the one spelled out in the Administration's proposed Toxic Substance Control Act of 1971 (see Chapter 1). That Act would call for extensive testing before production to reduce the likelihood of unanticipated environmental problems.

Actions by Climax Molybdenum Co., a subsidiary of American Metals Climax, indicate the potential of management and environmental citizen groups working together instead of opposing each other. Several years before the new Henderson molybdenum mine was to begin operations in the Rocky Mountain area west of Denver, company engineers and officials started meeting regularly with representatives from the Colorado Open Space Council. Company engineers accepted the challenge of finding new methods by which the ore could be mined and a mill operated with minimal harm to a spectacular scenic area heavily used by tourists. As a result of these conferences, Climax Molybdenum agreed on a number of measures, the most significant (and costly) being the construction of a 9-mile tunnel and rail line under the Continental Divide to transport the ore to a processing mill location away from a scenic highway and valuable fishing streams.

The Georgia–Pacific Corp. has put in scrubbing equipment to remove airborne gypsum dust in one of its plants. A system has been devised to collect the dust for recycling into wallboard. Whatever gypsum dust remains will be forced through a water spray into abandoned gypsum mine tunnels, eventually to accumulate in sufficient quantities to be remined.

Like the government, industrial management needs to reorganize to cope with the environment. Some companies already have done so. A study by the National Industrial Conference Board shows that 51 percent of 174 companies with heavy waste loads—including chemicals, utilities, food products, pulp and paper, mining, and petroleum—have reorganized to give increased emphasis to pollution control. Some have set up separate corporate units or assigned these activities to specific parts of the organization. General Motors Corp., for example, named a Vice President for environmental activities. The other 49 percent of the companies studied have not yet established separate corporate units to deal with pollution control. Among executives who do hold environmental responsibilities, only about 30 percent are charged with advance review of designs and plans. Yet without such pre-analysis, unwise decisions may be hard to prevent.

A recent *Fortune* magazine study shows the degree to which top management of the largest 500 companies participate in either communitywide or industrywide antipollution programs:

69 percent said they participated in such programs, 26 percent said they did not participate at all, and 5 percent were uncertain of their participation.

activities of service industries

Some service industries are pushing programs to spur faster pollution control by manufacturers. Such prodding from within the private sector—thus far quite limited—may prove a valuable adjunct to voluntary efforts and Government regulation.

For a small firm, getting capital for antipollution equipment may be a problem. The First National Bank in St. Louis has set up a $5 million fund to help companies finance control equipment. The fund will be augmented by the sale of special savings certificates. Chemical Bank in New York City loans money at prime rates to apartment house owners to purchase equipment to cut down emissions from trash incinerators and heating units. The Insurance Co. of North America has adopted a new policy that excludes insurance for claims that arise from continuous sources of pollution. Without such coverage, emitters can no longer protect themselves against suits for willful pollution.

collective industrial activities

A number of forums are springing up now through which industrial firms can conduct joint projects, discuss common problems, and advise the Government. The largest of these is the National Industrial Pollution Control Council (NIPCC). Associated with the Department of Commerce, it advises the President and the Council on Environmental Quality of industry efforts to reduce pollution. NIPCC has submitted a list of commitments to the President and has issued a variety of publications on industrial pollution control problems.

Industry-Government cooperation has been underway at the Federal level for many years in air and water pollution control research and demonstration. And it has had positive results. Industry cooperation with other levels of government has been less common, but is potentially very productive. For example, Westinghouse Corp.'s Meter Division is making its air pollution monitoring data available to the State of North Carolina. The Meter Division also has offered its technical expertise to help the State establish a statewide monitoring network.

Firms in the bottling, canning, and container industries have established the National Center for Solid Waste Disposal. Beginning with contributions of $900,000 for the first year, the Center is planning a number of studies of solid waste disposal problems.

Two firms—Bethlehem Steel Corp. and Electronic Memories & Magnetics Corp.—have jointly turned one industry's pollution

into another's valuable resource. Pickle liquor, a waste byproduct of steel production in a Bethlehem Steel plant, is now being used by Electronic Memories & Magnetics Corp. in the manufacture of its ferrities and ceramic magnetic products.

Trade associations have conducted joint research to reduce oil spills and to curb pollution from pulp and paper plants and from electric power generation. The Beet Sugar Development Foundation and EPA are jointly funding a closed-loop waste water recycling system to remove most of the BOD and suspended solids generated in a vegetable processing operation. The leftover sludge is being used to reclaim arid lands.

Collective industrial activities in environmental research and development are proving useful in some cases. They often permit economies of scale and a valuable pooling of diverse talents. Care must be taken, however, to insure that the desire to achieve these benefits does not exclude or remove the incentives for innovation by small firms, backroom inventors, and firms seeking to apply expertise in one segment of industry to the problems of another. In general, competition among a number of firms generates the best incentive to innovate and develop new technology.

citizen action

The American public became aware of its environment last year as never before. The environment has become a major national issue—a concern of Americans in all walks of life. It is impossible to predict what the staying power of citizen interest in the environment will be, but there are some hints.

Public opinion polls rate environmental quality as a top domestic concern. Bond issues for environmental improvement did extremely well at the polls in the fall of 1970. The Nation's environmental and conservation organizations are growing at rapid rates. Local groups, often dealing with a single issue, spring up daily. Environmental groups have entered political campaigns —endorsing candidates with good environmental credentials— and have influenced ballot box decisions. And citizens increasingly are turning to the courts for redress of environmental degradation. "Public interest" law firms are challenging in the courts major decisions of government and forcing industries to take cleanup actions.

environmental organizations

At the present time, best estimates show over 3,100 environmental organizations in the United States. A survey for the 1971 White House Conference on Youth identified approximately 2,500 local groups. This figure does not include civic, church, or

school groups or local chapters of national organizations. The 1971 Conservation Directory of the National Wildlife Federation lists over 250 national and regional and nearly 400 State environmental groups. The combined efforts of all these organizations have had an important influence on environmental improvement.

local groups—The variety in size, level of activity, and range of interest of local environmental groups make it impossible to generalize about their efforts and their impacts. However, the survey prepared for the White House Conference on Youth showed them most often pursuing citizen action and public information activities, with legislative and law enforcement activities not far behind. Water pollution led the list of specific problem areas, followed by solid wastes, air pollution, land use, and conservation of natural areas.

Local groups often form to concentrate on a single project—in many cases to save a particular area from ruin or degradation by pollution, construction projects, or poorly planned development. The examples of successful action by local groups during the past year are far too numerous to mention, but they have included challenges to such projects as a refinery in Maine, a

Table 5

Major Activities of Local Environmental Groups [1]

Major activity	Number of responses
General citizen action	1,027
Public information (seminars, workshops, conferences, files, bibliographies, research, reports)	915
Legislative activity (referenda, lobbying, testifying, preparing proposals)	396
Water pollution	362
General ecology	304
Solid wastes/recycling	283
Air pollution	257
Land use/planning/urban conditions	237
Law enforcement (suits, injunctions, government responsibility)	231
Conservation of natural areas	219
Energy crisis and resource use	102
Transportation (highways, mass-transit, automobiles)	101
Chemicals (pesticides, herbicides, toxics)	65
Population control	52
Noise and occupational health and safety	25
SST	22
Total	[2] 4598

[1] Approximately 2,500 groups were asked to list major activities.
[2] Many groups gave multiple responses.
Source: Based on Environmental Resources, Inc. data, Yell-o Pages.

shopping center in California, a dam on the Delaware River, a road through a forest in North Carolina, a hydroelectric facility in Wisconsin, a strip mine in Arizona, a new community in Illinois, and a nuclear power plant in Michigan. The primary objective of most of the groups was not to stop the project, but rather to assure that it was properly planned, adequately designed, and the alternative with least harm to the environment.

Sometimes the work of a local group reaches far beyond the local area. Such was the case with two groups in Michigan. The Michigan Steelhead and Salmon Fishermen's Association and Thermal Environment Must Be Protected, together with the Sierra Club and the Lake Michigan Federation, challenged issuance of an operating permit by the Atomic Energy Commission for a nuclear powerplant near South Haven, Mich. They reached a detailed agreement with Consumers Power Company on the handling of thermal discharges and radioactive wastes destined for already polluted Lake Michigan. The agreement states that the license will include the new specifications as a condition for operating the plant.

The efforts of environmental groups have not always led to confrontation or legal action, as the foregoing example illustrates. Often the weight of public opinion is sufficient to bring voluntary changes. Citizens in Bordentown, N.J., for example, became concerned about the red dust filtering across the Delaware River from United States Steel's Fairless Works in Pennsylvania. They organized, publicized the problem, and discussed it with plant officials. The result was accelerated installation of emission control equipment and clean air over Bordentown for the first time in many years.

Many local groups are outgrowths of the citizen activity which grew up around Earth Day, 1970. For example, after Earth Day, the Environmental Action Coalition (EAC) in New York began a recycling program called "Trash is Cash." EAC helps community groups establish collection programs, process scrap materials, transport them to local markets, and sell them. Recycled materials include newspapers, bottles, and cans. Eleven recycling centers are now operating with EAC support. EAC recognizes that these efforts have only minimal impact on New York's solid waste problems but believes there are side benefits in increased environmental and consumer awareness and more community pride and identity.

Concern for the problems of the urban environment and particularly those of the inner city has served as the focus for a growing number of local citizen groups. Some of these are long established environmental improvement activities that have gained new support from city dwellers. An example is Youth for Service, a 12-year-old San Francisco agency. It combines work training and beautification programs, offering inner city youth

job training and work in building neighborhood parks at the same time. The program has built four minipark playgrounds on former trash dumps and has stimulated similar efforts in other cities.

national organizations—Combined membership in the five largest national environmental organizations—the National Wildlife Federation, the National Audubon Society, the Sierra Club, the Izaak Walton League of America, and the Wilderness Society—jumped by almost 33 percent during the year ending June 1, 1971. From 1.2 million, the membership went up to 1.6 million. But the swelling of membership rolls does not fully reflect the stepup in activity.

The activities of national groups now embrace new areas which previously received relatively little attention. Chief among them are expanding programs to examine international and urban environment problems. The National Wildlife Federation launched a new periodical on the international environment which now has a subscription circulation of 300,000. The Conservation Foundation began a series of studies and symposia on problems shared by both traditional conservationists and those concerned with inner city problems. Young Adults for Resources and the Environment, a task force established by the Izaak Walton League, has used community workshops in the inner city to discuss the problems of that environment.

Other groups, with more limited membership and more specialized expertise, also expanded activities. The Nature Conservancy, which seeks to preserve environmentally critical areas by purchasing or receiving land donations, doubled its acquisitions in 1970 over the previous year—to 86,000 acres. Much of this acreage was acquired to prevent intensive development and eventually will be sold or turned over to public bodies that were unable to act in time to save the lands. Critically important wetlands, including some key parcels surrounding San Francisco Bay, accounted for 16,000 of the acres. A series of barrier islands and salt marshes off the coast of Virginia that were in danger of being lost to ocean front development added 11,000 acres. Nearly half of all the land received by the Conservancy was donated.

joint action—Cooperative efforts of national environmental organizations to achieve common goals also picked up speed in the last year. In the past, when public support was minimal and public interest growing slowly, many of the organizations operated independently. But recently these groups have shown an increased ability to marshall forces and work together toward shared objectives.

The growing momentum of cooperative action achieved one of its first major victories in 1969 when over 40 conservation and other groups joined in the Citizen's Crusade for Clean Water. They successfully urged the Congress to appropriate more funds

than had been budgeted for construction of sewage treatment facilities. The next year, a combine of environmental organizations helped to secure enactment of the Clean Air Act Amendments of 1970 (see Chapter 1). That effort showed that environmental groups could generate influential nationwide support at the local level to pass major national legislation. During the past year, environmental groups joined in oppostion to further appropriations for the supersonic transport. Environment, however, was only one factor involved in congressional disapproval of the SST appropriation. Environmental groups have also banded together on a number of diverse issues such as the Cross-Florida Barge Canal and the development of power facilities in the Southwest. Increasingly, their efforts rely not only on publicity but also on continual contact with elected officials, especially by local chapters of the national organizations.

Most recently, seven major conservation organizations formed the Coalition to Tax Pollution. The Coalition, which is inviting other organizations to join with it, will provide information to citizen leaders and push for enactment of a sulfur oxides emission charge.

Conservation groups are focusing more and more on how to win objectives by cooperating on an individual project basis. For example, the Nature Conservancy, which has funds to purchase environmentally critical areas that are endangered, has worked with other conservation groups which have the expertise to identify such areas and to determine their ecological value. Part of the unique Four Hole Swamp in South Carolina was spared from timber cutting by the Conservancy acting in concert with the National Audubon Society. The Conservancy also acted jointly on programs with the Izaak Walton League and with Trout Unlimited.

Environmental groups often have successfully joined to take legal action. Most of the litigation described in Chapter 5 represents suits brought by two or more environmental groups, often combining the resources of national groups and the firsthand know-how of local groups.

professional and scientific groups

Professional and scientific societies have taken unprecedented actions during the past year to bring their expertise to bear on environmental problems and to make their scientific and professional views available to the public and to decisionmakers. During the past year there has been a series of meetings to accomplish this, such as the First National Biological Congress, held in November 1970, with the theme of "Man and Environment." Sponsored by the American Institute of Biological Sciences and the Federation of American Societies for Experimental

Biology, it brought together the public, scientists from many biological disciplines, and legislators.

Many societies have established active programs to study specific environmental problems in their area of expertise in order to provide basic information needed for policy guidance. The American Fisheries Society, for example, has more than 35 committees studying water quality, endangered species, chemicals in fish, and similar issues. The Wildlife Society has groups that have dealt with subjects such as stream alteration programs, persistent pesticides, animal control programs, and sport hunting.

legal action

Much of the news about progress on environmental fronts in the past year has been tied to court action. Citizens and environmental groups across the country have turned to legal action as a remedy. Often they have been supported by expert testimony from biologists, urban planners, and other professionals who donate their time to study the technical aspects of the issue and appear before the court. Often litigation has been handled by lawyers specializing in raising issues related to environmental protection or other areas of the public interest.

"Public interest" law is the name applied in recent years to legal practice accenting such issues as civil rights, rights of the poor, consumer protection, and environmental protection. A few of the larger national environmental organizations have small legal staffs. Often, however, environmental organizations and private citizens with environmental concerns have relied on public interest lawyers supported by contributions and foundation grants. In the fall of 1970, the Internal Revenue Service issued guidelines confirming the tax-free status of contributions to nonprofit organizations pursuing public interest litigation. Buttressing the efforts of public interest law firms, many private attorneys and law firms have donated time on environmental litigation, and law students at a number of schools have provided support for the attorneys.

Besides their court actions and appearances before pollution control regulatory bodies in specific cases, public interest lawyers have launched an even broader legal effort that is likely to change the way in which government agencies view their environmental responsibilities. Through innovative legal procedures, lawyers have injected the policy of the National Environmental Policy Act into the proceedings of many Federal agencies, where consideration of the environment had at first not appeared very important—among them the Federal Communications Commission, the Federal Trade Commission, and the Securities and Exchange Commission. They have also sought to oversee all rule-making proceedings related to execution of the Clean Air Act

Amendments of 1970 and the Refuse Act permit program. This type of action will help to assure that administrative decisions important to environmental protection are fully aired and tested under the National Environmental Policy Act and other relevant laws.

the elections

Environmental issues ran a gamut of tests at the polls last year. Measured by dollar volume, 90 percent of all sewer and water bond issues passed, compared to only 60 percent for all bond issues. Voters in four States alone—California, Illinois, Oregon, and Wisconsin—approved $1.3 billion in State bonds for pollution control facilities. The only major environmental referenda to lose were the proposal to permit use of State gasoline tax revenues for mass transit in California and the proposal to ban nonreturnable beverage containers in Washington. The defeats followed intensive public relations campaigns by oil and auto interests in California and beverage and container interests in Washington.

Environmental quality also surfaced as an issue in election campaigns for public office last fall. Records and positions of candidates on environmental quality were important in a number of campaigns. The League of Conservation Voters endorsed 20 candidates and supported them with funds; 16 won. Environmental Action opposed 12 incumbent Congressmen; seven lost. Although it is difficult to attribute specific defeats and victories entirely to a candidate's stand on environmental issues, it appears that in some cases it was decisive. Clearly, a candidate's stand on important environmental issues can become a distinct asset or liability.

civic groups

Most Americans involved in improving the environment last year were neither active members of any environmental organization nor content merely to vote for pollution control bond issues and environment-oriented candidates on election day. Instead, the most widespread citizen involvement in environmental issues was through long-standing community groups, clubs, and other local organizations. Schools and college campuses often served as staging grounds.

Many important social and civic groups turned their attention to environmental issues. The League of Women Voters, Lions Club, Kiwanis Club, and other groups across the country launched cleanup projects and conservation programs.

Sometimes the effort was national in scope. The General Federation of Womens Clubs, with 10 million members, has chosen

"A Better Environment" as its theme for the next 2 years. On June 5, 1971, 3½ million Americans, under the auspices of the Boy Scouts of America and in league with industry's antilitter effort—Keep America Beautiful—conducted what was probably the largest 1-day litter cleanup project in history. The League of Women Voters has been active in environmental activities for years—at both the State and National levels.

These and many other civic groups have found answers to the question that puzzled many individuals only a year ago: "What can I do?" Many people have translated a simple idea into a major effort to solve an environmental problem. For instance:

—A scientist in a small Maryland suburb worked after hours with schoolchildren to mount a communitywide campaign to pass the first municipal ordinance in the Nation banning nonreturnable beer and softdrink containers. The campaign succeeded, although the ordinance is being challenged in court.

—Two women talking at a party in Washington, D.C., invited five friends to join them in forming Concern, Incorporated. The organization has mailed out more than 400,000 copies of *ECO-TIPS*, a housewife's guide to environmental buying, and has answered more than 90,000 unsolicited letters and inquiries.

—A biology teacher in Lewes, Del., conducted a door-to-door campaign with his students to save nearby beaches from pollution and development. His efforts wrought major changes. Planned sewage and industrial facilities were relocated. And some of the few remaining natural dunes along the Atlantic coast were saved. The State government has since adopted the strongest coastal land use legislation in the country.

—Two young university professors spent their summer sampling the polluted waters in the Pittsburgh area from a canoe. The evidence they collected was used by a U.S. attorney to prosecute a number of companies for pollution. The first conviction was handed down in June 1971. It was the first Refuse Act conviction based on citizen-supplied information.

—An airline captain defied threats to his job and refused to jettison accumulated flight fuel from his aircraft. His act has pressured the airlines to take steps to stop the procedure.

These few examples are dramatic evidence of the effectiveness of citizen—sometimes only single citizen—activity. Throughout the Nation, people are working together to solve the environmental problems that face their communities:

—Ecology centers are now operating in many cities. They are focal points for environmental education and a place for concerned citizens to meet.

—Recycling centers have been established in many cities, often with the support of container manufacturers.
—Many citizens have organized to identify polluters and to monitor land development activities. Pollution factfinding tours and photo contests have worked well.
—Litter cleanup efforts have cleared roadsides, parks, and beaches of bottles, cans, paper, and tires.
—Stockholders are challenging the environmental practices of major corporations by letter and at shareholders' meetings.

summary

American industry's progress in meeting environmental quality standards is difficult to pinpoint because of limited data and disparities in the scope of different industry expenditure analyses. However, a comparison of available information on industry's past, current, and planned expenditures for pollution control shows a steady increase. The extent to which investment levels must rise to meet pollution control goals set for the mid 1970's is not yet clear, in part because estimates of needs are also imprecise. Some firms have organized to deal with pollution problems, although a recent study indicates that only half of the pollution-intensive industries have done so. The extent to which pollution control and other environmental enhancement activities become part of conducting business—as part of organization, policies, and cost decisions—will be a significant measure of the Nation's ability to achieve a high quality environment.

The American citizen is becoming better informed on the major issues of pollution, recycling, land use, and other environmental matters. His variety of activity is considerable—and growing. He is lobbying legislators, enforcing environmental standards in court, and swaying elections on the basis of environmental issues.

As he becomes more knowledgeable about the impact of the action of public bodies and private interests, the citizen will participate with still more success in the political processes that are essential to upgrading environmental policy and quality.

The private sector remains the key arena for environmental improvement. The stimulus for such improvement must come from the citizen. His approval must be won for necessary public expenditures, such as those for sewage treatment. Much of the ultimate responsibility for action—to meet pollution control standards and to take the environment into account in a wide variety of decisions that will affect it—falls upon individuals and firms in the private sector.

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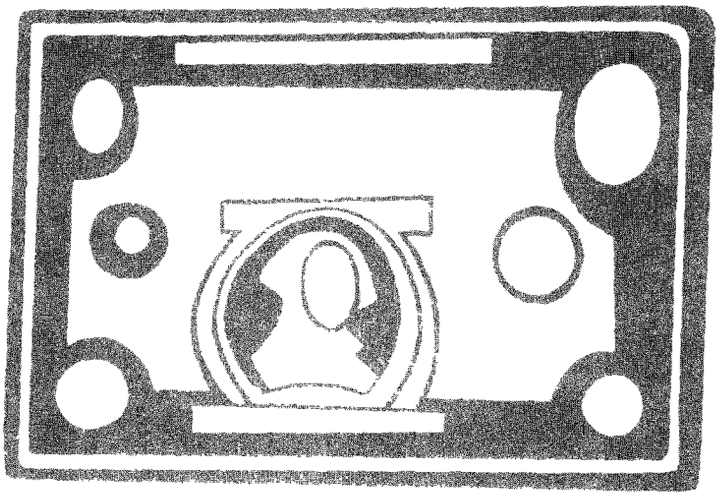


the economy and the environment

Environmental problems in large measure are rooted in the way the economy operates. In turn, efforts to maintain and enhance the quality of our surroundings impact on the economy. The economy and the environment do not, as some believe, present polar choices. But it is clear that adjustments in the economy will be needed if a higher quality environment is to be achieved.

the environmental demand

The size and productivity of the U.S. economy are well known. A rich endowment of natural resources, high rates of investment in technology and education, a large influx of skilled immigrants, and a fortunate political and economic history have all combined to yield a responsive economy and unequaled levels of material wealth.

American business and industry have responded to the changing demand of American consumers, and new technological developments have induced an ever widening array of goods and services. Although inequities remain, the fruits of this impressive productivity have been widely shared to yield a higher standard of living for more and more Americans.

In earlier years, scarce capital was combined with bountiful natural resources to serve a growing population with a full range of product choices. As consumer demands changed—here and

abroad—the economy, by and large, kept pace. Old products continually gave way to new—just as old methods yielded to new ones. Production of buggywhips ceased as horseless carriages rolled into the economy and the public found it could afford them. The water wheels that powered early industries bowed out to the steam engine, which then bowed out to electricity—fired first by coal, oil and gas, and now by nuclear energy.

Increasing demand for environmental quality and cleaner surroundings signals the need for still further changes in the economy. Along with material goods, the American public is placing a higher priority on the quality of its natural surroundings. Protection of natural biological communities; preservation of scenery; clean water and air; relief from noise, congestion, and monotonous city-scapes; as well as open space for active outdoor recreation have all taken on new importance. Support springs not only from the human concern for health but also from the growing desire to live, work, and play in more pleasant surroundings—the exclusive province of a small minority in the past. These changing desires stem from deeply rooted changes in economic and social factors which, rather than diminishing, show every indication of becoming more pervasive. More and more the notion that massive degradation of the environment is an essential ingredient for achieving higher levels of economic production is being sharply rejected.

Paralleling the pace of demands for esthetic enhancement is the finite capacity of the environment to absorb waste products without damaging the environment. The basic principles of physics dictate that all materials used in the productive and consumptive activities of the economy must eventually be returned to the environment. With low levels of economic activity and a sparse population, wastes could be assimilated with only minor damage to the environment. That is no longer the case. The capacity of rivers, lakes, and the atmosphere to absorb current waste loads is severely taxed. And pollution has, in many cases, reached intolerable levels.

The physical, chemical, and biological quality of the air, water, and the land have been altered on a massive scale. The immense increases in industrial production, energy conversion, and the flow of materials from nature through production and consumption processes are making enormous demands on the environment. Although these environmental insults are not all of recent origin, we are now more able to detect and describe even small changes in natural systems.

Exotic materials are entering the environment in much greater quantities. New chemical substances are confronting the world's biological systems with materials which may prove to be hazardous to certain organisms, including man. Many of these materials are now found in unexpected quantities in various life forms,

posing possible threats to the stability of whole food chains. The general public is just beginning to appreciate the persistence of some substances and their concentration in the food chain.

The sudden emergence of mercury as a menace is another reason for increased public concern about the environment. Public reaction has predictably and legitimately demanded higher margins of safety in disposing of materials into the environment, much as it has demanded improved food and drug procedures. Burden of proof requirements are shifting as people realize that they are unwilling victims of actions that affect their health and well-being and yet are beyond their control.

The American economy is now increasingly faced with changing values, which call for changes in resource commitments. These changes make a pleasing and healthful environment more prized and call for a greater use of resources directed to that end.

national economic growth

Historically, growth of the economy has yielded an unprecedented output of goods and services. Like others, however, Americans have chosen to take a part of the rewards of higher productivity in the form of more leisure time. The average workweek has fallen from about 60 hours in 1900 to less than 40 hours in 1970. This increased leisure time, as well as the rising tide of goods and services, have been the fruit of our increased productivity.

The economy, as traditionally measured by the market value of goods and services produced (the gross national product) will no doubt continue to grow. But greater attention to the environment will result in taking more of the increases in productivity in the form of enhanced environmental quality.

Traditional accounting of national income measures the market value of goods and services produced by the economy. These valuations were never intended to measure total economic welfare. The most that can be said is that a higher level of measured output is associated with what most feel to be a higher level of material well-being.

Environmental values are not easily reflected in our usual accounting systems. Many production and consumption activities degrade the environment—polluting, for instance, air or water. As people prefer cleaner air and water, the degradation becomes a real cost that is not subtracted from the previously calculated value of national output. Measures of output, then, often overstate the real value of additional production when environmental costs are ignored. Conversely, when uncounted enhancement of the environment accompanies production, the value of total output is understated.

economic incentives and the environment

Consumption and production patterns have vastly changed over the last decade. For example, the production of synthetic organic chemicals, containers and packaging, and electronics has grown rapidly while other industries have not grown or even declined. These fluctuating production patterns have been shaped by consumer demand. Demands, in turn, are shaped in large part by the prices of products. When the full production costs are included in the prices of final products, the market allocates resources efficiently. If, however, all costs are not included—for example, the costs to society of environmental degradation—then the resulting prices of the products are too low. When products are underpriced, consumption of them is higher than it would be if all costs were included. Consequently, compared with other products, too many resources are devoted to their production. To the extent that the costs of preventing undesirable environmental impacts are not reflected in the price of goods and services, the market fails to allocate resources efficiently, and too much waste is produced.

The common property resources—air and water—do not fully enter into the market exchange. They are progressively degraded because they are used as free "dumps" for consumption and production residuals. But such dumping, in fact, exacts positive social costs. It comes at a high price to society—in degraded air and water, impaired health, loss of fish and wildlife, loss of recreational opportunities and esthetic values, and added costs of treatment necessary for downstream water users. Yet these social costs are not to be found in the credit and debit ledgers of dischargers.

Excessive pollution and degradation of the environment are thereby encouraged. Indeed, little else should seriously be expected. Environmental problems stem largely from this fundamental failure of the economic system to take account of environmental costs.

The lack of incentives to promote products and processes compatible with a better environment is illustrated in the continued boom of noisy compressors and jackhammers used in construction. A quieter compressor can reduce noise levels to about 1 percent of their present intensity, but its price would increase by about 10 to 15 percent. The noise persists because there is little or no incentive to purchase the more expensive but quieter equipment.

Electric power is another example of the lack of financial incentives resulting in environmental damage. The prices of electricity to the industrial, commercial, and household consumer do not fully reflect the great damages to the environment—all the way from extraction, through transportation, production, and final transmission to the consumer. If the environmental control

costs of electric power were included in the price of electricity, marginal uses would be discouraged and less damage would be done to the environment.

The problem of the market's failure to give adequate weight to environmental values is often seriously compounded by a range of unrelated public actions. A case in point is the recycling of scrap metals. A greater amount of scrap would be used in the production of metal if certain economic policies did not act as impediments. The 15 percent tax depletion allowance gives virgin material a price advantage over reused metal. Similarly, the average freight differential of over $2 per ton for common hauls distinctly discriminates against scrap metal. For whatever reasons they were adopted, such policies discourage recycling.

The Nation's agricultural policies, at least in their present form, often encourage farmers to use excessive amounts of pesticides and fertilizers—some of which may result in damage to the environment—in order to produce higher yields on restricted acreage. Water resource projects, often the subject of intense environmental dispute, are encouraged by policies that make them available at little or no cost to the user. These cost-sharing arrangements and current evaluation procedures often encourage overly capital intensive solutions to water resources problems. Such public policies are examples of inadvertent institutional incentives that abet environmental deterioration.

Similarly, the way costs are assessed for municipal water and sewer services imposes added costs on center city users, undercharges new expansion into surrounding areas, and underprices treatment costs to industrial users. These practices generate excessive industrial loads; fail to discourage peak use; fail to provide money for financing future treatment facilities; and, to some extent, spur urban sprawl.

Local property taxes are also levied in ways which have a direct, and often detrimental, impact on land use patterns and the quality of the environment. Heavy taxation of buildings and other improvements relative to land, for example, encourages inefficient land use. Such practices encourage development away from center cities and thus encourage suburban sprawl and the "bombed out" look of many areas in the central city.

burden of cost responsibility

Property rights do not extend to the right of individuals and firms to pollute air and water. No one has a license to befoul the amenities and property rights of others. Because no one owns the environment—rather, the public does—there is little to suggest that the public is liable for costs of maintaining its quality. In fact, it can be argued that environmental degradation from private activity represents a taking of public property.

Courts distinguish between reasonable Government restrictions

on the use of land and appropriation of land for public use. Restricting use of a site by requiring pollution abatement has not called for the compensation guaranteed by the Constitution for the taking of private property for public use. In the case of pollution restrictions, the public acquires nothing for which just compensation need be made.

In practical application, the courts tend to make distinctions on the extent of the loss in value sustained as a result of the implementation of regulations. If such regulations leave the properties with significant value, seldom is a taking ruled. When the uses are severely restricted and the values largely eroded as a result, compensation is more often ordered. In practice, the degree of damage necessary for a ruling of taking is an uncertain variable. Courts are clearly ruling that property rights do not extend to rights to continue polluting activities, and the responsibility for undertaking cleaner operations lies with the waste discharger.

damages from pollution

Present levels of pollution and environmental degradation result in costs to society in the form of increased health services, lost productivity, and direct damage to crops, materials, and other property. The loss of scenic values and recreational areas, destruction of valuable ecological systems, and the loss of pleasant surroundings do not enter the traditional economic calculus directly, but they are no less economic costs.

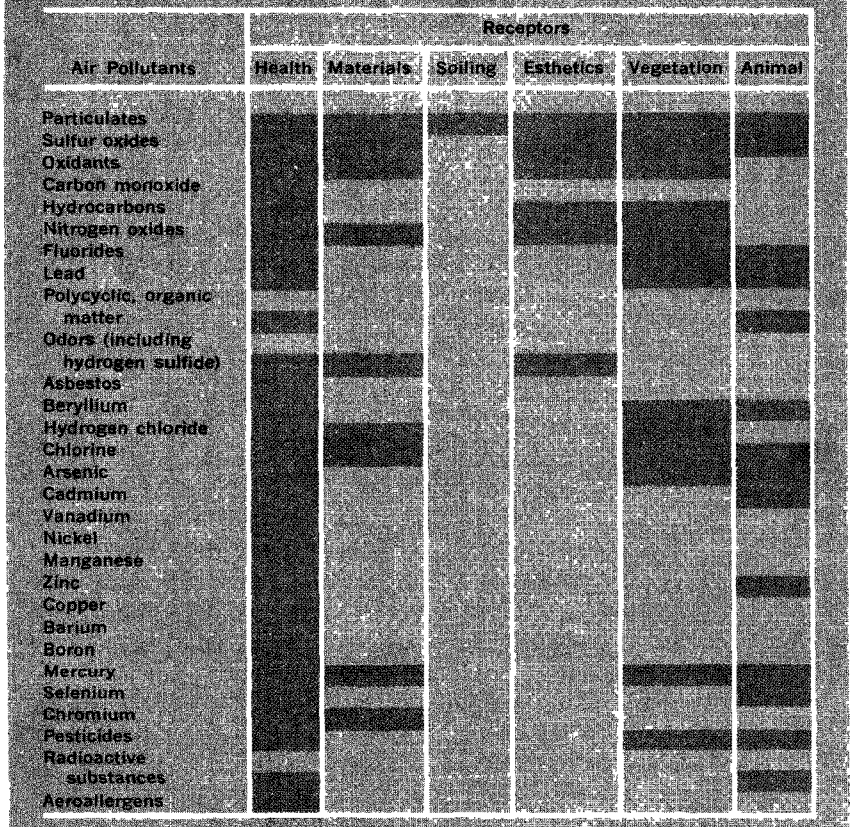
Any accounting of direct damage attributable to pollution is rudimentary at best. The evidence is not always clear cut, and research on many environmental effects is only now beginning. Further, most estimates are limited to a specific location or to a single level or type of pollution. Synergistic and cumulative, long-term effects of pollution on human health and wildlife are virtually impossible to gauge at this time. Further, minute changes, such as increases in carbon dioxide, could have profound impacts on world climate. Even if the relevant data were available, it would be difficult to place a dollar value on these impacts.

damages from air pollution

Though the total economic impact is still unclear, the costs of damages attributable to the major air pollutants—sulfur oxides, particulates, photochemical oxidants, carbon monoxide, and nitrogen oxides—have been estimated. The impacts from other pollutants have not been quantified, but effects on health, materials, and other receptors have been identified, as shown in Table 1. The damage estimates due to the major pollutants are

Table 1

Effects of Air Pollutants



Source: Environmental Protection Agency.

admittedly crude and at this stage, can only approximate the real costs of air pollution. In general, only direct monetary costs associated with air pollution damages to human health, materials, and vegetation and to property devaluations have been estimated. Even these studies rely heavily on judgment. Not yet available are data on esthetic costs, visibility, odor, soiled clothing, dirty homes, and the like. Yet these costs stir much of the public resentment to air pollution.

Scientific evidence on what air pollution does to human health is far from complete. Serious air pollution episodes have demonstrated how air pollution can severely impair health. Further research is spawning a growing body of evidence which indicates

that even the long-term effects of exposure to low concentrations of pollutants can damage health and cause chronic disease and premature death, especially for the most vulnerable—the aged and those already suffering from respiratory diseases. Major illnesses linked to air pollution include emphysema, bronchitis, asthma, and lung cancer.

Data from 1963 suggest that a 50 percent reduction in air pollution existing in major urban areas at that time would lower the costs of damage to health by $2.08 billion in a single year. A breakdown by the types of disease responsible is shown in Figure 1 below.

The Environmental Protection Agency (EPA) estimates that the economic cost of human mortality and morbidity from all air pollution is in the neighborhood of $6 billion annually. However, these estimated health costs relate only to medical care and work loss. If the costs of discomfort, frustration, and anxiety were included, these estimates would be greatly increased.

Vegetation and materials damage have also been assessed. Air

Figure 1

Health Costs of Air Pollution

pollution corrodes and damages materials and stunts and kills trees, plants, and crops. The direct costs of air pollution on both materials and vegetation are estimated at $4.9 billion annually.

A study of property values suggests that prices are sensitive to pollution levels. Averaging the effect of increased pollution on property values in a number of cities, EPA estimates lowered nationwide values of property from air pollution at $5.2 billion annually.

The annual toll of air pollution on health, vegetation, materials, and property values has been estimated by EPA at more than $16 billion annually—over $80 for each person in the United States. In all probability, the estimates of cost will be even higher when the impact on esthetic and other values are calculated, when the cost of discomfort from illness is considered, and when damage can be more precisely traced to pollutants. Also, the estimates may increase as more is known about the damages of long-term exposure to very low levels of any one pollutant or many in combination. It must be emphasized, however, that these cost estimates only crudely approximate the damages from air pollution.

damages from water pollution

The costs of water pollution damage are even less well documented than the costs of air pollution. The prices that industries and water users pay for treating polluted water for use, although relatively small, are measurable in dollars. Further, there are clear economic losses in contaminated fish and in lost fishery resources. Costs of lost amenities and recreational opportunities are less tangible but are no less real economic costs.

The losses of ocean and coastal fisheries and shellfish production by pollution of estuarine areas are substantial. Over one-fifth of the Nation's shellfish beds have been closed because of pollution. Before 1935, between 100,000 and 300,000 pounds of soft shell crabs were commercially harvested annually in San Francisco Bay. The industry is virtually nonexistent today, largely because of pollution. Similarly, the annual commercial harvest of shrimp from coastal areas dropped from over 6.3 million pounds before 1936 to only 10,000 pounds in 1965.

Increased salinity, due chiefly to man's use of water for irrigation, imposes costs on other users. Housewives must use more detergents in order to overcome water hardness. Industries must treat or dilute river water in order to meet boiler feed or cooling water requirements. Farmers may suffer decreased yields because of water salinity. The total of these damages in the Lower Colorado River Basin and Southern California Water Service area was estimated at $16 million annually in 1970. With the expected growth in these regions and the expected increase in

salinity, these damages are estimated to climb to $28 million annually in 1980, and to over $50 million by 2010.

The value of cleaner water for recreation alone is roughly indicated by the results of a 1966 study of water quality in the Delaware estuary. Water degradation causes an estimated loss in the present value of recreational opportunities of up to $350 million. This estimate suggests that water pollution may cause recreational losses extending into many billions of dollars nationwide.

The possibility of large recreational losses is supported by recent studies of the value of outdoor recreational opportunities in a series of California reservoirs, where water quality permitted a range of recreational activities. Annual benefits from water sports ranged up to over $2 million per lake—values that would be lost with the level of deterioration that is now found in many of the Nation's water bodies. The rapidly increasing demands for recreation and scenic amenities will raise the value of losses from pollution.

other environmental damages

Costs of many other forms of pollution have not even been approximated. Esthetic losses are very difficult to quantify. Litter in parks and along roads and rivers and abandoned automobiles—rusty derelicts cluttering the landscape—seriously degrade the environment. Some uses of land also take their toll esthetically. The 300,000 miles of transmission lines that traverse the countryside occupy nearly 4 million acres of right-of-way and visually affect millions of additional acres. Three million acres of land have been surface mined, of which only one-third has been partially reclaimed. Another 8 million acres are over underground mines and subject to cave-ins. These 11 million acres also contribute large quantities of sediment and acid mine drainage to adjacent waterways.

The esthetic and health damages associated with noise pollution, trash-filled alleys, urban congestion, and lack of open space are not priced. But to many citizens they are painfully evident costs of environmental degradation.

costs of pollution control

Estimating current and prospective costs to meet environmental objectives is a hazardous exercise. The limited data available generally cover only air pollution control, water pollution control, and solid waste management expenditures. Further, even for air and water pollution, the costs of controlling all pollutants or all sources have not been estimated. And some of the data are based not on recent studies but on individual case studies and on

engineering estimates of data compiled from a variety of sources. Some estimates are drawn from questionnaires, which may include a disproportionate number of respondents facing high pollution control costs, so there may be some bias in the results.

Moreover, the basic assumptions in the cost studies vary widely. Byproduct revenues, estimated equipment life, allocation of process change costs between pollution control and increased productive capacity, and numerous other factors are not dealt with uniformly. Costs are based primarily on treatment costs, with inadequate attention given to likely alternative methods of achieving abatement—such as process changes, improved plant management, and recycling. At best, regional variations in standards and discharge requirements can only be approximated. Also, as new laws are passed, additional pollutants will be regulated, and more rigorous abatement requirements will be applied to currently controlled pollutants. As with the cost of damages, cost estimates for abatement are but rudimentary. In all probability, they underestimate the actual expenses to be incurred—probably substantially.

The cost estimates in this section cover air and water pollution control and solid waste management. The data presented in Table 2 are largely derived from the 1971 editions of the *Cost of Clean Water* and *The Economics of Clean Air*, reports submitted to the Congress by the Environmental Protection Agency. These data vary from the more detailed information in the appendix to this chapter. For example, they are consistently calculated on the basis of 1970 dollars instead of 1967 dollars. Water pollution control figures are extended beyond 1974. Air pollution control figures are extrapolated nationwide from the 298 regions evaluated in *The Economics of Clean Air*, and a 4 percent per year cost rise is added to the solid wastes estimates to account for historic increases in waste generation.

Data for water pollution control expenditures are primarily for municipal and industrial waste treatment. Data on such "nonpoint" sources as agricultural runoff and acid mine drainage are considerably less reliable. The municipal, or public, costs are usually incurred for collecting, transporting, and treating domestic sewage. Industrial waste treatment costs are primarily incurred by manufacturing activities, although thermal pollution control by the electric power industry is also included. Together they represent most of the private sector water pollution control costs.

Most air pollution control costs have been incurred to reduce particulates and automobile pollutants. The standards resulting from amendments to the Clean Air Act will soon require major additional spending to control sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, oxidants, and selected toxic substances, such as beryllium or mercury—as well as particulates.

Unlike expenditures for water pollution, public expenditures

by State and local governments for air pollution control are primarily for planning, enforcement, and monitoring rather than for facilities to reduce waste discharges. Municipal incinerators and public buildings are the major areas of direct public costs—sources which are small in the aggregate.

Significant expenditures will be required by the private sector to control both stationary and mobile sources of air pollution. Most air pollution from stationary sources is generated by fuel combustion in power plants, industries, and homes and by industrial processing. The major mobile source of air pollution is the automobile, but trucks, buses, motorcycles, and airplanes also pollute the air.

Costs for solid waste management cover collection and disposal of residential, commercial, institutional, and industrial wastes. Part is spent to collect and transport solid wastes to disposal sites; part is to operate the sites—landfills and incinerators. Although Federal funds finance research and development, demonstration grants, and personnel training, local governments will shoulder most of the public burden for collection and disposal of solid wastes. Private collection and disposal costs for handling municipal wastes are also a significant part of the total. Further, industry incurs substantial costs to transport and dispose of its own wastes —usually separate from municipal operations.

Most available estimates, regardless of media, are for either construction investment or annual operation and maintenance of facilities. The total expenditures for a given facility include the capital investment costs, the interest paid on such capital, and the operation and maintenance costs over its lifetime. The annual depreciation—each year's share of the total capital investment—interest and operation and maintenance costs are usually denoted as annualized costs. Hence, three measures exist for cost estimates: total capital investment, annual operation and maintenance costs, and annualized costs.

Table 2 summarizes the costs of air and water pollution control and solid waste management for 1970, 1975, and for the 6-year period. Limitations of the data are explained more fully in the appendix of this chapter.

If standards are met on schedule, total annualized costs of pollution control in 1975 will increase approximately 97 percent over 1970. Annual investment will more than double. These cost increases from 1970–75 vary greatly by type of medium. Air pollution annualized costs will increase 840 percent, water pollution control 87 percent, and solid waste management 37 percent (see Figure 2).

Total spending required for the major sources of environmental pollution between 1970 and 1975 is estimated at about $105 billion—23 percent for air pollution control, 36 percent for water pollution control, and 41 percent for solid waste management. Figure 3 summarizes their relative contributions.

Table 2

Pollution Abatement Cost Summary [1]

(In billions of dollars)

Pollutant/medium	1970			1975			Cumulative requirements 1970-75		
	Capital investment		Annualized costs	Capital investment		Annualized costs	Capital investment	Total operating costs	Total expenditures
	Cumulative [2]	Annual		Cumulative [3]	Annual				
Air pollution									
Public [4]	$ 0.2	$0.1	$0.2	$ 0.5	$0.1	$ 0.2	$ 0.4	$ 1.2	$ 1.6
Private									
Mobile	.1	.1	—.2	4.3	2.9	1.5	5.4	.6	6.0
Stationary	1.0	.7	.5	7.7	1.8	3.0	8.0	8.1	16.1
Total	1.3	.9	.5	12.5	4.8	4.7	13.8	9.9	23.7
Water pollution									
Public									
Federal [5]	NA	NA	.2	.3	.1	.3	.3	1.3	1.6
State and local									
Treatment systems	13.7	1.2	1.6	24.2	1.5	3.3	13.6	9.3	22.9
Collecting sewers [6]	(12.0)	NA	NA	(12.0)	NA	NA	(3.6)	NA	(3.6)
Combined sewers [7]	NA	NA	NA	NA	NA	NA	(15.0—48.0)	NA	(15.0—48.0)
Private									
Manufacturing	3.9	.8	1.1	7.1	.6	1.9	4.8	7.2	12.0
Other	.9	.3	.2	1.1	.1	.3	.5	1.0	1.5
Total	18.5	2.3	3.1	32.7	2.3	5.8	19.2	18.8	38.0
Solid Waste [8]									
Municipal									
Public	NA	.1	2.1						
Private	NA	NA	2.3	NA	.3	7.8	1.5	42.0	43.5
Industrial	NA	NA	1.3						
Total [9]	NA	.1	5.7	NA	.3	7.8	1.5	42.0	43.5
Grand Total	NA	3.3	9.3	NA	7.4	18.3	34.5	70.7	105.2

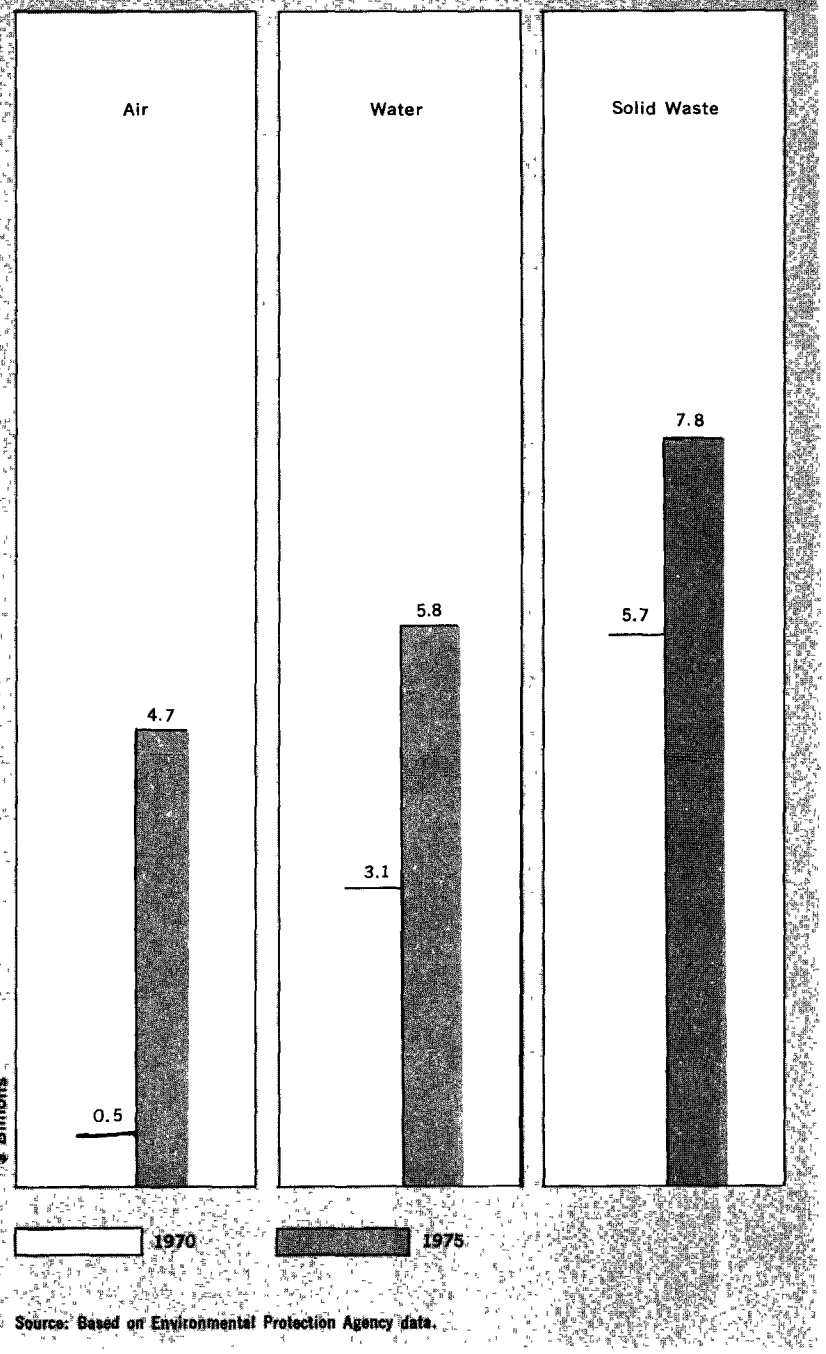
[1] For major air, water, and solid waste pollution control expenditures.
[2] Total capital in place as of the end of 1970.
[3] Total capital in place as of the end of 1975 is net of depreciation for the period.
[4] For construction and operation of Federal facilities only.
[5] For construction and operation of Federal facilities only. Does not include the Federal construction grant funds, which are included under State and local.
[6] Collecting sewers are shown as a non-add item due to lack of data.
[7] Combined sewers shown as a non-add item because of lack of data.
[8] Annualized costs exclude depreciation and interest because of lack of data.

Source: Based on Environmental Protection Agency data.

When comparing these expenditures, a number of important factors must be considered. For instance, the solid waste estimate greatly overstates the costs required for meeting higher standards of environmental quality. The overwhelming bulk of those costs is for collection of wastes, a service traditionally provided in urban areas. Thus, the costs of meeting air and water pollution standards are only $62 billion, or 59 percent of the total costs.

Figure 2

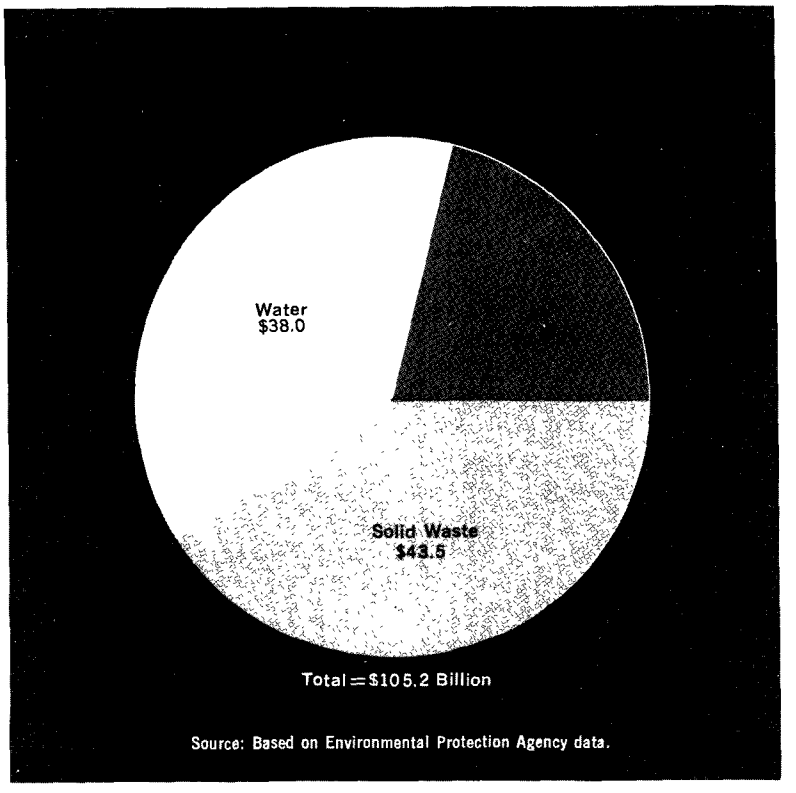
Growth in Annual Pollution Control Costs, 1970 and 1975



Source: Based on Environmental Protection Agency data.

Figure 3

Cumulative Expenditures for Air, Water, and Solid Waste Pollution Control, 1970–75



The timing of spending is another important factor. Water quality standards have existed for several years; hence, to meet the standards, expenditures will be spread more evenly over the 1970–76 period. For air pollution, however, implementation plans to meet the Clean Air Act standards are currently only under development, and the stringent new automotive emission standards will not be applicable until 1975. Hence major costs will occur later, especially in 1975 and 1976. Therefore, the relative importance of air pollution costs would increase appreciably if the period used were to extend beyond 1975.

It is also important to consider the possible addition of expenditures for controlling combined sewer overflows. Sewers that carry both sanitary and storm wastes quickly fill in a rainstorm. When that occurs, sewage treatment plants cannot handle the overload, and raw sewage, including what has accumulated in the pipes, is often dumped directly into rivers and lakes. The high

bacteria count of these overflows impairs water quality and prevents water-based recreation.

Although overflows from combined sewers are an important source of pollution, there is need for new comprehensive approaches and technology that are generally only in the early stages of development. The costs of corrective actions appear very high. For example, the American Public Works Association calculates that it will cost between $15 billion and $48 billion to remedy overflows from combined sewers. The $15 billion figure would cover a variety of alternatives short of complete separation, while the $48 billion would finance complete separation of combined sewers—$30 billion in public costs and $18 billion in private costs. These latter costs do not include the massive disruption that would occur in major U.S. cities from tearing up streets to accomplish such separation.

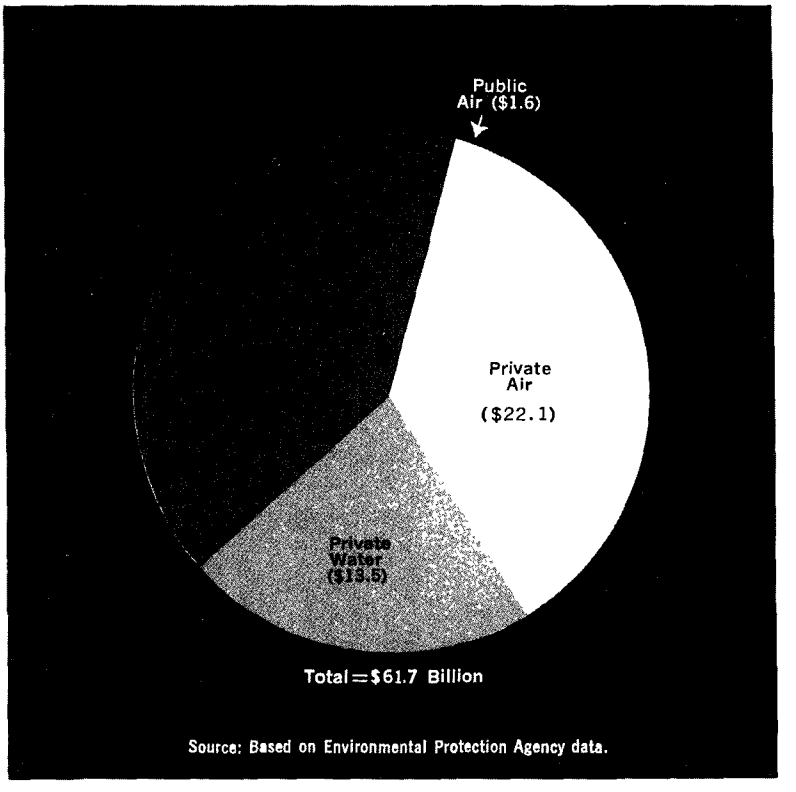
The impact of costs upon the public and private sectors differs among the pollution media. Under 25 percent of the total solid waste expenditures fall directly on the private industrial sector. The largest share is borne either by the public sector or directly by individuals. For air and water pollution control, it is a different story (see Figure 4). Almost two-thirds of the water pollution costs will be paid by the public sector while almost all of the air pollution costs will be paid by the private sector.

The estimates in Table 2, based chiefly on EPA data, may be compared with data obtained from other sources. The limited number of independent cost estimates and comparisons differ in the number of pollutants or emitters covered as well as in other basic assumptions. Using data from the National Industrial Conference Board (NICB), the International Research and Technology Corporation (IRT), and the Center for Political Research (CPR), however, some comparisons of estimates of 1970 investments, 1975 annual costs, and total costs to meet standards are possible.

The estimates of current environmental spending in Table 2 may be compared with surveys by McGraw-Hill and the National Industrial Conference Board. Although based on a large sample, the figures may be somewhat overstated because industries with high costs are more often inclined to respond to a questionnaire. Moreover, investments serving both abatement and increased productivity are often charged by industry to abatement alone. The NICB estimates were based on a smaller sampling of firms and did not include all of the industries surveyed by McGraw-Hill. The NICB study, when extrapolated by the same procedure used by McGraw-Hill, indicates investments of about 14 percent less on the average than the McGraw-Hill figures for the same industrial categories. Table 3 compares the 1969 estimated national expenditures for those industries covered by both surveys. For 1970, McGraw-Hill calculated manufacturing and electric utility

Figure 4

Cumulative Public and Private Expenditures for Air and Water Pollution Control, 1970–75



investments in air and water pollution control at $2.1 billion. If the NICB and McGraw-Hill data bore the same relative relationships in 1970 as in 1969, the NICB estimate would be $1.9 billion. This compares with $1.8 billion in Table 2.

There are a number of estimates of projected industrial pollution control costs from which to make comparisons. The McGraw-Hill study indicated that industry estimated a need for an additional $18.2 billion in expenditures to meet air and water quality standards in existence as of January 1, 1971. By contrast, the estimates in Table 2 show an additional investment of $13.3 billion by 1975, 27 percent below the estimates indicated in the McGraw-Hill survey.

Comparisons of estimated 1975 annual costs are difficult because of widely differing assumptions on the course of events over the next 5 years. IRT has estimated annual expenditures for 1975, assuming that 1970 Clean Air Act standards are met.

Table 3

Comparison of McGraw-Hill and NICB Estimates of Industrial Pollution Control Investment for Air and Water, 1969

(In millions of dollars)

Industry	McGraw-Hill	NICB[1]
Iron and steel	179	256
Nonferrous metals	41	43
Electrical machinery	32	18
Machinery	51	38
Autos, trucks, and parts	55	3
Aircraft	22	4
Fabricated metals	44	50
Instruments	25	17
Stone, clay, and glass	63	44
Chemicals	140	102
Paper	143	119
Rubber	9	27
Petroleum	260	219
Food and kindred products	58	36
Textiles	10	4
Total	1,132	974

[1] NICB data extrapolated to be comparable nationwide with McGraw-Hill data.

Source: McGraw-Hill Publications Co.

Its figures also assume secondary treatment or its equivalent for municipal and industrial effluents and adequate landfill and incinerator disposal of solid wastes. Industrial costs are based on process engineering cost estimates. The IRT figures, different from those in Table 2, are contrasted in Table 4. IRT's air pollution control costs are quite close to CEQ's. The water

Table 4

Comparison of CEQ and IRT Estimates of Annual Costs of Pollution Control, 1975

Source	CEQ		IRT[1]	
	Billions of dollars	Percent	Billions of dollars	Percent
Air Pollution (excludes Federal facilities and mobile sources)	$ 3.0	18	$ 3.2	25
Water pollution (excluding Federal facilities)	5.5	34	5.5	43
Solid waste (all)	7.8	48	4.0[2]	32
Total	16.3	100	12.7	100

[1] Data adjusted by a 15 percent inflation to reflect 1970 dollars instead of 1967 dollars.
[2] Includes costs of handling agricultural wastes, which account for 38 percent of IRT estimate and are not included in CEQ estimates.

pollution estimates are almost identical, but the solid waste management estimates by IRT are much lower.

Cumulative costs for the 1970 through 1975 period may be contrasted with similar estimates by a private research firm, the Center for Political Research (CPR). It puts total expenditures for air and water pollution control and solid waste management at $84.5 billion for the 1971–1975 period. As in the case of the CEQ estimates, CPR used sketchy but available data and was aware of numerous exceptions and omissions. Nonetheless, its estimates are consistent with the CEQ estimates, which cover an additional year and slightly different activities. If the CPR data were increased by 20 percent to reflect the additional year of expenditures, it would be about $101 billion—similar to the CEQ total estimate. The comparison is summarized in Table 5.

Table 5.

Comparison of CEQ and CPR Estimates of Total Expenditures for Pollution Control, 1970–75

Purpose	CEQ		CPR	
	Billions of dollars	Percent	Billions of dollars	Percent
Air pollution	$ 23.7	23	$ 9.7	12
Water pollution	38.0	36	40.2	47
Solid waste	42.3	41	34.4	41
Total	103.2	100	84.5	100

As mentioned earlier, estimating the costs of attaining environmental quality is hazardous. For example, the industry estimates are for separate control of pollutants discharged in each medium (air, water, and land), ignoring their interdependence. The extent to which control of air pollutants adds to the burden of discharges dumped into water or adds to increased costs of solid waste disposal has not been taken into account. As control programs are accelerated in each medium, it is likely that extra costs will surface in the other media that were previously not expected.

The estimates for abatement are, to a large extent, based on waste treatment alone. However, as industries face abatement requirements, they will choose to achieve them by a combination of process changes and improved plant management as well as treatment. This will result in significant economies over treatment alone, but these economies are not generally reflected in the cost estimates.

On the other hand, increased costs, upgraded standards, new pollutants covered by standards, and other factors will doubtless raise the total costs of attaining higher levels of environmental

quality. Moreover, the estimates do not include such environmental expenses as the costs of noise control, reclamation of strip and underground mines, and control of agricultural pollution. On balance, the costs of environmental control—including just the controls over air and water pollution and solid wastes—are understated, probably significantly.

costs and benefits

Increasing quantities of waste discharge bring about increasing environmental costs in the form of losses of amenities or damages to health and welfare. While too little is known about the values that should be attached to a cleaner environment, cleaner air and water are clearly preferable to lesser degrees of purity. Losses of simple amenities are a cost, but these generally increase rapidly as degradation reaches levels that are thought to be directly damaging to health. Different values are associated with different levels of quality attainment. Added increments of quality add value to the total.

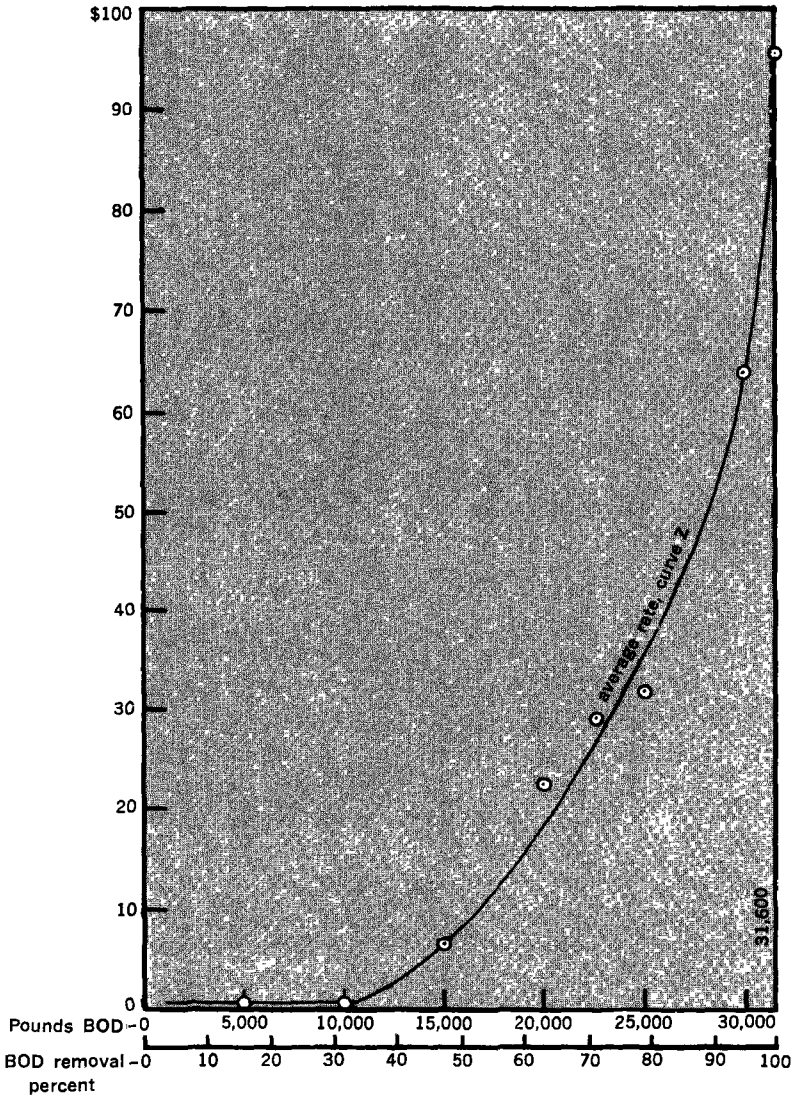
Costs of curbing the amount of discharged wastes vary at different levels of abatement. Usually the higher the proportion of waste discharge that is curtailed, the greater the cost of abatement per unit withheld. For example, in beet sugar plants, it costs less than $1 a pound to reduce BOD—a measure of the oxygen required to decompose organic wastes—up to 30 percent. But it costs an additional $20 for a one pound reduction at the 65 percent control level and an added $60 for a one pound reduction when over 95 percent control is achieved. These incremental cost increases are shown in Figure 5.

Rapidly rising incremental costs also hold true for controlling air pollution in a metropolitan area. Attaining low levels of control is relatively inexpensive but become more costly as higher levels of abatement are attained. A 1969 study of the greater Kansas City area indicated the additional costs to reach different levels of control of particulates and sulfur oxides. To reduce sulfur oxides and particulates 5 percent and 22 percent, respectively, would cost $50,000. To reduce these levels by 42 and 66 percent, respectively, would cost $7.5 million. However, to reduce sulfur oxides by only 6 percent more and particulates 3 percent more would triple the costs to over $26 million.

Decisions on attaining different levels of environmental quality need to take into account the benefits to be attained and the costs to be incurred. When the expected gains are large relative to the costs, it is clearly in our interest to move forward in cleaning up the environment. And such improvement should, of course, continue as long as the perceived added gains of attain-

Figure 5

Incremental Costs of Reducing BOD Content of Lime, Flume, and Condenser Water Wastes from 2,700-Ton-Per-Day Beet Sugar Plant



Source: Lof, G.O.G., and Kneese, A. V.

ing each higher level of environmental quality exceed the expected costs.

Our ability to precisely assess these added benefits is severely

limited. Although cost control estimation is somewhat more precise, we are only beginning to relate the necessary cost increases to different levels of environmental quality. Moreover, we cannot specify the degree to which individuals value avoiding environmental damages and especially how they value averting risks of uncertain environmental costs.

Decisions on levels of environmental quality are collective judgments increasingly made more explicit through the establishment of standards. Setting these standards implies evaluation or accounting of the added benefits and costs of higher levels of quality, with account taken of inherent uncertainties and risks.

In the case of the setting of air quality standards, evidence exists—although very rudimentary—that the benefits of higher levels of abatement clearly exceed expected costs. The annual damages from air pollution in 1968 have been estimated at about $16 billion. To reduce the bulk of these damages is estimated to result in an annualized cost of $4.7 billion by 1975. Thus, even when comparing 1968 benefits with 1975 annualized control costs, the identified benefits are over three times the costs.

Care is necessary in interpreting such analyses. The data on both costs and benefits are far from precise, and some pollutants are much more harmful than others. Moreover, these aggregate values are not complete guides on the benefits and costs of specific actions and desirable specific levels of control.

A study of the Delaware estuary illustrates how more detailed information can provide guidance for collective judgments on desired levels of environmental quality. That study estimated recreational benefits from $120 to $280 million for a level of water quality that would cost $65 to $140 million to achieve. Somewhat higher expenditures of $85 to $155 million would have yielded benefits of $130 to $310 million, while an even higher expenditure of $215 to $315 million would have yielded benefits of $140 to $320 million. The higher levels of water quality necessitated much higher levels of control costs compared to increased benefits. Although these calculations are admittedly crude and do not reflect all values and perceptions of risk, they did provide useful information upon which collective judgments were made on water quality levels for the Delaware.

Besides the overall issue of comparative benefits and costs of attaining different levels of quality, there are possibilities to achieve the same benefits at greatly differing costs, depending on how standards are attained. A number of analyses indicate wide variations in costs of achieving a given quality level. For example, the Kansas City data show that it is much cheaper to reduce air pollution the most where it costs the least than to try to cut it proportionately at every source. A proportionate reduction at each emission source would cost $16 million a year to decrease ambient particulate concentrations in Kansas City from 184 to

89 micrograms per cubic meter. But it would cost only $7.5 million—less than one-half of that—to get slightly better results with a cutback that took full advantage of the variable costs of abatement.

The Delaware Estuary study also shows that it costs less to achieve the same results by avoiding uniform treatment and using a least cost solution instead. The study indicates that a dissolved oxygen level of at least 3 parts per million would cost about twice as much with uniform treatment as a least-cost solution. The latter would demand large waste load reductions from firms with low abtatement costs and smaller reductions from firms with higher costs. To achieve a dissolved oxygen level of close to 4 parts per million in nearly all reaches of the estuary—approaching the standard actually adopted—the extra costs of equal reductions will be only about 50 percent greater than for an optimum solution. As standards are established at more stringent levels, the cost disadvantages of equal reductions are less, because most sources would require large waste load reductions. However, this analysis of the remaining cost difference at higher abatement levels understates the remaining advantage to the extent that no major processes or plant changes were taken into account even though such adjustments would be more efficient.

The cost advantages of optimum economic solutions are indeed substantial, and they indicate the priority that further research deserves. Also, these cost consequences point to the need for developing economic incentives, discussed later in this chapter, that help achieve more efficient solutions.

impacts of costs on the economy

Protecting the environment and reducing the harmful effects of pollution will not be without adjustments. Some firms and activities will find it difficult to accommodate to new rules. A few may well find it impossible. To deny that there will be transistional problems, including temporary loss of jobs, would be to deny that any major shift of resources can be accomplished without some dislocation and some turmoil.

This section discusses the impacts of pollution control costs on national growth, industries, firms, employment, consumers and taxpayers, and international trade.

impact on gnp and growth

Spending $105 billion between 1970 and 1975 may seem massive. But compared with the gross national product (GNP) and with capital investments, this amount assumes a different perspective. Annualized costs of environmental cleanup for 1970 were estimated at about $9.3 billion—about 0.9 percent of the 1970

GNP of $1 trillion. In 1975, annualized costs are estimated at $18.3 billion, or about 1.4 percent of the estimated 1975 GNP of $1.3 trillion. The cumulative environmental expenditure of $105 billion during the 6-year period—a much larger amount than the sum of annual costs because total investment rather than depreciation is included—is still only 1.6 percent of the cumulative GNP of approximately $6.7 trillion. However, as discussed earlier, only 59 percent, or $62 billion, of these costs are for meeting air and water quality standards; the rest are for solid waste disposal. Using only the estimates for meeting air and water quality standards, the annualized costs are 0.4 percent of 1970 GNP and 0.8 percent of the estimated GNP in 1975, and cumulative expenditures are 0.9 percent of the estimated total GNP over the 6-year period.

Measuring pollution control investments as a proportion of total capital investments is another way to gauge their relative impact. In 1970, nationwide investments in nonresidential structures and equipment were $103 billion. Only $3.3 billion of it was for environmental facilities. By 1975, total investment of $7.4 billion is estimated for environment control facilities. Without motor vehicle control devices, this investment would be $4.5 billion. Total pollution control investment was 3 percent of total capital investment in 1970. Even at 1975 levels of control investment, it would be 7 percent of 1970 capital investment and would be a considerably smaller percent of actual investments in 1975. The percentage would be even smaller if the costs of automobile emission control devices were excluded.

But size comparisons aside, what will be the impact of these environmental costs on total GNP and on economic growth? Their biggest impact will be to change the composition of output rather than the total value of the national product. As more resources are used for improving the environment, fewer final goods and services will be produced than otherwise. In this sense, tradeoffs will need to be made between environmental values and what has come to be regarded as traditional economic output. As heavier commitments are made to saving the environment, fewer other things will be produced, although an absolute decline is neither necessary nor likely.

The effect of diverting funds to environmental controls is to raise prices for those goods that require such controls. When total GNP is corrected for such price increases, the measured output of the economy will be slightly smaller. Considering, however, that increased air and water pollution control costs are such a small portion of GNP, the changes are slight.

Environmental control costs of one firm represent income and revenues to other firms and workers. The aggregate levels of employment should be little different from those of a time of lesser concern with the environment. The net result from the shifts

of employment to less polluting enterprises and to abatement activities would generally be only a change in the mix of total output, not a reduction in total employment. The Nation can lose economic welfare only by making choices on abatement levels or methods which incur costs larger than the benefits derived.

impact on industries

To say that environmental controls will hurt business and industry is to confuse the interests of existing firms with the health of commerce as a whole. Some companies—particularly those that must absorb large pollution costs—will be hard hit. But many firms will benefit, and new firms and industries will emerge in response to changing environmental demands.

A few major industries account for most industrial water use and most industrial water pollution. They will bear a much bigger share of the total burden, but as Table 6 shows, in most cases their water pollution control costs will probably fall substantially below 1 percent of the value of their products shipped. These estimates are for annualized costs of control in 1974—assuming secondary treatment by all manufacturers. However, the value of shipments is for 1967; hence the percentage of pollution control costs to value of shipments is overstated. The 5 percent increase in total payroll shown in Table 6 indicates

Table 6

Impact of Waste Water Treatment Costs on Selected Industries, 1974

(Dollars in millions)

Industry	1967 value of shipments	Total annual control costs	5 percent increase in wages	Control costs as percent of 1967 value of shipments	5 percent increase in wages as percent of 1967 value of shipments
Food and kindred products	$84,062	$260	$506	0.3	0.6
Textiles	19,733	80	218	.4	1.1
Paper	20,740	326	221	1.6	1.1
Chemicals	42,470	421	325	1.0	.8
Petroleum	22,042	110	61	.5	.3
Rubber and plastics	12,789	24	165	.2	1.3
Primary metals	46,550	396	492	.9	1.1
Machinery, excluding electrical	48,357	42	708	.1	1.5
Transportation equipment	68,238	115	752	.2	1.1

Source: Based on U.S. Department of Commerce, Bureau of the Census, and Environmental Protection Agency data.

that the costs of water pollution control are generally less than historic wage increases. And once the pollution control equipment is installed, the costs of operating it will probably not rise nearly as fast as labor costs.

These estimates may, however, understate the impact on some individual industries, given the large number of different products and processes within the manufacturing categories indicated. For example, the food and kindred products category in Table 6 includes everything from bakeries—with almost no problems of water pollution—to dairy and cannery operations, which must control huge amounts of waste water effluents. Consequently, average costs for broadly defined groups overstate costs for some and seriously understate costs for others.

Rapidly changing requirements and technologies make cost projections for air pollution control even more difficult. Table 7 compares industrial costs for anticipated control in 1976—when the 1970 Clean Air Act standards fully take hold—with values of shipments in 1967 and with historic wage increases. As in the case of water pollution, these estimates are for broad categories. Impact on specific industries can vary greatly from these averages. Although the petroleum category in Table 7 indicates pollution control costs of only 0.1 percent of value of shipments, these ratios vary greatly among industries under that heading. For example, petroleum refineries would incur costs of under 0.05 percent, while asphalt batching would incur costs up to 1.25 percent of 1967 value of shipments. For primary metals, the

Table 7

Impact of Air Pollution Control Costs on Selected Industries, 1976

(Dollars in millions)

Industry	1967 value of shipments	Total control costs	5 percent increase in wages	Control costs as percent of 1967 value of shipments	5 percent increase in wages as percent of 1967 value of shipments
Food and kindred products	$84,062	$296	$506	.4	.6
Paper	20,740	43	221	.2	1.1
Chemicals	42,470	60	325	.1	.8
Petroleum	22,042	23	61	.1	.3
Rubber and plastics	12,769	1	165	.01	1.3
Stone, clay, and glass	14,604	76	192	.5	1.3
Primary metals	46,550	875	492	1.9	1.1

Source: Based on U.S. Department of Commerce, Bureau of the Census, and Environmental Protection Agency data.

overall increase in value of shipments is estimated at 1.9 percent, but it is 2.3 percent for iron and steel companies and over 5 percent for the primary nonferrous industries.

Besides the stationary sources of emissions, the automobile will be heavily affected by air pollution controls. The cost of emission control devices alone is conservatively estimated to raise the average new car costs in 1975 by about $240, and the actual costs will probably be higher. These controls will result in increased automobile operation and maintenance costs of about $20.70 per year. The impact of the cost on 1976 models, the year in which nitrogen oxides must be controlled, has not been calculated because nitrogen oxide control technology has not yet been developed.

Total pollution control investment as a percentage of current total capital expenditures is large and rising. In 1970, the $2.5 billion that business and industry estimated they invested in air and water pollution control facilities was about 3.1 percent of their expenditures in new plant and equipment. The data in Table 8, based on McGraw-Hill figures, indicate that in the industry with the highest percentage—iron and steel—pollution control investments were 10 percent of total capital spending in 1970.

The effects of pollution control regulations on many industries and on prices are difficult to gauge because of the interdependence of many aspects of the economy. For example, the initial force of added costs, particularly for water pollution control, will strike the pulp and paper, chemicals, and primary metals industries heavily. They supply other manufacturing sectors rather than the ultimate consumer. Thus the added cost of waste treatment that begins with the first-stage processors will be passed on as the output moves upward through the production chain to the ultimate consumer. Based on the markups characteristic of each industry and other conditions, these increases may be magnified. However, many industries have already incurred large pollution control costs, which may mean that future adjustments will be less severe than might have been expected.

Not all industries are adversely affected by pollution control measures. Indeed, as the economy gears to higher levels of environmental protection and enhancement, some industries will be better off. Obvious examples are the suppliers of waste water control equipment and the construction industry. Similar effects can be expected from air pollution controls. But because of the technologies employed, expansion associated with air pollution control will center not only on construction but also heavily on the manufacture of equipment.

In 1970, investment for air, water, and solid waste pollution control is estimated at over $3 billion. By 1975, this investment will reach $7.4 billion, with cumulative investments for needed

Table 8

Total Capital Expenditures for Pollution Control as Percentage of Total Capital Expenditures

Industry	Actual 1970 (percent)
Iron and steel	10.3
Nonferrous metals	8.1
Electrical machinery	2.3
Machinery	3.5
Autos, trucks, and parts	4.2
Aerospace	2.8
Other transportation equipment	5.0
Fabricated metals	4.3
Instruments	3.6
Stone, clay, and glass	6.4
Other durables	9.2
Total durables	5.4
Chemicals	4.9
Paper	9.3
Rubber	5.3
Petroleum	6.0
Food and beverages	3.0
Textiles	2.3
Other nondurables	5.5
Total nondurables	5.4
All manufacturing	6.4
Mining	6.1
Railroads	1.6
Airlines	0.7
Other transportation	0.3
Communications	0
Electric utilities	3.8
Gas utilities	4.4
Commercial[1]	0.6
All business	3.1

Source: McGraw-Hill Publications Co.

[1] Based on large chain, mail order, and department stores; insurance companies, banks, and other commercial businesses.

equipment and construction of almost $35 billion. These expenditures mean sales and production in the constuction industry, equipment manufacturing industries, and numerous related industries.

Industries and firms that produce goods and services that incur little or no abatement costs will also profit. Many such industries and firms, depending on market conditions, will gain new business from buyers shifting from high pollution goods which will become more expensive. One example is natural gas—the cleanest of the fossil fuels—which is used in home heating, industrial heating, and electric power plants. The drive for a cleaner environment gives the natural gas and pipeline companies an advantage over coal and oil companies. And due to limited supplies, entire new industries may be generated to produce gas from coal.

impact on firms

As in the case of differences among industries, certain firms—and particularly certain plants—may fare better than others in the drive for environmental cleanup. Within any given industry there are efficient plants and inefficient plants. The new pollution abatement requirements are likely to fall with different impact among single plants in an industry, even though the same control requirements may apply to all. Different impacts will come from differing control costs and from different abilities to pass the added costs on to buyers or back to suppliers and shareholders.

The degree to which individual companies will encounter economic difficulties depends largely upon the costs that they will be compelled to absorb. This in turn will depend on market conditions for both sale of products and purchase of supplies.

Much of the cost increases will be reflected in price changes. How much of the increased costs can be passed directly to consumers, however, will depend on a demand for a firm's product and the position of that firm in the industry. A company may be able to raise prices without greatly reducing sales—if its products have few close substitutes.

More severe competitive conditions may force some firms to absorb at least part of the higher costs by production cutbacks and lower profits. As this occurs, the ability of such companies to command capital needed for operations will decline and a shift in their competitive position will follow. An individual company experiencing higher costs than others in an industry because of older or more obsolete plants may not be able to pass on as large a share of the costs in increased prices. Thus, competitive positions of firms are a major consideration in appraising detailed economic impacts.

specific adjustment problems

The U.S. economy is flexible and adjustable. Capital and other resources move quickly to exploit new situations, shifting from less profitable enterprises. This process is continuous in a dynamic economy, and business failures are not uncommon. In 1970, 10,748 commercial and industrial firms failed in the United States, 2,729 with liabilities exceeding $100,000. Failures over the past decade have averaged almost 13,000 a year.

Some weak or poorly situated plants or companies will unquestionably have difficulty gearing to environmental requirements. That weakness does not necessarily indicate bad management. It tends instead to be a function of obsolescence. In almost all industries, newer technologies not only are more efficient but they generally create less air and water pollution. Some old or small plants and those badly located are in trouble, in part, because

they have avoided environmental control measures adopted by others as a matter of course over the past decade.

Pollution control requirements will hasten the closing of some older, inefficient plants which have continued to operate because of capital expenditures already invested, tradition, and community ties—especially where the plant provides the principal payroll on which the area is dependent. Eventually nearly all will be closed for a combination of reasons. Companies often will close one or several marginal plants, making up production losses by building a larger, new plant. Some companies, indeed, can use pollution control as an excuse to shut down a plant they have long wanted to close.

Smaller firms operating single plants will tend to be more vulnerable to failure than large corporations with multiple plants and technologies. However, industries burdened with the highest environmental costs, such as chemicals, iron and steel, and pulp and paper, are mostly characterized by bigger companies' operating many plants, old and new. Hence, the impacts of pollution control expenditures on small business are not as severe as they would first appear.

Pollution control will represent added costs of production and when a plant is operating near the break-even point, even a slight incremental cost can tip the profit balance against it. A company must then decide whether to invest further in an obsolete facility in order to meet environmental standards or build a new facility. In many cases, it will choose to do the latter.

In the pulp and paper industry, it is not unusual for water pollution control to account for 25 percent of the capital invested in a new mill. Nor is it unusual that plants built early in this century—or even late in the last—are still operating. They frequently remain profitable because of fully depreciated capital which offsets higher per unit costs of operations. But although a plant may be very nearly fully depreciated, labor and raw material costs per unit of output tend to be considerably higher than in a modern plant.

If a manufacturer operates four old plants for which he must provide waste treatment, conceivably he could invest the same amount of capital in one new plant—and have not only adequate waste treatment but more capacity than with the four put together.

Eventually the more obsolete plants would probably close in any event. But waste treatment requirements alter the possible rates of return on investments, hasten closings, and tend to make the closings more immediate rather than spread out over a longer period of time. Recent case studies undertaken by EPA have demonstrated that pollution control requirements accelerated the rate at which firms failed. But in most instances studied, a large

number of other factors was chiefly responsible for the failures, and the plants would eventually have closed anyway.

One way to gauge how employment may be hit by a speedup of environmental spending is to look at the total number of jobs in pollution-intensive industries. Manufacturing is the major segment of the economy affected. It accounts for 20.2 million employees out of a total labor force of 84.2 million—or 24 percent. Manufacturing industries with the most intensive pollution problems account for almost 28 percent of total manufacturing employment. Therefore the employment in those industries that will be impacted to any significant degree by pollution control amounts to about 7 percent of the current work force. And of that, only a small percentage will be in those plants which would be so severely hit as to face possible layoffs. This possible unemployment is largely in the primary industries and hence does not include the effects in other industries whose costs increase because of pollution control expenditures by suppliers. Such secondary effects are expected to be small.

The major problem regarding employment is not one of aggregate unemployment brought about by pollution control. For one firm's pollution control cost represents another firm's profits and payroll. Although individual plants may shut down because of pollution control costs, other firms, industries, and professions will flourish. One reported estimate of future employment opportunities in environmentally linked fields predicts almost a doubling of career opportunities from about 660,000 in 1970 to about 1,180,000 in 1980. And this is only for employment in ecology, earth sciences, resources and recreation, environmental design, and environmental protection. It does not include much of the employment opportunities in construction and related areas.

effect on consumers and taxpayers

The incidence of costs of environmental improvement is important. Minor amounts of environmental costs may be absorbed in lower profits to firms, but generally the costs will be passed on in higher prices. Necessary public expenditures will be reflected in higher service charges, taxes, or decreases in other public services.

Over three-fourths of the solid waste collection and disposal costs will either be paid through taxes and service charges or will be paid directly to private firms for domestic and commercial disposal. About 42 percent of the 6-year costs for cleaning up air and water pollution, detailed in Figure 4, will be public costs—almost all of it for water pollution. Almost all the waste treatment operating costs and part of the capital costs are borne by local governments. These, generally, are funded from property

taxes and sewer service charges. However, a significant portion of the capital costs are paid for with Federal and State grants.

The other 58 percent of the air and water pollution control costs will initially be borne by industry. Most of that will be passed on to consumers in the form of higher prices. As stated earlier, increases in the value of shipments from pollution control requirements is usually a small percentage of the total. However, as primary industries supply other manufacturing sectors, the ultimate costs to the consumer may be larger than this initial burden.

To date, there are no detailed estimates of this cumulation of costs for water pollution control. However, some preliminary assessments for air pollution costs are available. The following table reflects the percentage of total production of other industries sold to the motor vehicle industry:

	Percent
Gray iron foundaries	25
Rubber	24
Iron and Steel	11
Petroleum	6
Primary lead	1
Powerplants	1

The increased costs to the auto industry of making automobiles—because of air pollution control costs incurred by its suppliers—is put at $225 million in 1976, approximately $22.50 additional per vehicle. Other additions to the cost of vehicles because of increased costs incurred by suppliers will, in all probability, also occur, but this impact should be minor.

Construction is another major industry whose dependence on other industries will cause a rise in costs greater than its own control costs. Increased air pollution control costs, particularly in the varnish, asphalt, cement, brick and tile, lime, and iron and steel industries may increase the price per average housing unit by $100. The complete cumulative impacts of all environmental control costs as they affect the cost of a house cannot be calculated with current data.

The funds for pollution control that come from the Federal Government are largely the product of progressive taxes, so a greater portion of the cost is borne by higher income taxpayers. State taxes are mixed: income taxes tend to be progressive, but sales taxes are not. Local government's share, based largely on property taxes and sewer service charges, however, tends to burden lower income taxpayers more. To the extent that environmental control costs are reflected in higher prices of products, those costs will be borne disproportionately by those with lower incomes because they spend a larger percentage of their incomes on such products.

Although there are burdens on low income groups, there are great advantages to achieving environmental programs at less cost to society through greater use of sewer service charges, for

example, and assuring that the prices of products reflect environmental control costs. A cleaner environment—particularly air over the cities and improved sanitation—will greatly benefit low income groups. And considering that cost increases will not be a significant part of the personal budget, the concern that the low income groups bear a heavier share of the cost for a cleaner environment is eased although not eliminated. This illustrates the desirability of dealing directly with income distribution problems rather than through subsidizing the costs of services or products.

the international impact

As nations move forward with environmental quality programs, competitive changes may well develop in international as well as domestic markets. Governments of trading nations will adopt various measures to assign the costs of pollution control. These measures may have different effects on production costs and on product prices. They may, therefore, have implications for international trade and investment flows.

Some U.S. firms will be faced with increased costs for their products which may not be matched by similar increases for foreign goods. However, environmental costs are but one among many international competitive factors and are often dwarfed by others.

A primary issue is whether the costs of pollution control will be borne by the goods whose production pollutes or whether they will be paid for from general tax revenues. In the United States, the primary responsibility for preserving and cleaning up the environment rests with those who degrade it, and prices of products reflect environmental cleanup costs. Not only is this policy fair and consistent with our system of assigning costs, but it leads to lower total pollution costs as consumers shift purchases toward goods that make fewer demands on the environment.

Although nations are bound to differ in their method of assigning costs, some agreement on principle is emerging. For example, at the Second U.S.-Japan Ministerial Conference on Environmental Pollution in June 1971, both countries confirmed "that the cost of control of pollution, including pollution control equipment, incurred in the production process by industry in order to meet emission standards necessary to achieve environmental quality standards established by each country in accordance with scientific criteria, should be borne by industry."

To impose direct costs on society as a whole through subsidies would relieve some industries but would be more costly to the whole economy. Such subsidies would have a similar effect on goods entering international trade, as would a tariff or export subsidy. The effect of such a shift or trade subsidy is that too many goods with high environmental costs would be domestically produced.

Even if there were international agreement that product prices absorb environmental control costs, shifts in international trade patterns would only be reduced, not eliminated. For many reasons—for example, differences in product mix, absolute levels of production, climatological and topographic factors—countries are likely to experience different costs for environmental controls. Those countries with low costs obviously benefit most in international trade.

Another factor is that environmental control standards will not be the same for every nation. With the exception of persistent pollutants that accumulate in the environment or pollutants that traverse international boundaries, the setting of standards will generally be a matter for each sovereign nation to decide for itself. Such choices will reflect the capabilities and preferences of each nation, which may vary depending upon different environmental, social, and economic circumstances.

Still another problem is that nations may use product standards as disguised nontariff barriers. For example, one country may set a standard more easily met by its own producers. As long as the standard is applied uniformly and is designed to minimize environmental costs, the barrier that it creates to imports is appropriate. However, a standard may discriminate against foreign products. The problems for trade policy are how to distinguish discriminatory standards from nondiscriminatory standards and to prevent the imposition of such trade barriers.

Some domestic U.S. industries will certainly be placed at a disadvantage as new standards are implemented. But most industries that will be affected will be those already suffering from outmoded production methods. However, most U.S. exports and imports are not goods with high pollution control costs. For example, of the total imports into the United States in 1969, less than 20 percent compete with products of the major U.S. industries with high pollution control costs. The breakdown is shown below.

Industry	*Total U.S. exports (millions)*	*Percent*
Pulp, paper, and manufacturing	$1,588	4
Petroleum products	1,115	3
Chemicals	1,232	3
Iron and steel products	1,724	5
Nonferrous base metals	1,374	4
Subtotal	7,033	19
Other imports	29,019	81
Total	36,052	100

Likewise, because of the composition of U.S. exports, a large share of our exports will be relatively unaffected. Of the total U.S. exports in 1969, under 20 percent was from industries with high pollution control costs. The breakdown by industry is shown below.

Industry	*Total U.S. exports (millions)*	*Percent*
Petroleum products	$428	1
Chemicals	3,383	9
Pulp, paper, and manufacturing	892	2
Metals and manufacturing	2,536	7
Subtotals	7,239	19
Other exports	30,749	81
Total	37,988	100

These estimates do not include all industries facing foreign competition that have large control costs. Nonetheless, there does appear to be little likelihood that the U.S. balance of payments will change significantly because of pollution abatement efforts.

Studies by Ralph C. d'Arge, sponsored by Resources for the Future, Inc., suggest that even relatively large cost increases for U.S. products in the absence of comparable price increases for its foreign competitors—an unlikely circumstance as more nations impose environmental quality requirements—would change the U.S. domestic economy little.

Whatever competitive advantages foreign products enjoy in the near term will shift as all nations begin to upgrade environmental quality. All of the industrialized nations are actively engaged in environmental protection programs of some sort. However, the United States is generally conceded to be considerably ahead—both in the degree of control and the quality of control technology. In the future, as other countries begin to make large investments in pollution control facilities, the U.S. position in world trade markets should improve. Moreover, its technological lead should establish the United States as an exporter of pollution control devices and engineering competence.

strategies for attaining environmental goals

Government faces two challenges: to find ways to control pollution most efficiently, fairly, and effectively and while doing so to develop strategies to cope with the transitional impacts of higher pollution control costs.

A number of strategies may be used, individually or in combination, to achieve environmental goals. Persuasion—relying on

community pride and responsibility—is one. Although it often works in prodding individual actions, such as anti-littering or beautification, it does not work well with a manufacturer worried about his competition and profits.

Enforcement has been the keystone of environmental quality control efforts in the United States. Many have suggested a mix of financial aids to supplement regulation, ranging from tax write-offs to guaranteed loans or grants. Another approach is to use economic incentives, such as the proposed lead tax and the sulfur oxides emissions charge.

Only regulatory authority and economic incentives are discussed as strategies for attaining environmental goals. Proposals for tax, loan, and grant assistance to industry cover only part of the full cost of pollution control, which by any particular firm is viewed as a basically nonproductive investment. So they provide little or no incentive for industry to pursue control activities. Therefore, subsidies are discussed later as policy options to aid transitional problems.

environmental standards

The most common strategy currently being used to deal with environmental problems is to set and enforce environmental quality standards. By and large, the principles are simple, straightforward, and build upon existing legal structure.

Police powers have been used to handle many questions of public nuisance. Environmental quality legislation enacted in recent decades has simply followed suit. The two principal Federal laws are the Clean Air Act, as amended, and the Federal Water Pollution Control Act, as amended.

Historically, Federal law has deferred to State and local governments to set air and water quality objectives. This approach still holds in the Federal Water Pollution Control Act and in the Administration's legislative proposals for water pollution. However, the President's proposals add new dimensions to the Act. They call for national effluent standards for hazardous pollutants. They also require effluent standards for each discharge source to meet ambient water quality standards and demand the best practicable treatment for new sources of water pollution.

The Clean Air Act of 1970 departs sharply from the past. It requires national ambient air quality standards for the chief air pollutants. Primary standards are set at levels to protect human health from air pollution. Secondary standards, even more stringent, protect crops, property, and esthetics. The Act calls for national emission standards for significant new sources of air pollution, such as power plants and nonferrous smelters. And it establishes national emission standards for new and old sources

of hazardous pollutants. States have the responsibility for developing implementation plans to meet ambient standards for existing facilities.

Both the Clean Air Act and the Administration's proposed water quality legislation recognize the need for specific standards to protect human health. They also recognize the need for using the best available technology to control new sources of pollution. Finally, both pieces of legislation greatly expand the geographic scope of Federal concern and the Federal Government's enforcement authority.

Absolute prohibitions of some pollutants are justified. For example, discharging extremely dangerous and persistent materials may need to be entirely forbidden. For other waste discharges not crippling to human health, it is more reasonable to curtail but not outlaw them.

Setting standards is an attempt to enforce a collective judgment. Total prohibition of many substances is as unwarranted as total freedom to discharge unlimited quantities. Desired uses of the environment—such as swimming and breathing air free from damaging health effects—are dictated collectively by the political process. Standards of quality are established to meet the uses, such as determining the quantity of a pollutant which can be in the ambient air or water and still achieve the uses. These standards or criteria are based on available scientific evidence of the toxicity, persistence, and other effects of pollutants. Implementation plans, usually specifying emission or effluent limitations, are then designed for each source to achieve the ambient standards.

Environmental quality standards are vital. For pollutants especially harmful to health, they give across-the-board protection to the population. Though explicit information on benefits and costs leaves much to be desired, standard-setting does provide mechanisms for collective decisions of their value in determining desired levels of environmental quality. And unlike some subsidy measures, they do not discourage firms from using a variety of alternative abatement measures. Once a standard is set, a firm can chart its own course by choosing the best mix of process changes, improved management, and treatment to meet the standards.

However, total reliance on regulatory authority raises a number of problems. Public agencies must not only specify standards and implementation plans, judging technical and economic feasibility, but they must also prove violations of standards. These responsibilities delay enforcement—sometimes for several years or even a decade or more. Some companies and municipalities which have been ordered to undertake specified control activities have been able, at a minimum of cost, either to delay or

circumvent the orders entirely. Granting variances for a wide variety of reasons has been commonplace.

Enforcing reductions in waste discharge levels remains an uncertain and continuing problem. Ambient pollution levels must first be measured. Then the sources of pollution must be traced. Eventually each discharger must be notified of his compliance requirements.

The ease and cost of pollution reduction hinge on several sets of variables—the industry, its product mix, its processes, age of plants, and operational controls. These differences raise important questions regarding whether the costs of any abatement scheme are fair, efficient, and reasonable.

Typically, environmental standards are implemented by setting approximate levels of abatement for each source. Usually these limits call for uniform or proportionate reductions by all dischargers. That is, if the total discharges exceed the ambient standards, each source is required to reduce discharges in proportion to its contribution to the total.

Though the equal-proportionate scheme has an air of equity and is fairly straightforward, it is also inefficient and expensive. In terms of equity, equal-proportionate reductions often have an unequal impact on profit rates or sales. A study of the gray iron foundry industry revealed that nearly equal percentage reductions in air pollution had about a fifth the economic impact on large foundries as on small foundries. Also, new plants have the advantage, especially for waste water discharges, of being able to design their processes to minimize pollution, while existing plants do not always have that option.

The same pollution control results can be achieved at far less cost if instead of making all existing sources cut back proportionately, those with low costs treat to high levels and vice versa. But this would require regulators to develop detailed information on the costs of reduction for each individual source—information that is not available and would be costly to obtain. Even if a least-cost standard-setting procedure were technically and administratively feasible—which it is not with current institutions for dealing with pollution—it would still raise serious equity problems. It would call for greater reductions from sources with low abatement costs and allow operators of plants with high abatement costs to escape responsibility.

pollution charges

Clearly, standard setting and enforcement is the primary way the Federal Government addresses most environmental problems. Certainly that strategy alone is especially useful for dealing with hazardous pollutants. It is also clear, however, that because of the enforcement, efficiency, and equity problems of the regula-

tory approach, other means of achieving pollution abatement must also be probed.

A promising possibility is to levy financial charges against dumping of waste materials into the environment. With little doubt, a well-constructed charge system tied to the amount and type of pollutants would quickly curb waste discharges because it would significantly change the basic costs facing individual polluters. Pollution charges would provide a strong abatement incentive and would tie environmental costs to the processes that generate the pollution.

Charge levels could be set to stimulate each discharger toward positive and effective action to cut pollution. Manufacturers would have an incentive to change production processes, improve internal plant management of wastes, and rely more heavily on recycling and recovery to reduce waste discharge. They would be encouraged to seek out and use new technologies rather than debating their technical feasibility.

Limited experience with sewer service charges buttresses such expectations. A Springfield, Mo., packing plant faced with a waste treatment charge of $1,400 per month, so modified its production processes that its monthly payment was scaled down to $225. When its treatment plant became seriously overloaded, Otsego, Mich., decided to charge a large industrial user. In response, the company cut its waste discharges from 1,500 pounds of BOD a day prior to the charge down to 900 pounds daily during the first month the charge became effective. In the second month, it reduced discharges to 733 pounds. Within 90 days, daily discharges were down to 500 pounds—a level the plant could treat effectively. These examples illustrate the effectiveness and desirability of assessing users of treatment facilities the full costs of their treatment. This principle is being expanded through EPA regulations and through the Administration's proposed amendments to the Federal Water Pollution Control Act.

With present rules, polluters can delay abatement. Pollution charges would create a positive incentive to accelerate abatement efforts and discourage delay. Moreover, a charge scheme would be continuous and predictable, not sporadic. In a sense, a pollution charge is a 24-hour "automatic enforcer." An incentive now lacking would be provided to install facilities and, most important, maintain and operate them efficiently.

As the costs of pollution control are incorporated into the market structure, producers and consumers of high pollution goods would carry their share of the burden. And as prices of goods reflect the relative costs of pollution abatement, consumers would, to some extent, shift to goods that embody lower environmental costs.

By placing the cost responsibility on the polluters, charge systems are equitable. The operator of a plant where reductions are

possible only at high costs is not forced to make large reductions. But neither does he continue to pollute without bearing the burden of the charge and thereby win a competitive advantage over those who undertake control and incur the costs. By placing an equal charge on all dischargers, the charge system provides an equitable basis for achieving greater efficiency in meeting environmental standards.

regulation and charges—a new strategy

Advocates of regulatory authority and advocates of pollution charges often considered the approaches as mutually exclusive. The two strategies were viewed as an "either/or" proposition instead of their being used together to attain desired standards of environmental quality.

However, first the lead tax proposal and then the proposed sulfur oxides emissions charge show the way to a new strategy combining elements of both approaches. Regulatory authority can be used to establish ambient standards and back-up enforcement, while pollution charges provide the economic incentive to achieve these standards.

The tax on lead used in gasoline complements the authority to control lead use in gasoline. Under the Clean Air Act, the Administrator of EPA has power to regulate additives in gasoline—including lead. But because some leaded gas will be necessary for older vehicles for many years, it will continue to be marketed. Yet the need exists for an economic spur for consumers who can use low- or unleaded gasoline now to do so. Consumer demand would then induce the oil industry to produce more low- and unleaded gasolines. Without the tax, gasoline buyers would continue to buy the cheaper leaded gasoline, and it would be difficult to develop the supply of unleaded gasoline needed to avoid fouling pollution control devices that will almost surely be required to meet the 1975 standards.

The sulfur oxides emissions charge, which the President directed the Council on Environmental Quality and the Treasury Department jointly to develop, would also combine regulatory authority with an economic incentive. The Clean Air Act of 1970 tightened the legal authority to control air pollution, including sulfur oxides emissions. But the necessary control technology still lags. And debate continues about the commercial availability of devices to curb sulfur oxides from stack gases. Enforcement often is hamstrung by this basic conflict over availability of control equipment and the feasibility of installing it.

The sulfur oxides charge will stimulate industry to develop and install the necessary control equipment. Because it acts as a continuous economic incentive to achieve the standards, it should also reduce the need for thousands of ad hoc enforcement actions.

It thereby strengthens the capacity of the regulatory process by paring enforcement actions to a manageable number.

If the charge is not adequate to achieve the ambient standards—as may be the case in some heavily congested urban areas—the regulatory authority will assure that the standards will still be met.

Because the charge can achieve the standard and still accommodate different levels of emission reduction from different sources, it could lead to significant cost savings. In blending regulatory authority and charges, it is critical to do so in a way that does not diminish the economic efficiency gains attainable with the charge.

Standard setting and enforcement coupled with complementary economic incentives provide two powerful tools to achieve a high quality environment. As successful experience with charge systems builds up, it will be appropriate to reevaluate which mixes of strategies are most appropriate to achieve environmental goals.

strategies to deal with economic adjustments

National efficiency and social well-being are best served by public measures that aid the adjustment to change—not by policies that prevent change. Higher costs for pollution control raise the same kind of adjustment questions as a shift in demand for a firm's products or any other increase in factor costs—for instance, increased costs for labor, land, capital, equipment, or raw materials.

The value of productive assets depend on profits. When profits fall because of increased costs of production or decreased sales, the value of the firm's fixed assets, which cannot be easily transferred, generally fall. When such assets decline in value, it is a signal of their economic obsolescence. The economy as a whole does not suffer because of it, for their continued use has little or no value. There is no economic reason for the public to subsidize an owner of fixed assets which have fallen victim to changing demand or increased costs. It is all part of necessary adjustments in the economy. However, factors in the economy that have alternative uses and keep their productivity regardless of demand and supply shifts are another matter. Society as a whole has an interest in using them promptly in other productive ways. Labor represents the major factor that has such alternative productive uses.

Minimum unemployment and maximum output of the economy can best be accomplished by assuring that those factors which have alternative employments are aided in transition and by disregarding those specialized or fixed factors which have no alternative uses. Indeed, social justice demands greater concern for individuals suffering disproportionate losses from dislocation, especially those who will be unemployed because of environ-

mental control actions. This principle might also hold true for small businesses and proprietors more than for large corporations whose losses are generally shared among many stockholders.

The major means to ease economic adjustment problems during the environmental transition are Government policies to promote overall growth, employment, and stability. Chief among them is the repertoire of fiscal and monetary policies the Government can call upon. Properly employed, they can create favorable aggregate demand levels, full employment, and stable prices.

The Government also encourages education and training, which aid mobility of human resources, and discourages monopolies, which tend to lock labor and capital into pursuits yielding lower levels of real output. Government programs also protect those severely disadvantaged by economic growth and change. Unemployment compensation, retraining assistance, small business loans, technical assistance, and aid to depressed areas—are examples of such programs. To both industry and labor, another major aid to adjustment is the phasing of environmental expenditures required to meet prescribed standards.

Special adjustment assistance to individual companies would tend to perpetrate obsolete facilities and would create undesirable incentives. Additionally, competitors could claim unfair competition in public financing of abatement measures, and it may reward those who have lagged in their abatement efforts. Such special assistance would also give rise to difficult problems in deciding which plant qualifies for special aid. This could open a Panadora's box of cost scrutiny and judgment of rates of return approaching that of public utility regulation.

There may be times when public assistance to firms is justifiable on economic grounds—for instance, in chronically depressed regions, where pollution abatement requirements would close several companies and lay off most of the labor force in a town. But the rationale for assistance would be to maintain employment rather than shore up fixed assets with little or no value.

The Congress and others have suggested several assistance programs to deal with transitional problems. They are broadly of two types: across-the-board assistance, such as tax write-offs, grants, or loans; and targeted assistance to workers, small businesses, or heavily disadvantaged firms.

across-the-board assistance

tax aid—Greater use of tax devices has been suggested to help ease industry's transitional problems. The Federal Government currently offers rapid amortization of capital expenditures for pollution control equipment under some circumstances. Over 30 States also offer rapid amortization, exemption from sales

and use taxes, exemption of facilities from property taxes, or some combination thereof. In at least one State, plants which principally use waste materials are valued at 25 percent of assessed valuation for property tax purposes. In many States, industrial development bonds can provide an interest subsidy that equals the difference between municipal and industrial costs of capital. The Tax Reform Act of 1969 exempts pollution control facilities from the general prohibitions on the use of industrial development bonds.

Although these financial incentives can help individual companies faced with increased pollution control costs, they also raise problems. One of the major arguments for tax relief is that some firms cannot make the required expenditures for pollution abatement and still stay in business. But if tax relief comes in the form of an income tax shelter, the benefit falls primarily to those firms enjoying net income flows. It tends then not to help firms most in need—those which are truly marginal and have little or no profits to be offset.

Further difficulty arises because of the bias that is created in favor of capital facilities. Almost of necessity, tax relief is tied to capital spending—such as for treatment facilities. If it were not, the Internal Revenue Service would be forced to make plant-by-plant decisions on whether a part of the industrial process is related to pollution control or just to production. Detailed industry studies indicate that for the most part, the cheapest way to reduce waste is through process changes, improved plant management, and reuse and recycling of materials—instead of almost total dependence on capital intensive waste treatment. Because tax advantages subsidize capital expenditure and do not—and in the main cannot—provide assistance for other expenditures, firms would be encouraged to undertake wasteful abatement techniques. And to the degree that pollution control costs are subsidized and not reflected in product prices, too many environmentally costly products will continue to be produced.

grants—All or part of industry's costs for pollution control could be met through direct Federal grants. Indirectly, this has been the case with the Federal grant program for construction of municipal waste treatment plants, where 50 percent of wastes treated are from industrial sources. More recently, however, municipalities receiving Federal grants are being required by EPA regulations to institute user charge systems for industrial waste treatment.

A one-time subsidy to waste dischargers has several advantages over tax relief. More subject to legislative and executive review, grant subsidies avoid the less scrutinized "backdoor financing" of tax assistance. Moreover, grants are less likely to become a more permanent feature of the cost structure of industry,

thereby not disrupting efficient resource allocation as much. Grants, however, do contain most of the disadvantages of tax subsidies, such as encouraging overly expensive capital facilities and failing to assure that the full costs of environmental improvement are reflected in the prices of products.

Grants may seriously inhibit progress in waste discharge abatement. There is evidence to suggest that until recently, the Federal municipal waste treatment plant construction program may have slowed construction in some parts of the country, although in total it stimulated a greater amount of overall construction. There is certainly reason to think that a grant program may, at least initially, encourage industries to wait in line for grants—instead of act.

loans—Loans are another way suggested to blunt the economic impact of pollution abatement. A guaranteed loan would not necessarily increase the availability of capital for a company, but it would reduce interest rates. A Government-subsidized loan could even reduce a company's costs further.

A loan program would not appreciably help a marginal firm whose problem is lack of profit, which would essentially preclude it from amortizing a loan, guaranteed or otherwise. And loans suffer most of the problems of subsidy and grant programs discussed above. Further, guaranteed loans will compete with other capital needs—such as Government securities, mortgages, and State and local bonds. It is not clear that another distortion in capital markets in order to assist industry to meet pollution control requirements is desirable in light of other goals: to maintain low Federal interest costs and to provide acceptable capital markets to encourage home building and improvement of State and local facilities—including sewage treatment plants.

targeted assistance

Some current Federal programs already can be tapped to help with the environmental transition. Programs administered by the Department of Labor under the Manpower Development and Training Act (MDTA) and the Economic Opportunity Act can retrain and reemploy workers laid off because of pollution control requirements. In fiscal year 1971, total training and related services administered by the Labor Department will reach more than 1 million individuals at a cost of $1.5 billion.

Small Business Administration (SBA) loans are available to help small firms. Section 7(a) of the Small Business Act authorizes SBA to make, participate in, or guarantee loans of up to $350,000 for the SBA share, with interest rates on that portion of up to 5.5 percent. The loans, which can be used for land acquisition, machinery, or equipment and plant construction,

conversion, or expansion, can assist in financing pollution control facilities.

The Economic Development Administration (EDA) can provide loans, grants, and technical assistance to local governments or industry for the purpose of promoting economic development in economically depressed areas. If environmental control costs are a barrier to economic development, or will cause severe unemployment, then this assistance can be for municipal public wo ks projects or industrial pollution control facilities.

Although these programs can help with transitional problems, they are limited. Funding for all of them has been set thus far without reflecting specific requirements for adjusting to the environmental transition. The MDTA programs are geared to disadvantaged workers, not necessarily to those laid off by plant closings due to pollution control requirements. SBA programs help only a small segment of the economy. EDA has broad authority to aid economically depressed areas, but this aid can be used only to help meet environmental transitional problems when they are a significant barrier to the economic well-being of an area.

Under the present Trade Expansion Act (TEA), the Tariff Commission and the Secretary of Commerce or of Labor can vouch that imports stemming from trade concession hurt workers or firms, entitling them to special assistance. At present, increased pollution control costs alone are not grounds for eligibility. The TEA model has been suggested for a special pollution control assistance program. Although attractive in its flexibility in determining eligibility and the types of assistance, it leaves the difficult decisions to adminstrative discretion.

Some have suggested that small businesses lack knowledge about pollution control requirements. Therefore, a pollution control technical assistance program has been suggested to help small firms minimize costs for pollution control. This might be particularly helpful to firms with little in-house expertise.

Another alternative in dealing with the transition is to expand current programs especially to meet pollution control adjustment problems. However, without better knowledge of probable impacts—on companies, industries,and regions—it is difficult to decide about appropriate budget levels and mixes among the programs.

Lack of accurate data on pollution control costs is still a barrier to intelligent policy development. The Council on Environmental Quality is working with the Environmental Protection Agency, the Department of Commerce, and other agencies on a study to determine more accurately the impact of pollution control expenditures on industries, companies, regions, and workers. The Administration is evaluating a range of possible

assistance measures to aid in overcoming transitional problems brought about by environmental expenditures.

conclusions

The costs of pollution control will be high overall but not great when compared with the gross national product, value of shipments by industry, or even total investment in capital facilities by industry. In general, U.S. business and industry will adjust to these costs just as they have adjusted to other changes in the cost of doing business. The most difficult adjustments will be to solve the temporary dislocation of workers made jobless by plant closings.

The Council believes that an optimum strategy for dealing with environmental problems is to employ both regulatory authority and pollution charges. Regulatory authority insures that legal remedies are ready to meet agreed-upon standards; pollution charges guarantee a strong incentive to install the necessary equipment and operate it efficiently. Use of charges and regulatory authority in tandem can achieve environmental standards faster and cheaper. As more experience with charge systems builds up, it will be appropriate to re-evaluate which mixes of strategies are most appropriate to achieve environmental goals.

Clearly, economics plays a major role in our effort to achieve a high quality environment. Intelligent economic decisions and the wise allocation of resources are essential to achieving environmental goals. While the aggregate costs of pollution control appear well within the capacity of the American economy to absorb, there will be some transitional problems. But there is every reason to believe that our Nation's commitment to environmental quality can be achieved within the context of a healthy, dynamic economy. Failure to take the necessary steps would cost the Nation much more in terms of health impairment, loss of recreational resources, and a decline in the quality of life.

appendix

costs of air and water pollution control and solid waste management

The summary data presented in the text were largely derived from the supporting data presented in this appendix. It provides a more detailed assessment and analysis of costs for air and water pollution control and solid waste management. The general limitations of the data are discussed in the chapter.

water pollution costs

Current data for water pollution control expenditures are primarily for

municipal and industrial waste treatment. Data on such "nonpoint" sources as agricultural runoff and acid mine drainage are considerably less reliable.

public treatment costs—During 1970, municipal waste treatment facilities serviced about 95 percent of the sewered population (70 percent of the total population). These municipal operations also provided waste treatment for most small non-water-intensive industries; for some heavy industry; and nearly all commercial, institutional and financial establishments. Over 60 percent of the total sewered population is receiving at least secondary (biological) treatment, and 35 percent is receiving only primary (settling) treatment. Only 5 percent of the sewered population is receiving no treatment at all.

The current replacement value of municipal treatment plants amounts to about $6.1 billion. Interceptor sewers, pumping stations, and outfalls associated with the waste treatment plants add a replacement value of approximately $7.6 billion, for a total of $13.7 billion. These figures do not include the estimated value of sanitary, storm, or combined sewers which feed into municipal systems—about $12 billion additional capital.

Much of this treatment plant investment has been made in recent years. Annual costs to operate, maintain, service, and replace this growing system have been rising steadily. In 1970, they were close to $1.6 billion, compared to $800 to $900 million in 1965.

In spite of the sharp rise in the levels of investment and their magnitude, far more capital will be required to keep municipal treatment in step with national water quality objectives. Estimates indicate that slightly more than $4 billion will be required to eliminate deficiencies in existing treatment facilities. Another $8 billion will be necessary between 1971 and 1974 to meet replacement and population growth needs.

This EPA estimate of $12 billion total is for treatment and related facilities, eligible for Federal grants. The National League of Cities/U.S. Conference of Mayors made another estimate of municipal waste treatment needs of between $33 and $37 billion. That estimate was calculated from responses from its member cities. However, when costs ineligible for funds under the Federal grant program are deducted and double counting eliminated, the National League of Cities/U.S. Conference of Mayors estimate becomes about $11 billion on a comparable basis with EPA estimates.

Based on 1968 data, additional costs have been estimated for capital investment needed to alleviate the problems of overflows from combined sewers. The American Public Works Association calculates that it will cost between $15 billion and $48 billion to remedy overflows from combined sewers. The $15 billion figure would cover a variety of alternatives short of complete separation, and the $48 billion would finance complete separation of combined sewers—$30 billion in public costs and $18 billion in private costs.

The accumulated investment in treatment systems by 1974 will be accompanied by substantially increased costs of operation. The 1974 annualized costs of municipal water treatment are projected at $3.2 billion. Table A–1 compares these municipal annual investments, cumulative investments, and annualized expenditures for 1970 and 1974. Costs will continue to increase even after 1974, but at less dramatic rates.

These annual expenditures can be compared with expenditures for other municipal services. The annual costs for municipal waste treatment will amount to about $20 to $22 per person served, compared to 1969 municipal per capita expenditures of $22 for police, $34 for education, and $18 for public welfare.

private treatment costs—The Bureau of the Census reports that of the 240,000 manufacturing establishments in the U.S. in 1968, fewer than 10,000 used 20 million or more gallons of water. Ninety-one percent of the 35.7 trillion gallons of water used by major manufacturers in 1968 was used by 5,000 food, pulp and paper, chemicals, petroleum, and primary metals firms. Their

Table A–1

Current and Projected Expenditures for Public Waste Water Treatment Systems, 1970 and 1974

(In millions of dollars)

Type of expenditure	1970	1974
Cumulative investment		
Waste treatment	$ 6,100	$ 9,400
Waste transmission	7,600	14,000
Total	13,700	23,400
Annual investment		
Replacement of existing facilities	400	800
New investment	800	3,200
Total	1,200	4,000
Annualized costs		
Operation	310	900
Replacement	410	760
Interest[1]	840	1,520
Total	1,560	3,180

[1] Expressed as an opportunity cost of carrying replacement value at average 1970 rate for high-grade local government bond, 6.51 percent.

waste water discharge was several times the amount discharged by the sewered population of the United States The bio-chemical oxygen demand (BOD)—a measure of oxygen needed to decompose the wastes—was roughly four to five times that of total domestic liquid wastes.

The waste loads of many of the smaller manufacturers do not significantly differ from other sources of municipal waste loads. The overwhelming number of these companies discharge directly to municipal systems Yet because they are relatively small water users, they account for only about 10 percent of all manufacturing waste water discharges.

There are significant differences in the economics of pollution abatement for municipal and industrial operations. Industrial investment is usually far smaller to achieve the same level of treatment. In most cases, a manufacturer does not incur the collection and intercepting sewer costs which represent a majority of municipal costs. In addition, the more concentrated nature and greater volume of their wastes result in lower unit investment costs for treatment. However, industrial operating costs are higher than municipal operating costs—averaging twice as much per unit of invested capacity.

Another difference between municipal and industrial abatement costs is the wider range of alternatives available to industry. Unlike municipalities, industries can reduce waste discharges through process changes and better internal management as well as through treatment. Industrial expenditures for process changes that reduce pollution often result in more efficient production. Accordingly, it is often difficult—and sometimes impossible—to allocate costs between pollution abatement and increased production.

Nationwide, an estimated 50 percent of the wastes treated in municipal plants are from industrial sources, although the percentage of municipal capacity so used varies greatly from plant to plant. The costs of such capacity are included within the estimates of capital and operating costs for municipal waste treatment plants.

Most existing industrial waste treatment facilities have probably been built over the last decade. As estimated by McGraw-Hill, investments by manufacturing plants were about $870 million in 1970 and $600 million in 1969—compared with less than $200 million in 1960. Industries other than manufacturing—mining, electric utilities, commercial establishments, etc.—estimate their 1970 investment for water pollution control at $287 million. The total 1970 investment, then, is approximately $1.2 billion. The McGraw-Hill survey indicated that industry planned to spend $1.6 billion for water pollution control investments in 1971. A breakdown of 1970 investments by industry is shown in Table A–2. Although most of this investment is for treating

Table A–2

Total Investment for Water Pollution Control, 1970

(In millions of dollars)

Industry	Investments
Food and kindred products	$46
Textiles	9
Paper	94
Chemicals	90
Petroleum	185
Rubber	18
Primary metals	140
Machinery	66
Transportation	31
Other manufacturing	193
Total manufacturing	872
Mining	42
Electric utilities	149
Other business	96
All business	1,159

Source: McGraw-Hill Publications Co.

process wastes, it also includes the costs for electric utilities to reduce thermal pollution. These figures do not include investment in municipal systems specifically for treating industrial wastes.

This large investment in treatment facilities requires significant expenditures for operation and maintenance. EPA estimates that the annualized costs—which include both capital and operation and maintenance costs—of manufacturing related water pollution treatment may amount to slightly over $1 billion for 1970 alone. About $575 million of it was operation and maintenance costs, and about $475 million was annualized capital costs. These figures do not include the user charges paid by many smaller firms for waste treatment by municipal systems. Nor do they include the operating costs associated with electric power generation, mining and a number of small industries.

EPA estimates that manufacturers' investments for waste treatment equipment should average about $1 billion per year between 1971 and 1974—$3.1 billion for new waste treatment facilities and another $1 billion for capital

replacement. Annualized costs of control in 1974 would also substantially increase, to over $1.8 billion.

EPA estimates that up to $2 billion additional investment will be needed to control thermal pollution from electric power plants. This estimate assumes complete use of recirculation or closed systems for cooling water.

Table A–3 contrasts current manufacturing expenditures with those required by 1974 water quality standards. As the table indicates, four industries—paper, food, chemicals, and primary metals—spent two-thirds of the money in 1970. By 1974, they will account for almost 80 percent of the total.

Table A–3

Estimated Costs of Industrial Waste Treatment, 1970 and 1974 [1]

(Dollars in millions)

Industry	1970 [2]		1974		
	Annual costs	Percent of total	Annual costs	Percent of total	Percent increase 1970–74
Primary metals	239.3	23	426.0	23	78
Chemicals	187.2	18	421.4	23	125
Food and kindred products	158.4	15	260.0	14	64
Paper	116.9	11	325.9	18	179
Transportation equipment	107.9	10	115.4	6	7
Petroleum	95.5	9	110.2	6	15
Machinery	60.1	5	42.3	2	(30)
Textiles	50.2	5	79.9	4	59
Rubber and plastics	8.9	1	23.5	1	164
All other manufacturing	29.2	3	57.2	3	96
Total	1,053.6	100	1,861.8	100	77

[1] Interest costs based on average 1970 rate of Aaa + Bbb corporate, or 7.42 percent.
[2] Assumes 1954–70 rate of increase in output and 1954–68 shift in water use per unit of output.

Source: Environmental Protection Agency

other water pollution control costs—Although erosion contributes more pollutants by weight than any other source, estimated control costs are unavailable, incomplete or rudimentary. Costs for erosion control on farms are unknown. EPA estimates of highway erosion control costs range from $130 million up to $7 billion. Increased costs for erosion control at urban construction projects has been esimated at between $140 million and $1.4 billion a year. Sediment control for 300,000 miles of stream banks is estimated at between $200 million and $3 billion.

Estimates of costs to curb pollution from mining also vary widely. One study estimated that to curtail acid mine drainage from the most severe cases of unreclaimed surface mines may cost upwards of $300 million. To reclaim the total 2 million acres of unreclaimed or inadequately reclaimed lands would cost an estimated $750 million. To upgrade these lands further to farming, grazing, and recreational quality levels might bring total costs to at least $1.2 billion. But even these estimates may be too low. For example, to control acid mine drainage in Appalachia alone—from both surface and underground sources—is estimated in another study to cost over $5 billion, which might raise the national bill to $7 billion.

Costs for control of vessel pollution have also been estimated. In 1971, EPA estimated that the initial costs of meeting marine secondary waste treatment standards would range between $1.1 and $2.3 billion.

These various estimates do not cover the costs of water pollution control from a number of other sources. For example, there are no reliable estimates of the costs of controlling feedlot or other animal wastes or oil spills and intentional discharges of oil.

air pollution costs

Most of the funds for air pollution control have been spent on reducing particulates and automotive pollutants. The standards resulting from amendments to the Clean Air Act will soon require major additional spending to control sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, oxidants and selected toxic substances such as beryllium or mercury, as well as particulates.

public costs—State and local government expenditures for air pollution control are primarily for planning, enforcement, and monitoring rather than for facilities to control emissions. Municipal incinerators and public buildings are the major areas of direct public costs—sources which are small in the aggregate.

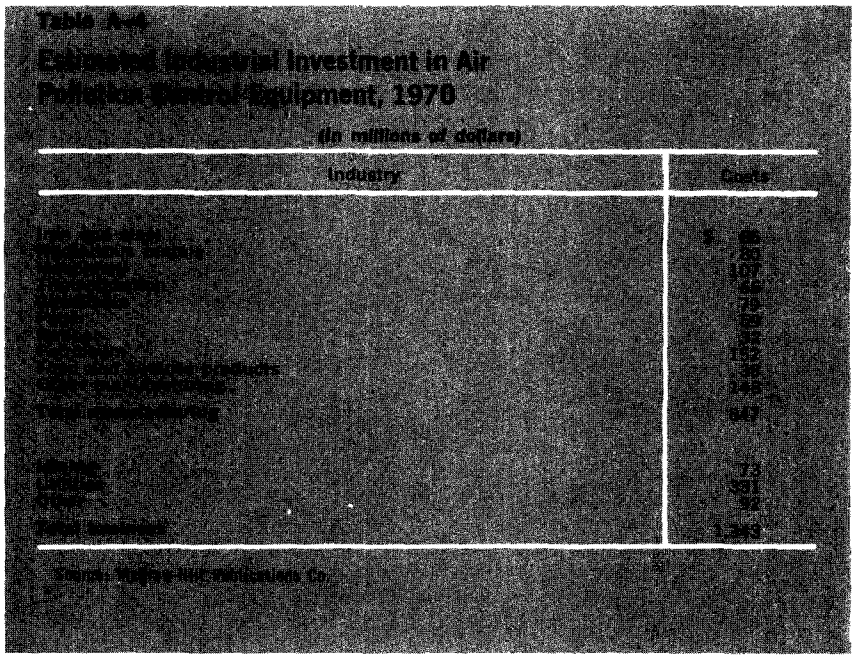
Public spending on air pollution control programs has increased steadily in recent years, much of it in Federal grant funds under the Clean Air Act. For fiscal year 1970, agencies receiving Federal grant support budgeted $64.4 million for air pollution control activities. Of this, $38.4 million was non-Federal, which represented a fourfold increase over fiscal year 1965. Future expenditures are projected to rise steeply as the new Clean Air Act Amendments are implemented. Federal expenditures are also expected to rise as research, planning, and enforcement activities are accelerated.

By 1976, over $200 million must be invested in capital equipment for municipal incinerators to meet air quality standards. Annualized costs of these facilities will amount to over $100 million by 1976. These expenditures will control only incinerator emissions. They do not include the large expenditures needed to close all open burning dumps or convert them to sanitary landfills.

private costs—Significant expenditures will be required by the private sector to control both stationary and mobile sources of air pollution. Most air pollution from stationary sources is generated from fuel combustion in power plants, industries, and homes and from industrial processing. The major mobile source of air pollution is the ubiquitous automobile, but trucks, buses, motorcycles, and airplanes also pollute the air. Controls over mobile and stationary sources differ greatly because of inherent differences in physical operation and types of pollutants emitted. Consequently, costs of control differ greatly.

stationary sources—Data on current costs of air pollution control at stationary sources are limited. With some exceptions, these costs are incurred by the industrial segment of the economy. The McGraw-Hill study estimated a total investment in air pollution control of over $1.3 billion in 1970. The study indicated that industry planned to spend $2.1 billion in 1971 on capital investments to reduce air pollution. A breakdown by major industrial sectors is shown in Table A–4.

Estimates for future air pollution control costs are very rough. No comprehensive annual cost estimates are available, either for the past or future. Rather, EPA estimates are based on cumulative costs between 1967 and 1976, the year when compliance with air quality standards is required under the Clean Air Act. *The Economics of Clean Air* report fails to take fully into account the costs of implementing the Clean Air Act Amendments of 1970. Data are available for only six pollutants—particulates, sulfur oxides, carbon monoxide, hydrocarbons, fluorides, and lead—and only for 298 metropolitan areas. These areas were identified by EPA as including most of the U.S. population and industry, although a significant portion of air pollution occurs outside those areas. These cost data appear in Table A–5.



EPA estimates that total investment for control of air pollutants from stationary sources in these 298 regions will total approximately $6.3 billion for the 10-year period 1967–1976. Most of that amount, roughly $5.3 billion, would be required from 1970 to 1975 to meet the standards set by the 1970 Clean Air Act Amendments. By 1976 annual costs of control are projected to reach $2.1 billion.

Control of emissions from fuel combustion at stationary sources, a large part of the total, will run to $2.4 billion by the end of fiscal 1976. The associated annualized cost will be $1 billion in that year. Steam-electric power plants and industrial heating each account for about one-half of the total. The costs of reducing emissions from commercial and institutional heating sources will be slight. The remaining control costs of about $3.9 billion, with annualized expenses of about $1.1 billion in 1976, are for industrial process sources, particularly for metal production.

Some of the projected costs for control of industrial air pollution have been disputed. For example, EPA had estimated investment costs of $87 million to control sulfur oxides from copper smelters in the 298 regions studied. In a study by Fluor Utah, Inc., however, investment costs of between $264 and $607 million were estimated. Some of this discrepancy can be explained by different coverage, cost allocation, control strategies, and other assumptions, but certainly not the bulk of it. These differences only highlight the need for more comprehensive and uniform analyses.

Although these data indicate large expenditures by 1976, they do not include total emissions as shown on Table A–6. Also to the extent that actual emission reductions required differ from the averages used, costs incurred will vary. These reductions are also shown in Table A–6. Further, as indicated by the McGraw-Hill survey, most of the types of sources with large costs are covered in the 298 regions, but not all of them.

mobile sources—Mobile sources are the other major area in which control costs will be incurred. The Clean Air Act requires a 90 percent reduction

Table A–5

Estimated Industrial Costs of Air Pollution Control at Stationary Sources, in 298 Metropolitan Areas, 1976

(In billions of dollars)

Source	Annualized Costs [1]	Cumulative Investments [2]
Stationary fuel combustion:		
Commercial institutional heating	25	42
Industrial boilers	555	1,050
Steam-electric power	426	1,340
Subtotal	1,006	2,432
Industrial process:		
Asphalt batching	12	15
Brick and tile	12	41
Coal cleaning	5	13
Cement	30	110
Elemental phosphorous	3	7
Grain plants	164	463
Gray iron foundries	108	317
Iron and steel	507	981
Kraft (sulfate) pulp	30	73
Lime	15	11
Petroleum	7	1,242
Phosphate fertilizer	10	32
Primary nonferrous metals:		
Aluminum	76	223
Copper	42	87
Lead	7	16
Zinc	2	5
Rubber (tires)	1	2
Secondary nonferrous metals	22	62
Sulfuric acid	41	176
Varnish	1	1
Subtotal	1,095	3,877
Total	2,101	6,309

[1] Incremental costs above 1967 levels, assuming negligible prior annual expenses.
[2] Cumulative investment from 1967 to 1976, excluding previously installed equipment.

Source: Environmental Protection Agency.

below current controlled levels of hydrocarbons and carbon monoxide by 1975. It also requires a 90 percent reduction of nitrogen oxides by 1976. The Administrator of EPA may allow a 1-year extension if he finds that a workable device for automobiles has not been produced in time and that industry has made a good faith attempt to develop such technology. The new standards will probably require not only changes in design and operation of the internal combustion engine but also control devices not yet fully developed for mass production. And they will demand a supply of unleaded gasoline that will not foul the control devices. The standards will result in increased costs for automobiles and in increased fuel consumption. But it may cost somewhat less to maintain a car using unleaded gasoline.

The estimated investment costs of implementing auto and truck standards for model years 1967 through 1976 are estimated at nearly $6.3 billion—$5.1 billion for 1975 and 1976 alone (see Table A–7). The operating costs for the 1967 to 1976 period would be $800 million. However, this low total is largely due to expected operating savings in the early years. For 1975 and 1976, the increased operating expenses are estimated at about $1.7 billion.

The projected per auto costs of meeting the 1975 auto standards are in dispute. The figures in Table A–7 are probably at the low range of estimates. The total costs of meeting the 1976 standards on nitrogen oxides are unknown, because no feasible control technology has yet been developed. Table A–7

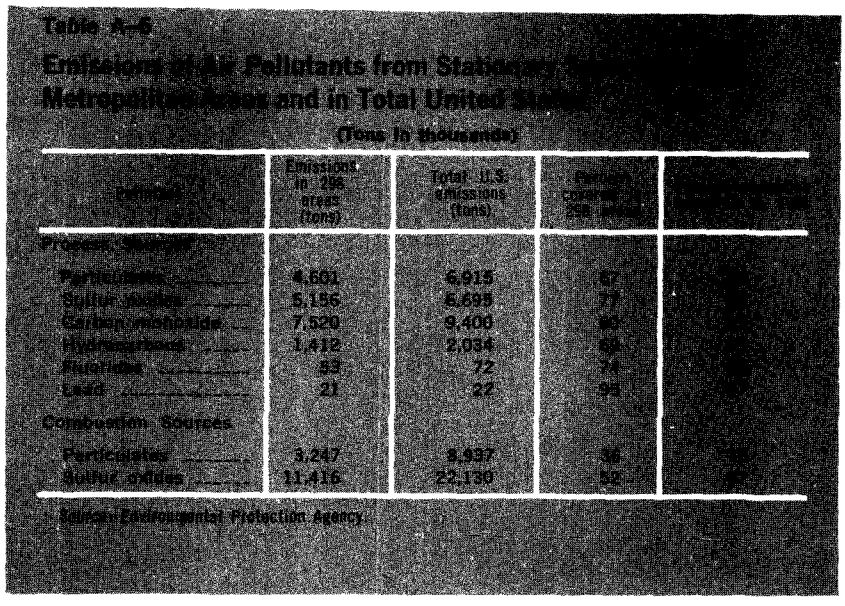


Table A–6

Emissions of Air Pollutants from Stationary Sources in Metropolitan Areas and in Total United States

(Tons in thousands)

Pollutant	Emissions in 247 areas (tons)	Total U.S. emissions (tons)	Percent contribution 247 areas	Percent contribution total
Process Sources				
Particulates	4,601	6,915	67	
Sulfur oxides	5,186	6,695	77	
Carbon monoxide	7,520	9,400	80	
Hydrocarbons	1,412	2,034	69	
Fluorides	53	72	74	
Lead	21	22	95	
Combustion Sources				
Particulates	3,247	8,937	36	
Sulfur oxides	11,416	22,130	52	

Source: Environmental Protection Agency.

also does not estimate capital costs and increased production cost to the petroleum industry of switching to lead-free gasoline.

solid waste costs

Costs for solid waste management cover collection and disposal of residential, commercial, institutional, and industrial wastes. Part is spent to collect and transport solid wastes to disposal sites; part is to operate the sites—landfills and incinerators.

public costs—Local governments bear most of the public costs of solid waste management. Although Federal funds finance research and development,

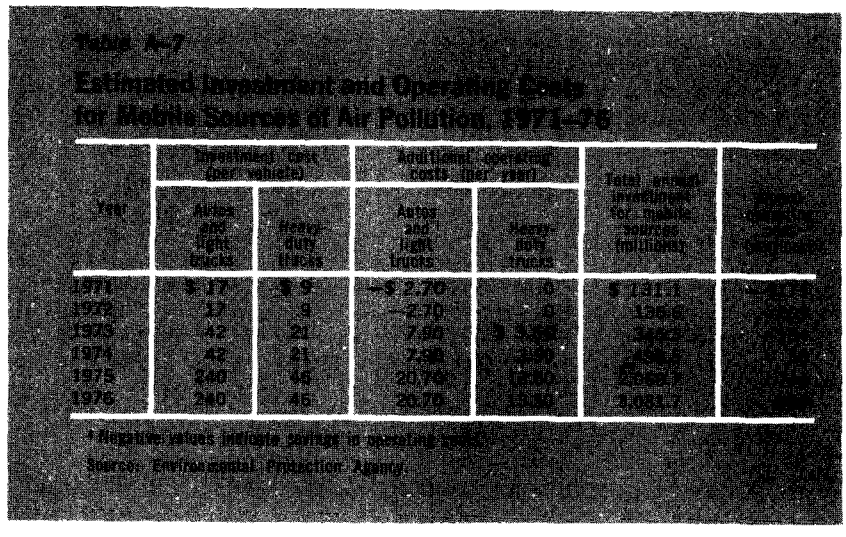


Table A–7

Estimated Investment and Operating Costs for Mobile Sources of Air Pollution, 1971–76

Year	Investment cost (per vehicle)		Additional operating costs (per year)		Total annual investment for mobile sources (billions)	Annual operating cost (billions)
	Autos and light trucks	Heavy-duty trucks	Autos and light trucks	Heavy-duty trucks		
1971	$ 17	$ 9	−$ 2.70	0	$ 1.11	
1972	17	9	−2.70	0	1.05	
1973	42	21	7.00	$ 3.00	3.02	
1974	42	21	7.00	3.00	2.85	
1975	240	46	20.70	12.00	20.00	
1976	240	46	20.70	12.00	3.03	

* Negative values indicate savings in operating costs.

Source: Environmental Protection Agency.

demonstration grants, and personnel training, local governments will shoulder most of the public burden for collection and disposal of solid wastes. Private collection and disposal costs are also a significant part of the total.

Current data on municipal disposal costs are imprecise. But data based on a 1968 national survey show their order of magnitude. In 1967, collection and disposal of 190 million tons of residential, commercial, and institutional solid waste cost more than $3.5 billion. Of that amount, municipalities spent $1.7 billion—$1.6 billion in operating costs and $100 million in new capital expenditures. Private collection and disposal costs accounted for the rest—$1.8 billion These cost data on public and private expenditures also include the handling of some industrial wastes, but the extent of this is unknown.

Total annualized costs for the Nation are not available because estimates of the investment in facilities and equipment are not available. Clearly, the $3.5 billion would be exceeded if interest and depreciation on all currently in-place equipment were to be included. However, operating costs are clearly the major share of annual waste collection and disposal costs

Roughly 75 percent or more of municipal solid waste disposal spending is for collection and the remainder for disposal. Disposal costs can range from $1 to $3 per ton for sanitary landfill and from $3 to $10 for incineration Collection costs average roughly $15 per ton, although they vary widely. In heavily populated urban areas, collection can go even higher. For example, in New York City, costs ran to $32 per ton in 1969, not including many employee benefits and depreciation.

Spending by municipalities in the future will probably continue to rise, because wastes are projected to increase even faster than population. Also, because collection is labor intensive, those costs will rise with wage increases, which are rising faster than other costs. As open dumps are replaced by sanitary landfills and incinerators, disposal will take even more of the municipal dollar. New York City estimated that a new incinerator would cost $30 per ton of wastes burned, largely because of air quality requirements and high construction costs. And sanitary landfills become more expensive as available sites are used up and they must be located farther from urban centers. A transfer station and rail haul of 100 miles, for example, increases disposal costs by between $5 and $7 per ton.

industrial costs—The most recent data on total industrial spending for solid waste management are for 1967. In that year, EPA estimates that industry spent $1 billion to handle its solid wastes. Although collection costs are not so large as for municipalities, per-unit disposal costs are probably higher because many industrial wastes require costly treatment prior to disposal due to their toxicity and concentration.

Solid waste management promises to become a larger part of industry's future total pollution control spending. Not only will total quantities and per unit costs of disposal increase, but air and water pollution control requirements may result in additional solid wastes which are even more troublesome to dispose of.

Although detailed data by the public and the private sector are not available, EPA estimates the cost of upgrading national solid waste collection activities at another $540 million annually in operating costs and $20 million annually in capital spending. To upgrade disposal sites and facilities will cost another $95 million annually in capital expenditures. Operating costs will run to an additional $180 million a year Hence total additional spending needed for adequate national solid waste management may reach over $800 million annually

Recycling, an alternative to disposal, could cut both municipal and industrial solid waste management costs dramatically as well as recover and conserve resources. As the full cost impact of adequate disposal techniques is felt, pressures should arise to recycle a greater amount of wastes. However, new technology and significant changes in current economic relationships will also be required before recycling is widely used.

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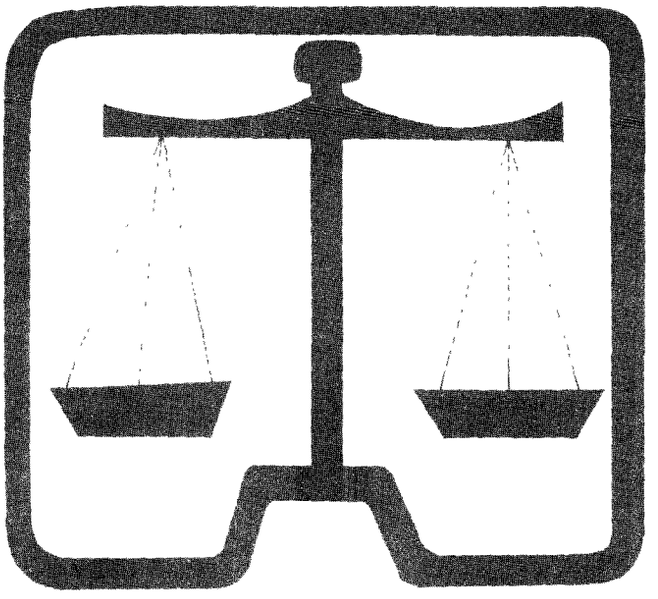

the law and the environment

On January 1, 1970, as his first official act of the new decade, the President signed into law the National Environmental Policy Act (NEPA). That symbolic step has highlighted a year and a half of unprecedented development of the law relating to protection of the environment.

There have followed: court decisions giving force to NEPA and similar Federal laws, actions forcing more consideration of environmental factors in Federal administrative decisions, stronger Federal pollution control laws, and a host of innovative environmental actions by the States. Together they furnish important evidence that the Nation is beginning to institutionalize its concern for the quality of life.

Perhaps the most striking recent legal development has been the step-up in citizen "public interest" litigation to halt degradation of the environment. In the face of a history of administrative decisions that ignored environmental impacts and against a tide of legislative delays in developing pollution control law, citizens concluded that they must use the courts to cure the neglect. The citizen litigation has not only challenged specific government and private actions which were environmentally undesirable. It has speeded court definition of what is required of Federal agencies under environmental protection statutes. The suits have forced greater sensitivity in both government and industry to environmental considerations. And they have educated

lawmakers and the public to the need for new environmental legislation.

Citizens in environmental suits have: stopped construction of a road and oil pipeline across the Alaska wilderness, pending thorough environmental studies; prompted cancellation proceedings against the pesticide DDT; halted construction of an expressway on the banks of the Hudson River; shielded wildlife habitats in Texas and Arizona from development; suspended construction of a Corps of Engineers dam in Arkansas until NEPA was complied with; postponed highway encroachment on Overton Park in Memphis, Tenn., pending review of its necessity; and protected parts of the National Forests until it was decided whether they should be saved as wilderness areas. In this litigation, the courts have broadened the concept of a citizen's right to bring suit and the scope of court review of administrative actions.

A less dramatic development—but perhaps of more long-term significance—has been the trend in government toward tighter systems of environmental regulation. There has come with it a greater Federal recognition of the breadth of the areas needing protection. Already the progress indicates that development of the law may be as important to environmental quality as it has been, for example, to civil rights.

federal law

federal agencies and the environment—a framework emerges

A key trend in Federal legislation is the series of provisions—of which NEPA is the broadest and most important—which write environmental interests into Federal Government decisionmaking.

NEPA laid down the environmental impact statement requirement in section 102(2)(C),[1] since supplemented by guidelines from the Council on Environmental Quality.[2] An agency proposing a major action with significant environmental impact must: describe the impact; study and describe alternatives to its proposal; obtain comments from environmentally expert Federal, State, and local agencies; and make public, in advance, its environmental analysis and the comments of other agencies. This process—and the advance public response to these environmental analyses—are making Federal agencies far more sensitive to the environment.

Most courts have concluded that the NEPA "102" environmental statement procedure is court enforceable at the suit of interested citizens. This provides a new basis for judicial review of Federal administrative action affecting the environment. In the year and a half since enactment of NEPA, there have been

over 20 reported Federal district court decisions involving citizen challenges to Federal action under the Act. They involved, for example, federally financed highway projects,[3] Interior Department permits for the Alaska pipeline and its related haul road,[4] an Interior Department contract termination,[5] a Bonneville Administration powerline,[6] Forest Service management of National Forests,[7] Department of Agriculture use of the pesticide Mirex against fire ants,[8] Corps of Engineers water resource projects,[9] a Corps of Engineers permit action,[10] a Farmers' Home Administration loan,[11] and a Justice Department grant for a prison facility.[12] Although one decision, arising from a somewhat special set of circumstances, states that NEPA does not impose court-enforceable duties,[13] the great bulk of district court decisions have allowed citizens to enforce the "102" procedure.

In a number of early cases, the Federal activities challenged had been commenced prior to the enactment of NEPA, and the question arose whether the "102" procedure applied to them. In several instances, the courts held that it did, because there remained further major Federal actions to which the procedure could be applied.[14] In other instances, courts ruled that the procedure did not apply because all significant Federal decisions with respect to the activity were made before NEPA took effect.[15]

Significantly, several district court NEPA decisions indicate that the courts will do more than just determine whether the required impact statement has been filed. They will also review whether agency compliance with the necessary analytical procedures is adequate.[16] In this review the courts have taken evidence from the plaintiffs on the environmental impact of, and alternatives to, a proposed action. These aspects of NEPA will receive more definitive interpretation as NEPA cases move into the Federal appellate courts.

NEPA has a further important effect through its requirement in section 102(1)—that "the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act." That section arms Federal agencies with the authority and duty to exercise their powers to promote environmental ends. In a leading case, *Zabel* v. *Tabb*,[17] the Corps of Engineers denied a permit, on ecological grounds, to a developer who wished to fill a portion of Florida's Boca Ciega Bay for a trailer park. A Federal district court held that the Corps could deny a permit only to protect navigation, which was the original concern of the permit statute. However, the Court of Appeals for the Fifth Circuit reversed the decision, relying in part on the conclusion that NEPA "essentially states that every Federal agency shall consider ecological factors when dealing with activities which may have an impact on man's environment." [18]

A second key case, *Calvert Cliffs*,[19] involved Atomic Energy

Commission (AEC) responsibility under NEPA to consider environmental factors beyond radiological health and safety in nuclear plant licensing. Although AEC began applying procedures for considering environmental factors after March 1971, the Federal appeals court was not satisfied. It criticized AEC for not implementing such procedures earlier and for the limitations built into them. The court ordered the Commission to conduct an environmental review of the Calvert Cliffs plant already under consruction on Chesapeake Bay, for which a license had been granted.

Other agencies now include environmental considerations in exercising their regulatory authority. The Coast Guard now considers land use and pollution factors when it reviews bridge permit requests. And the Interstate Commerce Commission considers what freight rates for scrap metal will do to the economics of recycling. The Securities and Exchange Commission is moving to require that corporate reports now include environmental information. NEPA also buttresses the President's decision to institute a Corps of Engineers permit program to enforce water quality standards under the Refuse Act of 1899.

NEPA is the major statutory lever for environmental quality in Federal Government actions. But it is neither the first nor the only one.

The Congress, more and more in recent years, has enacted environmental protection laws aimed at particular Federal programs. Some of these predate NEPA and served as models for its broader directives. All of them apply some safeguard against environmentally adverse decisions in specific programs. And many of the key court decisions to protect environmental values are based on them. (For relevant sections of these environmental protection provisions, see the appendix to this chapter.)

Section 4(f) of the Department of Transportation Act of 1966 [20] broadly protects public parks, wildlife refuges, and historic sites against encroaching federally approved transportation projects. It prohibits such encroachment unless there is no feasible and prudent alternative and unless the project is shaped to minimize harm to the environment. The Supreme Court this year in *Citizens to Preserve Overton Park* v. *Volpe*,[21] citing the strong congressional policy against encroachment upon parkland expressed in section 4(f), ruled:

> The few green havens that were public parks were not to be lost unless there were truly unusual factors present in a particular case or the cost or community disruption resulting from alternative routes reached extraordinary magnitudes.

The Fish and Wildlife Coordination Act,[22] as amended in 1958, bars water resource projects undertaken by a Federal agency, or with a Federal permit, from running roughshod over wildlife. It requires that wildlife be given "equal consideration"

with other aspects of water resource development. It further requires that Interior's Fish and Wildlife Service and State wildlife agencies be consulted prior to project approval. In its 1970 decision in *Zabel* v. *Tabb*,[23] the Court of Appeals for the Fifth Circuit ruled in effect that a Federal agency could deny or condition a permit if the action threatened wildlife. The Court observed:

> Common sense and reason dictate that it would be incongruous for Congress, in light of the fact that it intends conservation to be considered in private dredge and fill operations . . . not to direct the only Federal agency concerned with licensing such projects both to consult and to take such factors into account.

The Wilderness Act [24] establishes a National Wilderness Preservation System of Federal lands and legally protects it against inroads. The Act itself puts certain Federal lands within the System and creates a mechanism to review further tracts in the National Forests, National Parks, and National Wildlife Refuges for the same protection. Over 10 million acres have been set aside as wilderness so far. President Nixon has recommended 3 million acres more for congressional approval. In *Parker* v. *United States*,[25] a Federal district court barred the sale of lumber rights in a relatively untouched tract of a National Forest—until a study is completed and the wilderness character of the tract determined.

The Federal Power Act [26] requires the Federal Power Commission to insure that any dam or related project for which it issues a license be adapted to a comprehensive plan which considers commerce, water power, and "other beneficial public uses, including recreational purposes." In *Scenic Hudson Preservation Conference* v. *FPC*,[27] local groups challenged licensing of the Storm King powerplant on the Hudson River. They argued that the FPC had failed to consider the plant's impact on the scenic beauty of the river. The Second Circuit Court held that "recreational purposes" includes conservation of natural resources and maintenance of natural beauty. It directed the FPC to reconsider the application with an eye to these factors and to possible alternatives to the project. Two years later, in *Udall* v. *FPC*,[28] the Supreme Court gave the statute the same reading and overturned a license for the High Mountain Sheep Dam on the Snake River—because the FPC failed to consider, among other things, its impact on fish and wildlife and the relative desirability of private and Federal development.

Section 1 of the National Park Service Act [29] is another potentially important piece of environmental protection legislation. It requires that park areas be kept "unimpaired" for future enjoyment. The National Historic Preservation Act of 1966 [30] is another. It establishes a register of historic places and requires consultation prior to any Federal action potentially damaging to

them. The Multiple Use-Sustained Yield Act of 1960 [31] is still another. It directs the Forest Service to combine environmental and economic purposes in administering the National Forests.

A growing number of other environmental protection provisions have yet to go before the courts. The most recent are: section 136 of the Federal-Aid Highway Act of 1970,[32] requiring that final decisions on Federal-aid highway projects reflect environmental factors to be outlined by the Secretary of Transportation; section 16(c)(4) of the Airport and Airway Development Act,[33] prohibiting Federal approval of airport projects that hurt the environment except under stringent conditions; and section 14 of the Urban Mass Transportation Act of 1964, as amended,[34] requiring a detailed statement of environmental impact plus public hearings prior to project approval.

The court decisions on environmental protection legislation have had and will have a much more lasting impact than merely clarifying particular legislation. *Scenic Hudson,* by placing a positive responsibility on the FPC to consider less environmentally damaging alternatives, laid a foundation for the obligation to develop alternatives imposed by NEPA. *Overton Park, Parker, Zabel* v. *Tabb, Scenic Hudson,* and *Udall* v. *FPC* confirm that courts will apply congressional expressions of environmental policy to overturn agency actions when environmental values are not adequately considered, or, conversely, to uphold agency authority to take action based on these values.

federal pollution control—new legal techniques

New legal techniques of pollution control have accompanied tighter Federal pollution control standards. The Congress has authorized the Federal Government to set national standards of its own for ambient air quality and for certain emissions—moving away from the former approach in which States set standards based on Federal criteria. New provisions in the air pollution laws and other proposed pollution control legislation signal a change in the burden of proof. Now those discharging certain materials into the environment will be required to show that their actions will not be harmful, rather than the Government having to prove the danger after the fact. Federal air and water quality laws have been changed to place new legal restrictions on pollution from Federal facilities. New legislation now permits citizens to augment Government enforcement (see Chapter 1) by suing polluters in Federal court if they do not meet Federal-State air quality standards. Finally, the Federal Government is strongly backing international efforts to control marine pollution.

national antipollution standards—Nationwide controls have previously existed on pollution from certain mobile sources—motor vehicles, aircraft, and vessels—and pesticides and radiation. Fed-

eral control over mobile sources is necessary because no State or local government or individual can protect against environmental degradation from a moving source without creating an unacceptable burden on commerce. Pesticides and radiation have been subjected to nationwide controls because they are inherently dangerous.

The Clean Air Amendments of 1970 [35] set a variety of legal precedents. In the past, air pollution was regulated primarily in airsheds by State and local authorities. The Clean Air Act authorized national standards. The Act calls for national air quality standards on certain pollutants designated by the Environmental Protection Agency (EPA). It sets a deadline for primary standards—those designed to protect health. Significant new sources of air pollution, such as new powerplants and smelters, and both new and old sources of hazardous air pollutants will fall under national emission standards. The President's water pollution control legislation sent to the Congress also calls for national effluent standards on hazardous materials.[36]

Federal authority was also extended to include every area of the Nation under the requirements of the Clean Air Act.[37] Similar extension is requested in the Administration's proposed water pollution legislation. That legislation would require that the States or EPA establish water quality standards for all intrastate as well as interstate waters—and would give EPA new muscle to enforce them. Current Federal law requires federally approved water quality standards on interstate waters only and authorizes Federal enforcement ordinarily only when pollution from one State damages the health and welfare of citizens in another.

burden of proof—on the polluter—The Clean Air Amendments of 1970 [38] are an example of a recent shift in burden of proof in pollution control. Once the EPA Administrator tags an air pollutant as hazardous, he may, after giving notice, publish emission standards. Then any objector must establish "that such pollutant clearly is not a hazardous air pollutant." When EPA believes that an air pollutant is a health hazard, industry must either comply with the emission standards or prove that the hazard does not exist.

The Administration's proposed bill to regulate ocean dumping [39] further illustrates this new approach to burden of proof. The bill would place the burden on the applicant for a dumping permit. He would be obliged to show that the proposed dumping will not unreasonably degrade or unreasonably endanger human health or other specified environmental values.

The Administration's proposed Toxic Substances Control Act [40] would require industry to perform tests prescribed by the Administrator of EPA prior to marketing any new chemical substance. The Administrator could request information on the

results of these tests. Based on EPA's analysis of the tests or other information, it could ban or prohibit uses of a chemical substance if necessary to protect human health or the environment.

abatement of pollution from federal facilities—The Congress has enacted into law the policy of an earlier Executive Order aimed at pollution from Federal facilities. It amended both the Federal Water Pollution Control Act [41] and the Clean Air Act [42] to make Federal facilities fall in line with air and water quality standards. In addition, the new vessel sewage control provisions in the Federal Water Pollution Control Act were made to apply to Federal vessels. [43]

The Clean Air Amendments also limit the exemptions that may be granted. No exemption is now permitted from the performance standards set for new stationary sources, and hazardous emission standards may be postponed only if the technology is lacking or if the polluting operation is necessary to the national security.[44] No exemption may be granted on the basis of lack of an appropriation unless the President "shall have specifically requested such appropriation . . . and the Congress shall have failed to make available such requested appropriation." [45] By expressly waiving sovereign immunity, the Amendments also permit State or local government—or citizens—to enforce Clean Air Act rules against Federal facilities.[46]

citizen enforcement of pollution standards—Citizens may sue to enforce air pollution standards against Government and private entities. In the Clean Air Amendments, the Congress set a major precedent when it created this power of citizen enforcement.[47]

Concurring that citizen enforcement suits can provide a valuable supplement to Federal enforcement efforts in areas in which clearly established Federal or Federal-State pollution control standards exist, the Administration has proposed that similar provisions be added to the Federal Water Pollution Control Act.[48]

international controls over marine pollution—Just as Federal antipollution laws are trending strongly toward nationwide standards and enforcement, there is now movement to set certain international controls. These first international measures relate to marine pollution.

The *Torrey Canyon* stranding dramatically spotlighted oil spills—both large and small—and spurred international efforts to prevent and cope with oil pollution. President Nixon has forwarded three treaty actions on this subject to the Senate.[49] And the United States, together with other nations, is actively pursuing efforts to secure other international agreements. The U.N.'s Intergovernmental Maritime Consultative Organization (IMCO), NATO's Committee on the Challenges of Modern Society, and

the U.N.'s 1972 Conference on the Human Environment all have important marine pollution control items on their agendas.

The Administration's proposed legislation on ocean dumping [50] would order the Secretary of State to "seek effective international action and cooperation" to support the policy of that Act. In 1972, the U.N. Conference on the Human Environment at Stockholm may consider an international agreement on ocean dumping. The International Seabeds Convention, proposed by the United States, also contains environmental control provisions.

Finally, the United States and Canada are negotiating a bilateral agreement to control pollution of the Great Lakes. The agreement would establish common water quality objectives for the Lakes to be overseen by the International Joint Commission.[51]

citizen checks on agency action affecting the environment—the law responds

The ability of citizens and citizen groups to make their views known and to participate in government decisionmaking on the environment is critically important. Often individuals and groups can contribute data and insights beyond the expertise of the agency involved. In some cases, citizen groups are seeking—and making—significant changes in agency policy.

There has been a marked expansion in citizen rights to know about, to participate in, and ultimately to challenge Federal agency actions, particularly those affecting the environment. This new citizen's role has evolved in many different forums. The courts have contributed—through new interpretations of such existing laws as the Freedom of Information Act and the Administrative Procedure Act. And a variety of administrative agencies have instituted procedural changes to implement NEPA.

The new openness to citizen involvement is bound to check, stimulate, and test future Federal agency activities. Citizen concern cannot substitute for assumption of environmental responsibilities by government and industry. Nor can it provide the mechanism to resolve the many policy issues involved. What it can provide, however, is a highly potent quality control and "feedback." This citizen role has been greatly developed in the last year and a half.

the citizen's right to know—The Freedom of Information Act,[52] passed in 1966, predates the upwelling of citizen environmental action. It laid down a general rule that all agency data must be available to the public, with certain exceptions, and is basic, therefore, to public availability of environmental data. The exception most likely to enter into environmental controversies permits agencies to refuse to disclose any internal papers with

opinions or advice on matters of policy. But in a recent decision on whether the public could see a scientific report on the SST, a U.S. court of appeals held that the exemption does not protect "purely factual or investigatory reports." [53] Factual information is exempted "only if it is inextricably intertwined with policy-making processes." Read thus, the Act should open to the public factual studies and analyses of environmental issues used by Federal agencies in preparing environmental impact statements, as well as the statements themselves.

NEPA recognizes the importance of public access as a force for corrective action. It does so by requiring public availability of environmental impact statements and of agency comments, regardless of whether they contain advice on matters of policy. An Executive Order and the guidelines issued by the Council on Environmental Quality have both implemented this policy. Executive Order 11514, of March 5, 1970, directs Federal agencies to maximize public information about environmentally significant programs so that the public's views can be considered.[54] The Council guidelines generally require that draft and final environmental impact statements be available to the public for minimum periods of 90 and 30 days, respectively, before the agency acts.[55] The guidelines also require that draft statements be made public at least 15 days before hearings. As described in Chapter 1, various channels of distribution are being set up to make the environmental impact statements and agency comments more easily available to the public.

Section 309 of the Clean Air Act,[56] added in 1970, gives the public an additional right to information on the environmental aspects of Federal action. It requires the Administrator of EPA to comment on any proposed legislation, regulation, or agency action affecting air or water quality, pesticides, solid waste disposal, radiation, or noise control. These comments must be publicly available in writing at the end of EPA's review.

Together, these legal provisions greatly expand the citizen's right to the environmental information on which proposed Government actions are based. Opening the decisionmaking process to public scrutiny should help insure that Federal agencies act in the public interest. It should also guarantee that actions not responsive to the national environmental goals set in NEPA receive timely attention.

the citizen's right to participate—Citizens and citizen groups have obtained ever increasing rights and opportunities to participate meaningfully in Federal agency decisionmaking. The extent of participation varies considerably, depending chiefly on whether the agency determination is made formally or informally. Formal procedures are prescribed by the Administrative Procedure Act (APA) [57] and by similar provisions in other acts.

A wide variety of Government decisions are made informally, without legislatively set procedures.

NEPA has enhanced the citizen's possible role, whether or not statutory formalities apply to the agency action. It ensures more detailed and easily available notice to citizens of environmental issues. It permits the public to focus on the agency's environmental findings and conclusions through the environmental impact statement.

formal proceedings under the apa—The Administrative Procedure Act defines and prescribes procedures for two types of formal agency proceedings: adjudications and rulemaking.[58] An *adjudication* is a formal process in which the agency's decision must be made on the record of a hearing similar to a trial. Parties to the proceeding are allowed to submit evidence, rebut opposing evidence, and cross examine opposing witnesses. Examples of agency adjudications are: the assessment by the Coast Guard of a civil penalty against a person who knowingly discharges oil into U.S. navigable waters, contrary to the Federal Water Pollution Control Act;[59] and the refusal by the Environmental Protection Agency to register a new pesticide for a particular use under the pesticide laws.[60] The agency must provide a statement of "findings and conclusions, and the reasons or basis therefor," on all issues involved. The decision can be reviewed and set aside by a court if the record does not contain substantial evidence to support it.[61]

The public's right to participate in adjudications has received wide recognition. The APA leaves the agencies free to decide who may participate in the proceedings. Initially, agencies limited participation to persons who would be the direct objects of the agency action or regulation. Spurred by a 1966 landmark Federal circuit court decision in *Church of Christ* v. *FCC*,[62] emphasizing agency obligations to take cognizance of a wider spectrum of public interests, the agencies that conduct APA adjudications have, by and large, considerably expanded public participation.

Rulemaking is the agency process for formulating, amending, or repealing a rule. It involves major Federal regulations, such as EPA's setting air and water quality standards. Because of the broad and pervasive nature of rulemaking, participation in developing agency rules is a key opportunity for citizen input into Government decisions.

The APA requires an agency generally to give advance notice of rulemaking in the *Federal Register*. Then the agency must allow 30 or more days between the notice and adoption of a rule. During this time, any interested person may "participate in the rulemaking through submission of written data, views, or arguments." The agency may hold an informational hearing but need not unless required by another statute.[63] An interested per-

son does not have to depend on the agency to initiate action. He may "petition for the issuance, amendment, or repeal of a rule." [64] An agency's failure to act on such a petition is an "agency action" reviewable in court.[65]

When an adjudication or a rulemaking falls within section 102(2)(C)'s requirement for an environmental impact statement, NEPA strengthens the citizen's right to present relevant environmental information to the agency. It has also increased the amount of detailed environmental information that must be included in the advance notice.

determinations made informally—Thousands of Federal agency determinations take place without the formalities of adjudications or rulemaking. These include the day-to-day decisions of a Federal agency as well as performance of specific duties—such as consulting under the National Historic Preservation Act of 1966.[66] The APA does not specify procedures for these decisions but merely provides for court review. Generally no law requires a public hearing, but in some instances agencies hold an informational hearing on their own initiative.

When a hearing is held, citizens may object and make suggestions. For example, an interested person may testify at the public hearings held by the Corps of Engineers for proposed water resource projects. Agency practices, however, are not yet uniform in notifying the public of hearings.

Traditionally, citizens have had particularly little voice in the innumerable decisions made by agencies without public hearings. In the past, Defense Department decisions on the ocean disposal of surplus munitions and many Interior Department decisions to grant mineral leases on Federal lands have been made without public notice and without any means, other than by letter, for citizens to be heard.

NEPA'S requirements are particularly important in informal agency decisions. Without APA proceedings or other public hearings, the environmental impact statement is the only way the public can learn of an impending action—or of the environmental issues raised. Even more important, NEPA and the Council's revised guidelines require agencies, when appropriate, to consider the comments of citizens as well as those of government agencies.[67] Another effect of NEPA and the Executive Order which implements it is its influence on agencies to hold hearings when they would not otherwise have done so.

the citizen's right to challenge in court—One of the most striking and significant developments in environmental law is the right of citizens to take to court Federal agency actions affecting the environment. NEPA and other laws require agencies to consider the environment in their actions. And citizens are now initiating lawsuits when they believe an agency has failed to do that.

The citizen's success in challenging an agency decision depends in part on a number of legal doctrines that limit court intervention in agency affairs. These doctrines determine the citizen's standing to bring suit. They regulate the extent to which a court may review an agency decision. They determine the evidence the court may consider beyond that developed by the agency. And they dictate whether the plaintiff must participate in the agency decision before seeking court review. Citizen suits to protect the environment are bringing evolution in all of these doctrines.

standing—Citizens do not automatically have standing to seek review of agency decisions in court. In the past, lack of standing has been a significant impediment to a citizen's right to challenge Federal agency actions. The law generally allows only persons who are "aggrieved" by agency action to seek court review.[68] Several court review provisions give standing to "aggrieved" persons, and despite earlier uncertainty, the courts have concluded that the APA permits "aggrieved" persons to seek review of agency actions in almost every case in which a specific review provision is lacking.[69]

The Supreme Court, in *Data Processing Service* v. *Camp*,[70] recently held that to be "aggrieved," a person must have suffered "injury in fact" from the agency action, and the interest he seeks to assert must be an interest intended to be protected by the specific statute invoked. Environmental plaintiffs have usually been successful in meeting both requirements.

In *Data Processing*, the Court did not clearly define "injury in fact." But it did stress that the injury need not be economic but may be "aesthetic, conservational or recreational." This may mean that any responsible citizen or group may sue to protect an environmental resource, such as a recreational area, that exists for the benefit of the public.

Three U.S. Courts of Appeals, for the Second, Fourth, and District of Columbia Circuits, seem to have reached this conclusion.[71] The Second Circuit concluded "that the public interest in environmental resources . . . is a legally protected interest affording these [environmental groups] . . . standing to obtain judicial review of agency action . . . ."[72] On the other hand, the Ninth Circuit, in *Sierra Club* v. *Morton*[73] (known as the *Mineral King* case), refused to permit the Sierra Club to sue to protect Sequoia National Park. It did so because neither the Club nor its members had property threatened by the action and the Club's status as an organization was not threatened. In a later decision,[74] the Ninth Circuit refused to permit an environmental group to sue to protect San Francisco Bay on the same grounds. The court, however, did permit individual members of the organization to stay in the suit. The conflict between the

courts of appeals will be resolved when the Supreme Court reviews the *Mineral King* case in the fall of 1971.

The Ninth Circuit's rule that citizen groups lack a sufficient interest to sue to enforce environmental laws threatens to leave such enforcement exclusively to Government—whose actions may on occasion conflict with those laws. As the Federal District Court for Alaska has noted, denying citizen groups standing to raise environmental issues "would have the practical effect of preempting many meritorious actions, as one individual, or a small number of individuals, would have to sustain the entire financial burden of the lawsuit." The costs of effective litigation are so high that "few members of the general public will have resources or courage to face such odds for the sake of vindicating a right to which all are entitled as a matter of law." [75]

Because environmental lawsuits are usually brought under statutes clearly intended to protect environmental values, they easily meet the protected-interest test of *Data Processing*. Citizen groups have successfully won standing not only under NEPA but also under the Federal Power Act, the Department of Transportation Act, the Multiple Use-Sustained Yield Act, the Wilderness Act, and Federal pesticide laws.[76] Court decisions under NEPA, which has a broadly stated environmental purpose, indicate that virtually any environmental interest falls within the protection of that Act.

court review of agency decisions—The courts do not hesitate to review questions of law decided by Federal agencies. But traditionally they have deferred to the agency for determinations of fact. As a general rule, particularly for informal decisions, the courts overturn agency "factual" findings only if they are "arbitrary or capricious." [77] This rule makes it primarily the agencies' job to find the basic, objective facts.

Interpreting facts is a subjective process, however. And an agency's "factual" conclusions may involve weighing environmental values against other policies important to the agency. Recognizing this, the courts have recently begun to broaden the meaning of "arbitrary or capricious." It now includes agency decisions that disregard the policies of environmental laws.

In *Overton Park,* the Supreme Court confirmed this recent trend to give greater bite to review under the arbitrary-or-capricious test. Such review "is to be searching and careful," and action should be reversed when "there has been a clear error of judgment." Although the Court also gave the reassurance that the reviewing court "is not empowered to substitute its judgment for that of the agency," its discussion indicated that court review of the facts will be exacting.[78]

evidence outside the agency record—In reviewing an agency's adjudication or formal rulemaking, the courts are required to decide whether the agency record supports the agency action.[79]

If it does not, the action is set aside. If the agency failed to consider relevant factors, the court directs it to consider evidence and then to make a new decision. The citizen is not, however, allowed to present new evidence to the court to discredit the agency's decision.

An agency decision made without formal APA proceedings may be backed by little or no written record to explain it. So unless the court receives some evidence, it has little against which to test the agency's action. By prodding the agency to make a more complete record and by permitting the citizen to submit his own evidence, the courts are making citizen review more effective.

In *Overton Park,* the Court said that in reviewing informal agency decisions, courts must examine the "full administrative record" on which the agency acted. They cannot be satisfied with after-the-fact "rationalizations" alone. When the record does not disclose all the factors considered, the reviewing court may require the responsible officials to explain their action. The agencies thus are encouraged to produce thorough, contemporaneous written records backing their decisions.[80]

The Supreme Court did not discuss the extent to which a plaintiff may submit his own evidence to discredit an agency action. However, in cases under NEPA the lower courts have freely admitted evidence bearing on the legality of action under the Act. For example, evidence was admitted in *Environmental Defense Fund, Inc.* v. *Corps of Engineers*[81] to show the inadequacy of the Corps' section 102 statement in considering the danger posed for the environment by the Gillham Dam project. In the recent *Mirex* case,[82] the court received evidence on the fire ant situation and determined that the Department of Agriculture's environmental study was adequate. Similarly, in *Parker* v. *United States,*[83] the court heard evidence to show that an area was protected by the Wilderness Act until a study of its wilderness character was finished.[84] Further litigation will define the limits of the citizen's right to introduce evidence that was not considered by the agency.

exhaustion of administrative remedies—The citizen's expanded right to challenge Federal agency decisions in court complements his right to participate in agency decisions; together, they give him a new role in shaping the environmental impact of government activity. However, the citizen may not always be free to choose the stage at which to interject his views. Generally, one who foregoes an opportunity to make his claims before an agency cannot later go into court, because he failed to "exhaust administrative remedies."

The reason for this rule is that failure to object to the agency initially deprives it of the chance to consider the objections and perhaps modify its action without judicial intervention.

The exhaustion rule supports the form of decisionmaking created by the Congress. By permitting the agency to make a factual record, it also promotes more effective judicial review.[85]

The exhaustion requirement applies primarily when the agency has followed formal procedures allowing for citizen participation. However, it may apply more and more to informal decisions now that citizens receive notice and can participate. An example is the recent decision in *Sierra Club* v. *Hardin*.[86] There the Sierra Club challenged a Forest Service timber sale in the Tongass National Forest. Although it knew of the impending timber sale, the Club did not invoke Forest Service procedures for protest and review, and the court therefore refused to consider its claims. Similarly, the Audubon Society was foreclosed from challenging Corps of Engineers permits for dredging in Texas waters because it did not show that it had objected to the appropriate agencies first.[87]

state law

State governments have responded to environmental problems with a variety of legal innovations.

constitutional changes

Constitutional amendments are a fundamental form of expression of legal policy. A number of States have added environmental protection provisions to their constitutions. Other States are considering doing so. Some State constitutions already contain provisions dealing with conservation of natural resources. However, recent proposals focus on the individual's right to environmental protection and raise the possibility of increased resort to the courts to vindicate that right.

New York's constitutional amendment, effective January 1, 1970, was one of the first recent changes. Popularly called the "Conservation Bill of Rights," it declares a State policy "to conserve and protect its natural resources and scenic beauty." It directs the State legislature to act to carry out that policy. The amendment addresses legislative responsibility more than individual rights, but another provision of the State constitution permits citizen suits to restrain its violation.[88]

A constitutional provision adopted by the Illinois electorate in December 1970 is more directly oriented toward individual rights and obligations. Besides declaring a state policy to protect the environment, it provides that "[e]ach person has the right to a healthful environment." The Illinois amendment authorizes every person to sue to enforce this right against "any party, governmental or private." The right is subject to reasonable limitation and regulation by the State legislature.[89]

Pennsylvania's and Rhode Island's new constitutional amendments also declare environmental "rights" in the people, but they do not expressly authorize private suits.[90] Amendments of these several types are under consideration in a number of other States.

Experience under these State constitutional amendments is still too short to determine how well they work to protect the environment. It is unclear whether the New York amendment was intended to be enforceable by private citizens or merely a declaration of policy to be implemented by the legislature. Even where direct private enforcement is clearly contemplated, as in Illinois, the courts may take years to define the constitutionally protected rights. Despite these difficulties, support appears to be growing for writing environmental guarantees into State charters.

environmental statements for state agency actions

Since enactment of NEPA, a number of State legislatures have passed "action forcing" requirements similar to NEPA's environmental impact statement requirement. At least four State legislatures and the Commonwealth of Puerto Rico have established such procedures.

In June 1970, only 6 months after passage of NEPA, the Commonwealth of Puerto Rico enacted a law directing agencies to consider the environment in their actions. It created an environmental statement procedure identical to NEPA's.[91] The law also creates in the Governor's Office an Environmental Quality Board, which has both policymaking and regulatory authority over air and water pollution, solid waste disposal, and other environmental problems. The law also authorizes citizen suits for violation of its regulatory provisions.

Montana enacted legislation in March 1971 that adopts the environmental statement procedure of NEPA and creates a State Environmental Quality Council.[92] The Montana Council's role differs from that of either the Federal Council or the Puerto Rican body. Its 13 members include the Governor or his representative, four gubernatorial appointees, and four members of each house of the State legislature. It thus serves as a joint arm of the executive and legislative branches to review and formulate State environmental policy. Legislation derived from NEPA has also been enacted in California,[93] Washington,[94] and Delaware [95] and is under consideration elsewhere.[96]

State government activities, no less than Federal, have far-reaching, often unanticipated, environmental impacts. The recent State statutes are new efforts to control those consequences. Other States may be expected to make similar efforts—either

by adopting the environmental statement mechanism or by developing new and and as yet untried procedures.

citizen suit legislation

State legislatures, like the U.S. Congress, have moved to bolster the citizen's right to challenge activities detrimental to the environment in court. The Michigan Environmental Protection Act of 1970 is one of the most publicized of these measures.[97] It authorizes any private or public entity to sue any other private or public entity for equitable relief from "pollution, impairment or destruction" of the "air, water, and other natural resources and the public trust therein."

Like section 304 of the Federal Clean Air Act,[98] the Michigan Act eliminates the defenses of lack of standing and sovereign immunity. However, although the Federal law provides a mechanism for private citizens to enforce antipollution standards established by Government agencies, the Michigan statute takes a different approach. It directs State courts to develop a common law of environmental degradation through case-by-case definition of "pollution, impairment or destruction" of the environment. Antipollution standards fixed by State agencies can be challenged. If found deficient, they may be replaced by a court-ordered substitute.

Both the Michigan Act and section 304 of the Federal Clean Air Act affirm the importance of the citizen's role before the courts. However, the Michigan Act transfers to the courts much of the standard-setting authority traditionally exercised by the other two branches of government. It thus places this authority in the branch most insulated from the elective process. In contrast, the Federal provision reaffirms the role of Congress and the executive in setting standards and enlists the citizen's aid in enforcing those standards.

Legislation similar to the Michigan Act was passed recently in Connecticut.[99] New citizen suit statutes in Indiana and Minnesota, like the Federal provision, direct the courts to look to the antipollution standards adopted by State agencies.[100]

invoking nuisance law

All States maintain programs to control air and water pollution under the Federal Clean Air Act and Water Pollution Control Act. Yet many continue to provide alternative pollution control remedies under older, court-evolved, common law doctrines. One of these, the law of public nuisance, has been used more and more as an antipollution tool. A public nuisance is generally defined as conduct causing "an unreasonable interference with a right common to the general public." [101] It may

be enjoined in a suit by State authorities or, in some cases, by private citizens.

Resort to the public nuisance doctrine in the aftermath of a 5-day air pollution crisis in Birmingham, Ala., during April 1971 is discussed in Chapter 2. There the State attorney general sought an injunction against 13 major industrial corporations to require them to curb their emissions within 6 months. He charged that they endangered Birmingham citizens.

Public nuisance law arms State officials with an enforcement tool free of cumbersome pollution control procedures. But it has certain shortcomings that limit its effectiveness. Because the concept of public nuisance is general and nonquantitative, the courts have no way to assess permissible limits of polluting activities. Rather, they must try to weigh the gravity of the harm against the social utility of the defendant's conduct.[102] In nuisance cases involving pollution, the problem could be overcome with pollution control standards as the measure of conduct amounting to a nuisance.[103]

The courts now are being asked more and more to entertain public nuisance suits brought by private citizens. Under the common law, if all members of the community suffered equally, none could sue. Their elected officials were expected to sue for them—on behalf of the State. However, very recently, there have been signs that the courts may permit private persons to sue to abate a public nuisance when only prospective relief, and not monetary damages, is sought.[104] In a proposed study of the law on this subject, the American Law Institute has noted that this development is consistent with expanded concepts of the standing of citizen groups generally.[105]

state suits in the supreme court

The U.S. Constitution empowers the Supreme Court of the United States to exercise original (trial court) jurisdiction over "all Cases, in Law and Equity . . . between a State and Citizens of another State." [106] The States have invoked this authority rarely on pollution matters. But growing concern about interstate pollution has triggered increased State interest in this direct resort to the Supreme Court.

In the first of several recent cases, *Ohio* v. *Wyandotte Chemicals Corp.*,[107] Ohio sought an order to abate mercury pollution of Lake Erie by several Michigan and Canadian chemical companies. Ohio charged that this was a public nuisance. The Supreme Court declined to adjudicate the case, explaining that State courts were a more suitable and generally better equipped trial forum. The Court also implied that current State, Federal, and international government efforts to deal with mercury pollution were "a more practical basis" for solving the problem

than a nuisance action in any court. The Court's position on the availability of its original jurisdiction in interstate pollution matters may be further clarified in three other cases which it will hear this fall.[108]

state authority to control land use

The States are growing more concerned about protecting the public interest in valuable land resources. Chapter 2 describes new State laws passed to provide this protection. As in Maine and Vermont, these laws often increase restrictions on the way private landowners use their property. They do this under the authority of broad State "police powers" to protect the general welfare. However, the Fifth and Fourteenth Amendments to the U.S. Constitution forbid States to take property for public purposes without paying the owner "just compensation." Landowners often challenge restrictions on their rights on the basis that the regulations amount to a State "taking" of property, which requires compensation. Obviously, the States may be inhibited from pursuing new regulatory approaches if the courts too freely find the new restrictions to be a "taking" of property. The States cannot protect all critical areas and control major development if they must compensate for—or purchase—the land whose use they seek to regulate.

The Supreme Court upheld State authority to control land use through general zoning in 1926.[109] It has not yet ruled on more modern land use control techniques. Although some State courts have been skeptical,[110] other recent decisions are giving fairly broad latitude to States to channel private land use decisions along State policy lines. For example, in 1970, a California court upheld the power of the State's new Bay Conservation and Development Commission to control filling of San Francisco Bay.[111] The Commission had refused to permit a corporation to fill submerged land that it had purchased for disposal of debris. The court rejected the corporation's claim that this refusal amounted to a taking of its property. The court stressed that the State law creating the Commission "clearly define[d] the public interest in San Francisco Bay." It held that prevention of filling was not an "undue restriction" on the landowner's property rights.

Other forms of land use control present a similar problem. For example, some States have tried to preserve open space by requiring that subdividers dedicate a portion of each new development to public recreational use. Landowners have challenged this type of measure, also, as a taking of property. A recent decision by the California Supreme Court rejected such a challenge. The developers insisted that a city ordinance designed to preserve for park use 2½ acres of land for each 1,000

new subdivision residents was a taking of property.[112] The ordinance required each subdivider either to dedicate a portion of his tract or to pay a fee. The court held that because new subdivisions both increase city population and diminish available open space, the city's measure was a legitimate way to maintain a balance between population and park areas. The court implied that the ordinance would be valid even if the new park were not located near the subdivision.

Although too few to establish a trend, these decisions suggest that the Fifth Amendment permits innovative land use control without compensation when a clear State interest exists.

conclusions

Development of the law by itself cannot achieve environmental quality. It will require concerted use of economic, scientific, and management tools—along with application of law. But the recent pace of development in the law's handling of environmental issues has been encouraging. It is both a sign of progress on environmental problems and evidence of the responsiveness of our legal system.

The successes of citizen participation in this development owe much to the groundwork laid in other areas of public concern. The experience of groups litigating for civil rights, consumer protection, and other "public interest" issues set the stage for environmental litigation. So did previous work in implementing the Administrative Procedure Act and the Freedom of Information Act. Also, what has been done to develop the concept of citizen standing to present intangible concerns is highly relevant to environmental litigation. In turn, environmental suits can be expected to increase the effectiveness of other citizen public interest litigation.

As in other areas of public concern, the organized legal profession is providing aid and guidance in the development of environmental law. National and local bar associations have spawned new committees to study, recommend, and testify before the Congress on environmental issues. Law schools have broadened their curricula to include environmental law, and new law students' organizations are devoting themselves to environmental protection.

What is unique about current citizen environmental litigation is that the considerable resources, nationwide attention, and judicial receptivity accorded it have created, in effect, an "environmental ombudsman" for the Nation. Rather than creating a new public officer to challenge official actions on environmental issues publicly, citizen groups are now doing it themselves—and are being effective. Legal developments have fostered this, and the environment has stirred widespread public support as an

issue. No other country has yet experienced this development. In the United States, the process will lead to the most rigorous probing of the environmental impacts of government action and private action subject to governmental regulation.

The attention now given citizen litigation should not, however, be allowed to overshadow the need for systematic administrative action. Nor should it upstage the strides taken by the Federal Government in controlling the environmental impact of its own actions and in improving the regulation of pollution. Nor can litigation be a substitute for legislative authority to deal with the basic problems of air and water quality and land use.

There are serious limits to what citizen litigation can do. The courts, deciding only the particular cases that reach them, are not in a position to develop coordinated policies or to provide consistent implementation. Insulated from the elective process, they are not equipped to develop standards responsive to public preferences when values conflict.

Ultimately, government, to which NEPA and the other environmental protection legislation assign clear responsibility, must supply the responsive and systematic action needed for effective environmental management. Undoubtedly this calls for major reform in agency attitudes and procedures and difficult decisions for legislatures. Citizen litigation makes its greatest contribution by forcing the pace of reform and by acting as one quality control over government programs. Currently this litigation helps compel agencies to come to grips with the need for new environmental policies. And it fuels the move for more open and responsive agency procedures and highlights the need for comprehensive legislative solutions.

NEPA has brought about a basic policy commitment by the Federal Government comparable to the Full Employment Act of 1946,[113] which created the Council of Economic Advisers, upon which the Council on Environmental Quality was patterned. It has also supplied tools for implementing that commitment. Its environmental statement requirement has proved an effective "action forcing" procedure. And its expansion of agency authority to act on the basis of environmental considerations is having steadily growing impact.

Important innovations in Federal and State environmental regulation are taking place. At both the Federal and State levels, the pace of new institutional development in environmental management has quickened beyond expectation. The broadest program of environmental legislation ever transmitted to the Congress is now awaiting action.

The Court of Appeals for the District of Columbia recently observed:

> A new public sensitivity to issues of environmental protection has im-

posed new responsibilities on the courts, the legislature, and the administrative agencies.[114]

Recent developments in the law of environmental protection indicate that all three branches are facing up to these responsibilities.

footnotes

1. The full text of NEPA appears in Appendix A.
2. The full text of the Council's guidelines, as revised April 23, 1971, appears in Appendix G.
3. E.g., *Brooks* v. *Volpe*, 319 F. Supp. 90 (W.D. Wash. 1970); *Bucklein* v. *Volpe*, 2 ERC 1082, 1 ELR 20045 (N.D. Calif. 1970); *Pennsylvania Environmental Council* v. *Bartlett*, 315 F. Supp. 238 (M.D. Pa. 1970).
4. *Wilderness Society* v. *Hickel*, 325 F. Supp. 422 (D.D.C. 1970).
5. *National Helium Corp.* v. *Morton*, 326 F. Supp. 151 (D. Kan. 1971).
6. *Investment Syndicates, Inc.* v. *Richmond*, 318 F. Supp. 1038 (D. Ore. 1970).
7. *Sierra Club* v. *Hardin*, 325 F. Supp. 99 (D. Alaska 1971); see also *West Virginia Highlands Conservancy* v. *Island Creek Coal Co.*, 441 F.2d 232 (4th Cir. 1971).
8. *Environmental Defense Fund, Inc.* v. *Hardin*, 325 F. Supp. 1401 (D.D.C. 1971).
9. *Environmental Defense Fund, Inc.* v. *Corps of Engineers*, 324 F. Supp. 878 (D.D.C. 1971); *Environmental Defense Fund, Inc.* v. *Corps of Engineers*, 325 F. Supp. 728, 749 (E.D. Ark. 1971); *Sierra Club* v. *Laird*, 1 ELR 20085 (D. Ariz. 1970).
10. *Delaware* v. *Pennsylvania New York Central Transp. Co.*, 323 F. Supp. 487 (D. Del. 1971).
11. *Texas Committee* v. *United States*, 1 ERC 1303 (W.D. Tex.), *dismissed as moot*, ___F.2d___ (5th Cir. 1970).
12. *Ely* v. *Velde*, 321 F. Supp. 1088 (E.D. Va. 1971), on appeal to the Court of Appeals for the Fourth Circuit.
13. *Bucklein* v. *Volpe*, *supra* note 3.
14. E.g., *Environmental Defense Fund, Inc.* v. *Corps of Engineers*, 325 F. Supp. 728, 749 (E.D. Ark. 1971); *Sierra Club v. Laird*, *supra* note 9; *Texas Committee* v. *United States*, *supra* note 11.
15. E.g., *Pennsylvania Environmental Council* v. *Bartlett*, *supra* note 3; *Elliott* v. *Volpe*, 2 ERC 1498, 1 ELR 20243 (D. Mass. 1970); *cf. Daly* v. *Volpe*, 2 ERC 1506, 1 ELR 20242 (W.D. Wash. 1971); *Sierra Club* v. *Hardin*, *supra* note 7.
16. E.g., *Wilderness Society* v. *Hickel*, *supra* note 4; *Environmental Defense Fund, Inc.* v. *Corps of Engineers*, 324 F. Supp. 878 (D.D.C. 1971); *Environmental Defense Fund, Inc.* v. *Corps of Engineers*, 325 F. Supp. 728, 749 (E.D. Ark. 1971); *Environmental Defense Fund, Inc.* v. *Hardin*, *supra* note 8.
17. 430 F.2d 199 (1970), *cert. denied*, 39 U.S.L.W. 3360 (1971).
18. *Id.* at 211; see also Peterson, An Analysis of the National Environmental Policy Act, 1 ELR 50035.
19. *Calvert Cliffs' Coordinating Committee, Inc.* v. *AEC*, No. 24, 839 (D.C. Cir., decided July 23, 1971).
20. 49 U. S. C. §1653(f).
21. 401 U.S. 402 (1971).
22. 16 U.S.C. §§661, *et seq.*
23. 430 F.2d at 209; see also *Udall* v. *FPC*, 387 U.S. 428, 443–44 (1967).
24. 16 U.S.C. §§1131, *et seq.*
25. 1 ERC 1163 (D. Colo. 1970), on appeal to the Court of Appeals for the

Tenth Circuit; see also *West Virginia Highlands Conservancy* v. *Island Creek Coal Co., supra* note 7.

26. 16 U.S.C. §803(a).
27. 354 F.2d 608, 614 (2d Cir. 1965).
28. 387 U.S. 428 (1967).
29. 16 U.S.C. §1.
30. 16 U.S.C. §§470, *et seq.*
31. 16 U.S.C. §§528, *et seq.*
32. 23 U.S.C. §§109 (g)-(j).
33. 49 U.S.C. §1716(c)(4).
34. 49 U.S.C. §1610; see Primer for the Practice of Federal Environmental Law, 1 ELR 50001 (1971).
35. P.L. 91–604, 91st Cong., 2d Sess. (December 31, 1970).
36. S. 1014, H.R. 5966, 92d Cong., 1st Sess. (1971).
37. 42 U.S.C. §§1857, *et seq.*
38. P.L. 91–604, 91st Cong., 2d Sess. (December 31, 1970).
39. S. 1238, H.R. 4247, H.R. 4723, 92d Cong., 1st Sess. (1971).
40. S. 1478, H.R. 5276, H.R. 5390, 92d Cong., 1st Sess. (1971).
41. 33 U.S.C. §1171(a).
42. 42 U.S.C. §1857f.
43. 33 U.S.C. §1163.
44. 42 U.S.C. §1857(c)(2).
45. 42 U.S.C. §1857f.
46. 42 U.S.C. §1857h-2.
47. *Id.*
48. *Supra* note 36.
49. Executive G, 91st Cong., 2d Sess. (May 20, 1970).
50. S. 1238, H.R. 4247, H.R. 4723, 92d Cong., 1st Sess. (1971).
51. For further discussion of international developments, see Chapter 1.
52. P.L. 89–554, as amended, 5 U.S.C. §552.
53. *Soucie v. David,* 2 ERC 1626, 1 ELR 20147 (D.C. Cir. 1971).
54. Executive Order No. 11514, 3 C.F.R. chap. II, at 104 (March 5, 1970).
55. CEQ, Guidelines §10(b), reproduced in Appendix G.
56. 42 U.S.C. §1857h-7.
57. Act of June 11, 1946, ch. 324, 60 Stat. 237, as amended and codified, 5 U.S.C. §§551, *et seq.*
58. 5 U.S.C. §§551(5), (7).
59. 33 U.S.C. §1161(b)(2).
60. 7 U.S.C. §§135, *et seq.*
61. 5 U.S.C. §706(2)(E).
62. 359 F.2d 994 (D.C. Cir. 1966) (opinion by Burger, J.).
63. 5 U.S.C. §553.
64. 5 U.S.C. §553(e).
65. 5 U.S.C. §551(13).
66. 16 U.S.C. §470f.
67. CEQ, Guidelines §6(a)(vii), reproduced in Appendix G.
68. 5 U.S.C. §702.
69. *Data Processing Service* v. *Camp,* 397 U.S. 150 (1970); *Abbott Laboratories v. Gardner,* 387 U.S. 136 (1967); *Citizens Committee for the Hudson Valley* v. *Volpe,* 425 F.2d 97 (2d Cir.), *cert. denied,* 400 U.S. 949 (1970); *Sierra Club* v. *Hardin, supra* note 7; *Road Review League* v. *Boyd,* 270 F. Supp. 650 (S.D.N.Y. 1967).
70. 397 U.S. 150 (1970).
71. *Citizens Committee for the Hudson Valley* v. *Volpe, supra* note 69; *West Virginia Highlands Conservancy* v. *Island Creek Coal Co., supra* note 7; *Environmental Defense Fund, Inc.* v. *Hardin,* 428 F.2d 1093 (D.C. Cir. 1970).
72. *Citizens Committee for the Hudson Valley* v. *Volpe, supra* note 69, at 105.

73. 433 F.2d 24 (9th Cir. 1970) (Hamley, J., dissented on the issue of standing).
74. *Alameda Conservation Association* v. *California,* 2 ERC 1175, 1 ELR 20097 (1971).
75. *Sierra Club* v. *Hardin, supra* note 7, at 111.
76. See, e.g., *Scenic Hudson Preservation Conference* v. *FPC, supra* note 27; *Citizens to Preserve Overton Park* v. *Volpe, supra* note 21; *Sierra Club* v. *Hardin, supra* note 7; *Parker* v. *United States, supra* note 25; *Environmental Defense Fund, Inc.* v. *Ruckelshaus,* 439 F.2d 584 (D.C. Cir. 1971).
77. 5 U.S.C. §706(2)(A).
78. See also *Environmental Defense Fund, Inc.* v. *Ruckelshaus, supra* note 76.
79. 5 U.S.C. §706(2)(E).
80. *Supra* note 21; see also *Environmental Defense Fund, Inc.* v. *Hardin, supra* note 71, at 1099–100.
81. 325 F. Supp. 728, 749 (E.D. Ark. 1971).
82. *Environmental Defense Fund, Inc.* v. *Hardin, supra* note 8.
83. *Supra* note 25.
84. See also *Sierra Club* v. *Hardin, supra* note 7, at 124.
85. *McGee* v. *United States,* 39 U.S.L.W. 4571 (U.S. 1971).
86. *Supra* note 7, at 115–17.
87. *National Audubon Society* v. *Johnson,* 1 ERC 1709 (S.D. Tex. 1970).
88. N.Y. Const., Art. XIV, §§4, 5.
89. Pa. Const. art. 1, §27 (approved by electorate May 18, 1971, but not yet certified); Ill. Const., Art. XI, §§1, 2, effective January 1, 1972.
90. Rhode Island Const. §17, adopted November 3, 1970.
91. Public Environmental Policy Act, Law No. 9, [1971] Puerto Rico Laws (Senate Law 258 and 703), June 18, 1970.
92. Montana Environmental Policy Act, Ch. 238, [1971] Montana Laws (House Bill 66), March 9, 1971.
93. Cal. Public Resources Code §§21000 *et seq.*
94. Ch. 109, [1971] Washington Laws (Senate Bill 545), Aug. 9, 1971.
95. Ch. 70, Title 7, [1971] Delaware Laws (House Bill 300), June 28, 1971.
96. E.g., Calif. Assembly Bill 1056, introduced Mar. 18, 1971 (bill to modify existing California statute); Mass. House Bill 5144, introduced Mar. 10, 1971.
97. Mich. Stat. Ann. §§14.528(201), *et seq.,* reprinted in 1 ELR 43001.
98. 42 U.S.C. §1857h-2.
99. House Bill No. 5037, [1971] Conn. Laws, May 9, 1971.
100. Senate Enrolled Act 345, [1971] Ind. Laws; Minnesota Environmental Rights Act, Ch. 952, [1971] Minn. Laws (S.F. No. 418), June 7, 1971.
101. American Law Institute, Restatement (Second) of the Law of Torts §821B(1) (Tent. Draft No. 17, April 26, 1971).
102. American Law Institute, *supra* note 101, §821B comment e.
103. Note, Water Quality Standards in Private Nuisance Actions, 79 *Yale L.J.* 102 (1969).
104. E.g., *Miami* v. *Coral Gables,* 1 ERC 1184 (Fla. Dist. Ct. App. 1970); American Law Institute, *supra* note 101, §821C.
105. American Law Institute, *supra* note 101, §821C comment j.
106. U.S. Const., Art. III, §2; Eleventh Amendment; see also 28 U.S.C. §1251(b).
107. 39 U.S.L.W. 4323, 2 ERC 1331, 1 ELR 20124; see also Comment, 1 ELR 10038 (U.S. 1971).
108. *Illinois* v. *Milwaukee,* 49 Orig.; *Vermont* v. *New York,* 50 Orig.; *Washington* v. *General Motors,* 45 *Orig.,* 39 U.S.L.W. 3486 (U.S. 1971); see also Comment, 1 ELR 10018.
109. *Euclid* v. *Ambler Realty Co.,* 272 U.S. 365 (1926).
110. E.g., *MacGibbon* v. *Duxbury,* 1 ERC 1122 (Mass. Sup. Jud. Ct. 1970);

Bartlett v. *Zoning Commission,* 2 ERC 1684, 1 ELR 20177 (Conn. Sup. Ct. 1971).

111. *Candlestick Properties, Inc.* v. *San Francisco Bay Conservation and Development Commission,* 2 ERC 1075 (Cal. Dist. Ct. App. 1970).

112. *Associated Home Builders* v. *Walnut Creek,* 484 P.2d 606, 94 Cal. Rptr. 630, 2 ERC 1490, 1 ELR 20223 (1971).

113. 15 U.S.C. §§1021–25.

114. *Welford* v. *Ruckelshaus,* 2 ERC 1123, 1125, 1 ELR 20065, 20067 (1971).

appendix

selected environmental protection legislative provisions [1]

section 4(f) of the department of transportation act, 49 u.s.c. 1653(f)

SEC. 4. (f) It is hereby declared to be the national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites. The Secretary of Transportation shall cooperate and consult with the Secretaries of the Interior, Housing and Urban Development, and Agriculture, and with the States in developing transportation plans and programs that include measures to maintain or enhance the natural beauty of the lands traversed. After August 23, 1968, the Secretary shall not approve any program or project which requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State, or local significance as determined by the Federal, State, or local officials having jurisdiction thereof, or any land from an historic site of national, State, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use.

sections 1, 2(a), (b) of the fish and wildlife coordination act, 16 u.s.c. 661, 662(a), (b)

SEC. 1. For the purpose of recognizing the vital contribution of our wildlife resources to the Nation, the increasing public interest and significance thereof due to expansion of our national economy and other factors, and to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation for the purposes of this Act in the United States, its Territories and possessions, the Secretary of the Interior is authorized (1) to provide assistance to, and cooperate with, Federal, State, and public or private agencies and organizations in the development, protection, rearing, and stocking of all species of wildlife, resources thereof, and their habitat, in controlling losses of the same from disease or other causes, in minimizing damages from overabundant species, in providing public shooting and fishing areas, including easements across public lands for access thereto, and in carrying out other measures necessary to effectuate the purposes of this Act; (2) to make surveys and investigations of the wildlife of the public domain, including lands and waters or interests therein acquired or controlled by any agency of the United States; and (3) to accept donations of land and contributions of funds in furtherance of the purposes of this Act.

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[1] Federal law contains many provisions guiding Government action with respect to the environment. This appendix includes only a selection of the important provisions cited in the text.

SEC. 2. (a) Except as hereafter stated in subsection (h) of this section, whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license, such department or agency first shall consult with the United States Fish and Wildlife Service, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular State wherein the impoundment, diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing loss of and damage to such resources as well as providing for the development and improvement thereof in connection with such water-resource development.

(b) In furtherance of such purposes, the reports and recommendations of the Secretary of the Interior on the wildlife aspects of such projects, and any report of the head of the State agency exercising administration over the wildlife resources of the State, based on surveys and investigations conducted by the United States Fish and Wildlife Service and such State agency for the purpose of determining the possible damage to wildlife resources and for the purpose of determining means and measures that should be adopted to prevent the loss of or damage to such wildlife resources, as well as to provide concurrently for the development and improvement of such resources, shall be made an integral part of any report prepared or submitted by any agency of the Federal Government responsible for engineering surveys and construction of such projects when such reports are presented to the Congress or to any agency or person having the authority or the power, by administrative action or otherwise, (1) to authorize the construction of water-resource development projects or (2) to approve a report on the modification or supplementation of plans for previously authorized projects, to which this Act applies. Recommendations of the Secretary of the Interior shall be as specific as is practicable with respect to features recommended for wildlife conservation and development, lands to be utilized or acquired for such purposes, the results expected, and shall describe the damage to wildlife attributable to the project and the measures proposed for mitigating or compensating for these damages. The reporting officers in project reports of the Federal agencies shall give full consideration to the report and recommendations of the Secretary of the Interior and to any report of the State agency on the wildlife aspects of such projects, and the project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits.

sections 2 (a), (c), 3 of the wilderness act, 16 u.s.c. 1131 (a), (c), 1132

SEC. 2. (a) In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition, it is hereby declared to be the policy of the Congress to secure for the American people of present and future generations the benefits of an enduring resource of wilderness. For this purpose there is hereby established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", and these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness; and no Federal lands shall be desig-

nated as "wilderness areas" except as provided for in this Act or by a subsequent Act.

(c) A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this chapter an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

SEC. 3. (a) All areas within the national forests classified at least 30 days before September 3, 1964 by the Secretary of Agriculture or the Chief of the Forest Service as "wilderness", "wild", or "canoe" are hereby designated as wilderness areas. The Secretary of Agriculture shall—

(1) Within one year after September 3, 1964, file a map and legal description of each wilderness area with the Interior and Insular Affairs Committees of the United States Senate and the House of Representatives, and such descriptions shall have the same force and effect as if included in this chapter: *Provided, however,* That correction of clerical and typographical errors in such legal descriptions and maps may be made.

(2) Maintain, available to the public, records pertaining to said wilderness areas, including maps and legal descriptions, copies of regulations governing them, copies of public notices of, and reports submitted to Congress regarding pending additions, eliminations, or modifications. Maps, legal descriptions, and regulations pertaining to wilderness areas within their respective jurisdictions also shall be available to the public in the offices of regional foresters, national forest supervisors, and forest rangers.

(b) The Secretary of Agriculture shall, within ten years after September 3, 1964, review, as to its suitability or nonsuitability for preservation as wilderness, each area in the national forests classified on September 3, 1964 by the Secretary of Agriculture or the Chief of the Forest Service as "primitive" and report his findings to the President. The President shall advise the United States Senate and House of Representatives of his recommendations with respect to the designation as "wilderness" or other reclassification of each area on which review has been completed, together with maps and a definition of boundaries. Such advice shall be given with respect to not less than one-third of all the areas now classified as "primitive" within three years after September 3, 1964, not less than two-thirds within seven years after September 3, 1964, and the remaining areas within ten years after September 3, 1964. Each recommendation of the President for designation as "wilderness" shall become effective only if so provided by an Act of Congress. Areas classified as "primitive" on September 3, 1964 shall continue to be administered under the rules and regulations affecting such areas on September 3, 1964 until Congress has determined otherwise. Any such area may be increased in size by the President at the time he submits his recommendations to the Congress by not more than five thousand acres with no more than one thousand two hundred and eighty acres of such increase in any one compact unit; if it is proposed to increase the size of any such area by more than five thousand acres or by more than one thousand two hundred and

eighty acres in any one compact unit the increase in size shall not become effective until acted upon by Congress. Nothing herein contained shall limit the President in proposing, as part of his recommendations to Congress, the alteration of existing boundaries of primitive areas or recommending the addition of any contiguous area of national forest lands predominantly of wilderness value. Notwithstanding any other provisions of this Act, the Secretary of Agriculture may complete his review and delete such area as may be necessary, but not to exceed seven thousand acres, from the southern tip of the Gore Range-Eagles Nest Primitive Area, Colorado, if the Secretary determines that such action is in the public interest.

(c) Within ten years after September 3, 1964 the Secretary of the Interior shall review every roadless area of five thousand contiguous acres or more in the national parks, monuments and other units of the national park system and every such area of, and every roadless island within, the national wildlife refuges and game ranges, under his jurisdiction on September 3, 1964 and shall report to the President his recommendation as to the suitability or nonsuitability of each such area or island for preservation as wilderness. The President shall advise the President of the Senate and the Speaker of the House of Representatives of his recommendation with respect to the designation as wilderness of each such area or island on which review has been completed, together with a map thereof and a definition of its boundaries. Such advice shall be given with respect to not less than one-third of the areas and islands to be reviewed under this subsection within three years after September 3, 1964, not less than two-thirds within seven years of September 3, 1964, and the remainder within ten years of September 3, 1964. A recommendation of the President for designation as wilderness shall become effective only if so provided by an Act of Congress. Nothing contained herein shall, by implication or otherwise, be construed to lessen the present statutory authority of the Secretary of the Interior with respect to the maintenance of roadless areas within units of the national park system.

(d) (1) The Secretary of Agriculture and the Secretary of the Interior shall, prior to submitting any recommendations to the President with respect to the suitability of any area for preservation as wilderness—

(A) give such public notice of the proposed action as they deem appropriate, including publication in the Federal Register and in a newspaper having general circulation in the area or areas in the vicinity of the affected land;

(B) hold a public hearing or hearings at a location or locations convenient to the area affected. The hearings shall be announced through such means as the respective Secretaries involved deem appropriate, including notices in the Federal Register and in newspapers of general circulation in the area: *Provided,* That if the lands involved are located in more than one State, at least one hearing shall be held in each State in which a portion of the land lies;

(C) at least thirty days before the date of a hearing advise the Governor of each State and the governing board of each county, or in Alaska the borough, in which the lands are located, and Federal departments and agencies concerned, and invite such officials and Federal agencies to submit their views on the proposed action at the hearing or by no later than thirty days following the date of the hearing.

(2) Any views submitted to the appropriate Secretary under the provisions of (1) of this subsection with respect to any area shall be included with any recommendations to the President and to Congress with respect to such area.

(e) Any modification or adjustment of boundaries of any wilderness area shall be recommended by the appropriate Secretary after public notice of such proposal and public hearing or hearings as provided in subsection (d) of this section. The proposed modification or adjustment shall then be recommended with map and description thereof to the President. The President

shall advise the United States Senate and the House of Representatives of his recommendations with respect to such modification or adjustment and such recommendations shall become effective only in the same manner as provided for in subsections (b) and (c) of this section.

section 10(a) of the federal power act, 16 u.s.c. 803(a)

SEC. 10. All licenses issued under this Part shall be on the following conditions:

(a) That the project adopted, including the maps, plans, and specifications, shall be such as in the judgment of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of waterpower development, and for other beneficial public uses, including recreational purposes; and if necessary in order to secure such plan the Commission shall have authority to require the modification of any project and of the plans and specifications of the project works before approval.

sections 1, 20 of the national park service act, as amended, 16 u.s.c. 1, 20

SEC. 1. There is created in the Department of the Interior a service to be called the National Park Service, which shall be under the charge of a director. The Secretary of the Interior shall appoint the director, and there shall also be in said service such subordinate officers, clerks, and employees as may be appropriated for by Congress. The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations hereinafter specified, except such as are under the jurisdiction of the Secretary of the Army, as provided by law, by such means and measures as conform to the fundamental purpose of the said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

SEC. 20. In furtherance of the Act of August 25, 1916 [the National Park Service Act], as amended, which directs the Secretary of the Interior to administer national park system areas in accordance with the fundamental purpose of conserving their scenery, wildlife, natural and historic objects, and providing for their enjoyment in a manner that will leave them unimpaired for the enjoyment of future generations, the Congress hereby finds that the preservation of park values requires that such public accommodations, facilities, and services as have to be provided within those areas should be provided only under carefully controlled safeguards against unregulated and indiscriminate use, so that the heavy visitation will not unduly impair these values and so that development of such facilities can best be limited to locations where the least damage to park values will be caused. It is the policy of the Congress that such development shall be limited to those that are necessary and appropriate for public use and enjoyment of the national park area in which they are located and that are consistent to the highest practicable degree with the preservation and conservation of the areas.

sections 1, 106 of the national historic preservation act of 1966, 16 u.s.c. 470, 470f

SEC. 1. The Congress finds and declares—

(a) that the spirit and direction of the Nation are founded upon and reflected in its historic past;

(b) that the historical and cultural foundations of the Nation should

be preserved as a living part of our community life and development in order to give a sense of orientation to the American people;

(c) that, in the face of ever-increasing extensions of urban centers, highways, and residential, commercial, and industrial developments, the present governmental and nongovernmental historic preservation programs and activities are inadequate to insure future generations a genuine opportunity to appreciate and enjoy the rich heritage of our Nation; and

(d) that, although the major burdens of historic preservation have been borne and major efforts initiated by private agencies and individuals, and both should continue to play a vital role, it is nevertheless necessary and appropriate for the Federal Government to accelerate its historic preservation programs and activities, to give maximum encouragement to agencies and individuals undertaking preservation by private means, and to assist State and local governments and the National Trust for Historic Preservation in the United States to expand and accelerate their historic preservation programs and activities.

SEC. 106. The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation established under title II of this Act a reasonable opportunity to comment with regard to such undertaking.

sections 1, 2, 4 of the multiple use-sustained yield act of 1960, 16 u.s.c. 528, 529, 531

SEC. 1. It is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. The purposes of this Act are declared to be supplemental to, but not in derogation of, the purposes for which the national forests were established as set forth in section 475 of this title. Nothing herein shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish on the national forests. Nothing herein shall be construed so as to affect the use or administration of the mineral resources of national forest lands or to affect the use or administration of Federal lands not within national forests.

SEC. 2. The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom. In the administration of the national forests due consideration shall be given to the relative values of the various resources in particular areas. The establishment and maintenance of areas of wilderness are consistent with the purposes and provisions of this Act.

SEC. 4. As used in this Act, the following terms shall have the following meanings:

(a) "Multiple use" means: The management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the

other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

(b) "Sustained yield of the several products and services" means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.

section 136 of the federal-aid highway act of 1970, 23 u.s.c. 109 (g)-(j)

(g) The Secretary shall issue within 30 days after the day of enactment of the Federal-Aid Highway Act of 1970 guidelines for minimizing possible soil erosion from highway construction. Such guidelines shall apply to all proposed projects with respect to which plans, specifications, and estimates are approved by the Secretary after the issuance of such guidelines.

(h) Not later than July 1, 1972, the Secretary, after consultation with appropriate Federal and State officials, shall submit to Congress, and not later than 90 days after such submission, promulgate guidelines designed to assure that possible adverse economic, social, and environmental effects relating to any proposed project on any Federal-aid system have been fully considered in developing such project, and that the final decisions on the project are made in the best overall public interest, taking into consideration the need for fast, safe and efficient transportation, public services, and the costs of eliminating or minimizing such adverse effects and the following:

(1) air, noise, and water pollution;

(2) destruction or disruption of man-made and natural resources, aesthetic values, community cohesion and the availability of public facilities and services;

(3) adverse employment effects, and tax and property value losses;

(4) injurious displacement of people, businesses and farms; and

(5) disruption of desirable community and regional growth.

Such guidelines shall apply to all proposed projects with respect to which plans, specifications, and estimates are approved by the Secretary after the issuance of such guidelines.

(i) The Secretary, after consultation with appropriate Federal, State, and local officials, shall develop and promulgate standards for highway noise levels compatible with different land uses and after July 1, 1972, shall not approve plans and specifications for any proposed project on any Federal-aid system for which location approval has not yet been secured unless he determines that such plans and specifications include adequate measures to implement the appropriate noise level standards.

(j) The Secretary, after consultation with the Administrator of the Environmental Protection Agency, shall develop and promulgate guidelines to assure that highways constructed pursuant to this title are consistent with any approved plan for the implementation of any ambient air quality standard for any air quality control region designated pursuant to the Clean Air Act, as amended.

section 16 (c) (4) of the airport and airway development act, 49 u.s.c. 1716 (c) (4)

SEC. 16. (c) (4) It is declared to be national policy that airport development projects authorized pursuant to this Part shall provide for the protection and enhancement of the natural resources and the quality of environment of the Nation. In implementing this policy, the Secretary shall consult with the Secretaries of the Interior and Health, Education, and Welfare with regard to the effect that any project involving airport location, a major runway ex-

tension, or runway location may have on natural resources including, but not limited to, fish and wildlife, natural, scenic, and recreational assets, water and air quality, and other factors affecting the environment, and shall authorize no such project found to have adverse effect unless the Secretary shall render a finding, in writing, following a full and complete review, which shall be a matter of public record, that no feasible and prudent alternative exists and that all possible steps have been taken to minimize such adverse effect.

section 14 of the urban mass transportation act of 1964, as amended, 49 u.s.c. 1610

SEC. 14. (a) It is hereby declared to be the national policy that special effort shall be made to preserve the natural beauty of the countryside, public park and recreation lands, wildlife and waterfowl refuges, and important historical and cultural assets, in the planning, designing, and construction of urban mass transportation projects for which Federal assistance is provided pursuant to section 3 of this Act. In implementing this policy the Secretary shall cooperate and consult with the Secretaries of Agriculture, Health, Education, and Welfare, Housing and Urban Development, and Interior, and with the Council on Environmental Quality with regard to each project that many have a substantial impact on the environment.

(b) The Secretary shall review each transcript of hearing submitted pursuant to section 3(d) to assure that an adequate opportunity was afforded for the presentation of views by all parties with a significant economic, social, or environmental interest, and that the project application includes a detailed statement on—

(1) the environmental impact of the proposed project,

(2) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(3) alternatives to the proposed project, and

(4) any irreversible and irretrievable impact on the environment which may be involved in the proposed project should it be implemented.

(c) The Secretary shall not approve any application for assistance under section 3 unless he finds in writing, after a full and complete review of the application and of any hearings held before the State or local public agency pursuant to section 3(d), that (1) adequate opportunity was afforded for the presentation of views by all parties with a significant economic, social, or environmental interest, and fair consideration has been given to the preservation and enhancement of the environment and to the interest of the community in which the project is located, and (2) either no adverse environmental effect is likely to result from such project, or there exists no feasible and prudent alternative to such effect and all reasonable steps have been taken to minimize such effect. In any case in which a hearing has not been held before the State or local agency pursuant to section 3(d), or in which the Secretary determines that the record of hearings before the State or local public agency is inadequate to permit him to make the findings required under the preceding sentence, he shall conduct hearings, after giving adequate notice to interested persons, on any environment issues raised by such application. Findings of the Secretary under this subsection shall be made a matter of public record.

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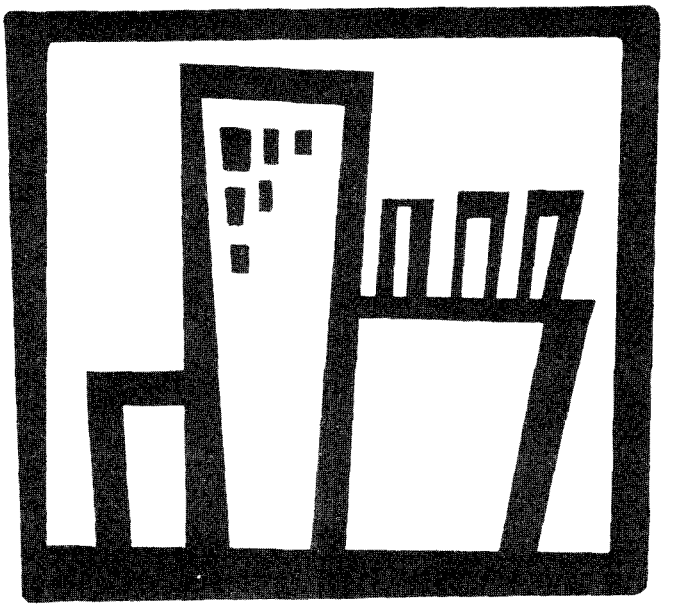


the inner city environment

Life in the inner city embraces a range of environmental problems, some starkly evident, some disguised, some acknowledged as environmental, some wearing other labels. The inner city has no classifiable boundaries setting it apart from the rest of the urban area, but it generally includes the decaying, older areas which usually intertwine with or encircle the center of the city. The term is also applied to sections away from the central core which share similar environmental characteristics.

The inner city, whatever its precise boundaries, is recognized by its inferior environment. Air pollution, a problem for nearly all of the Nation, lays its pall most heavily over the inner city in many metropolitan areas. Open space, parks, and recreational opportunity are high priorities for a better environment. Yet in the inner city they are lacking to a higher degree than in other parts of the urban complex. Problems of noise, sanitation, and congestion affect nearly all sectors of the larger cities. But overcrowding, rats, flaking leaded paint, deteriorating housing, and everpresent litter and garbage are afflictions more typical of the inner city.

Although an annual report cannot hope to cover the entire range of environmental factors in all of America, it was felt that special attention this year should be given to the inner city where many of our most severe environmental problems interact with social and economic conditions which the Nation is also seeking to improve.

This chapter is thus an attempt to focus on some of the acute environmental problems faced by the inner city. It is necessarily

incomplete and inconclusive because environmental problems in the urban setting cannot be sharply differentiated from nonenvironmental problems; because for many of the problems affecting the inner city, there are no acceptable, quick answers; and because the afflictions of the inner city are closely related to the difficulties which beset the entire urban area. The chapter highlights a series of problems different in many respects from those of traditional conservation. It attempts to lay a preliminary basis for a broader dialogue on the problems of the urban environment, many of which are most severe in the inner city.

The environmental decay of the inner city, of course, affects more than the poor. Middle and upper income families residing within inner city sanctuaries are not spared the health and economic toll of air pollution, noise, and traffic congestion. Yet they can insulate themselves from some of the environmental burdens of life in the city: Air conditioners screen the air and shut out street noise, housing is kept in repair against the assaults of weather and rodents, much more living space is available, and mobility and higher income make it possible to escape periodically to more pleasant environments. For the inner city poor, however, there is little relief and limited opportunity for escape.

The traditional environmental objectives of clean air and water and preservation of national parks and wilderness are not the central concerns of most inner city poor. They focus instead on more immediate economic and social interests. Some spokesmen for inner city areas fear that the environmental movement may divert public attention and funds from these issues to more traditional environmental issues. For many inner city residents, the overwhelming concern is poverty and its accompanying ills—inadequate housing, high crime rates, poor health, unsanitary conditions, inadequate education and recreation, and drug addiction—all of which are exacerbated by racial discrimination. These factors may not be environmental when looked at individually. But their net effect is to lower the quality of life.

Nevertheless, there is growing evidence that among the urban poor—those with the most to gain from environmental improvements—are some who have decided to embrace environmentalism in their own distinct way. Their use of the term environment is broader than the traditional definition. Their concept embraces not only more parks, but better housing; not only cleaner air and water, but rat extermination.

The environmental movement in the inner city is still in its infancy, although inner city groups and established environmental organizations are beginning to identify some shared objectives. In a number of cities—Boston, Cleveland, Detroit, Los Angeles, New York, Philadelphia, St. Louis, Washington, D.C.—community groups and new organizations are attacking environmental problems of the inner city. At the same time, some traditional conservation groups are developing programs to assist in

improving the quality of life in inner city neighborhoods. An example is Young Adults for Resources and the Environment (YARE). A small spinoff from the Izaak Walton League of America, it is intended to open channels of communication between inner city young adults and citizen conservation organizations through environmental workshops and citizen action projects such as antilitter programs, and organization of people to participate in hearings on local issues which affect their interests. YARE is working in Cleveland, Duluth, New York City, and Washington, D.C.

At the White House Conference on Youth in April, an environmental task force concluded:

> Although environmental degradation has become recognized in recent years as a major social crisis, the public focus on this issue has usually been directed towards problems that are important to middle-class Americans. The issues of urban transportation, slum housing, inadequate health care, recreation and education, and unemployment are vital to urban poor people; but have not been properly understood in an environmental context or dealt with from an ecological perspective.

Conference delegates passed a resolution "that national priority be given to the actions necessary to improve the quality of the environment of the people of America's inner cities."

Several existing Federal programs deal with the physical circumstances of the inner city environment. Some of these, such as air and water pollution control or parkland development, are directed toward all citizens. A few programs, such as Federal assistance to urban areas for rat control, are aimed primarily at inner city problems.

The variety of environmental problems of the inner city and the absence of simple answers to these problems make it particularly important that efforts to overcome them be tailored to the needs and priorities of each locality. This becomes even more important when it is recognized that most of the resources used for coping with the broad environmental problems of a city are raised within the locality itself. Federal assistance, although large and continuing to grow, is only a fraction of the total resources available for dealing with local problems. A solution to these problems requires, first of all, that the significant local resources be used in a planned, effective way to meet locally determined priorities. Federal aid can be most effective when it helps the locality to meet its own recognized needs rather than impeding or distorting local priorities.

air pollution

Air pollution generally hangs more heavily over the inner city than the rest of the urban area, and far more heavily than over most suburban and rural areas. In some cities the central business district absorbs the most severe air pollution; in other cities close-in industrial areas bear the heaviest pollution loads.

The largest concentrations of the urban poor often live near these two areas. A 1969 study conducted for the National Air Pollution Control Administration (NAPCA, now a part of the Environmental Protection Agency) confirmed that concentrations of particulate matter, carbon monoxide, and sulfur oxides decline steadily out from urban areas (urban measuring points are all located in downtown areas). This may be seen in Table 1.

Based on samples collected over a 2-year period, the study shows that average concentrations of particulates in nonurban areas are between 10 and 50 percent of the average in urban areas. Moreover, within metropolitan regions, similar variations hold between suburbia and the central city.

A study of the St. Louis area made in 1966 by NAPCA reported that suspended particulates, dust fall, and concentrations of sulfur dioxide were higher in the predominantly poor black neighborhoods of St. Louis and East St. Louis than elsewhere in the metropolitan area.

A recent air pollution computer model of the Chicago region, when correlated with census data, indicates that the lowest income neighborhoods are in the areas of highest pollution concentrations (see Figures 1 and 2). Similar conclusions surface in

Table 1

Selected Particulate Constituents as Percentage of Gross Suspended Particulates, 1966–67

	Urban		Nonurban					
	(217 stations)		Proximate (5)[1]		Intermediate (15)[2]		Remote (10)[3]	
	µg/m³	Percent	µg/m³	Percent	µg/m³	Percent	µg/m³	Percent
Suspended particulates	102.0	----	45.0	----	40.0	----	21.0	----
Benzene soluble organics	6.7	6.6	2.5	5.6	2.2	5.4	1.1	5.1
Ammonium ion	0.9	0.9	1.22	2.7	0.28	0.7	0.15	0.7
Nitrate ion	2.4	2.4	1.40	3.1	0.85	2.1	0.46	2.2
Sulfate ion	10.1	9.9	10.0	22.2	5.29	13.1	2.51	1.8
Copper	0.16	0.15	0.16	0.36	0.078	0.19	0.060	0.28
Iron	1.43	1.38	0.56	1.24	0.27	0.67	0.15	0.71
Manganese	0.073	0.07	0.026	0.06	0.012	0.03	0.005	0.02
Nickel	0.017	0.02	0.008	0.02	0.004	0.01	0.002	0.01
Lead	1.11	1.07	0.21	0.47	0.096	0.24	0.022	0.10

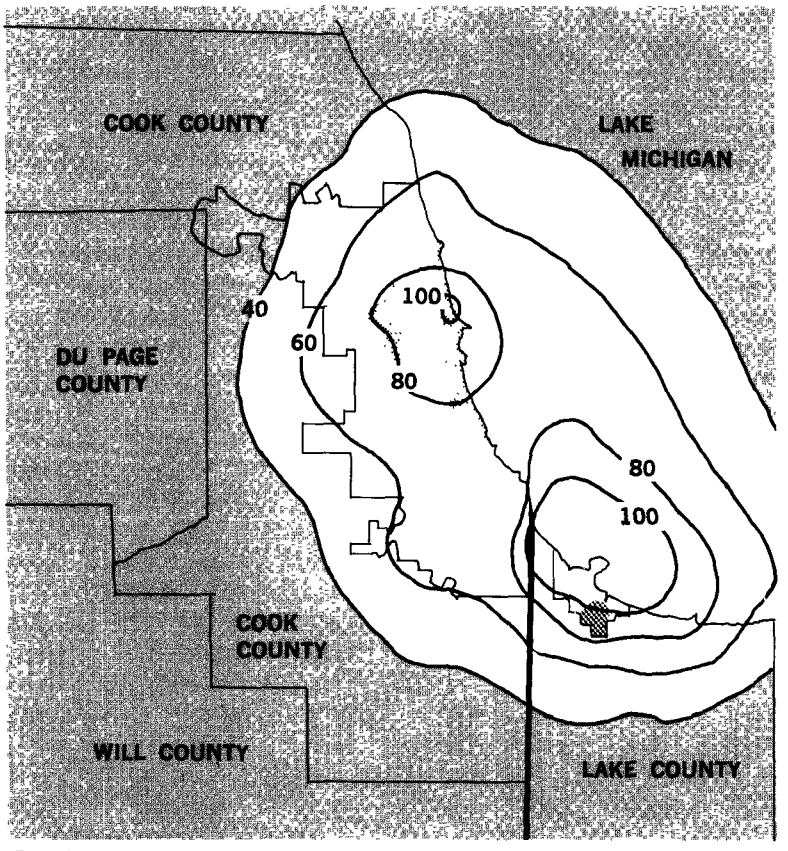
[1] Technically in nonurban areas, but conspicuously influenced by proximity to city, i.e., Cape Vincent, N.Y.; Kent County, Del.; Washington County, Miss.
[2] Closer to urban areas, usually with agricultural activity, i.e., Jackson County, Miss.; Humboldt, Calif.
[3] Farthest from large population center, i.e., Glacier National Park; White Pine County, Nev.

Source: Environmental Protection Agency.

Figure 1

Current Expected Mean Concentrations of Sulfur Dioxide, Chicago, Ill., and Gary, Ind.

(In micrograms per cubic meter)



Source: Based on computer simulation model of data from Atomic Energy Commission, Argonne National Laboratory, and on U.S. Department of Commerce, Bureau of the Census data.

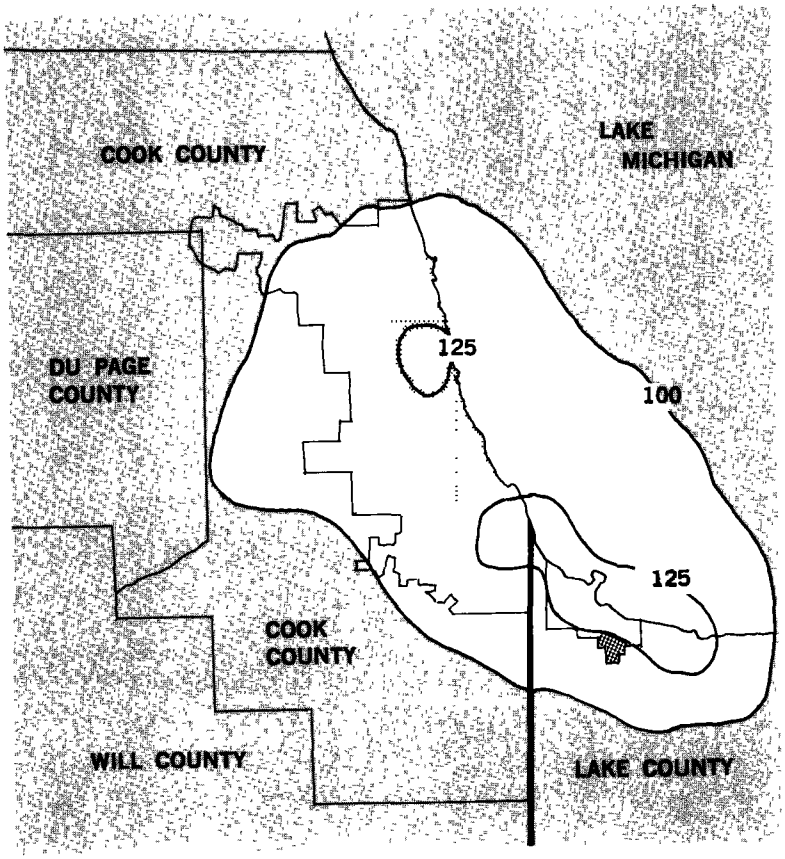
data drawn from Kansas City, Mo., St. Louis, and Washington, D.C. (see Table 2).

Another survey conducted by NAPCA of 22 other metropolitan areas, including Cincinnati, Dallas-Fort Worth, Denver, Indianapolis, Louisville, New York City-Northern New Jersey, Pittsburgh, Providence, San Antonio, and Seattle, substantiates unequal geographical distribution of certain pollutants within metropolitan

Figure 2

Current Expected Particulate Concentrations for Chicago, Ill., and Gary, Ind.

(In micrograms per cubic meter)



Source: Based on computer simulation model of data from Atomic Energy Commission, Argonne National Laboratory, and on U.S. Department of Commerce, Bureau of the Census data.

areas. Emissions of carbon monoxide, sulfur oxides, and particulate matter in these areas were measured by source and proximity to heavy population centers. Emissions of carbon monoxide result from vehicles; sulfur oxides and particulate emissions come from residential and commercial burning of coal and oil. For each of the three pollutants, the pattern is the same: Emission densities are highest in the core city and diminish with distance outward. Overall, the areas of highest emissions within the tested cities coincide with the areas of highest population density.

Table 2
Air Pollution Exposure Indices by Income

Income	Suspended particulates	Sulfation	Mean
Kansas City			
0-2,999	76.7	0.22	1.16
3,000-4,999	72.4	.20	1.09
5,000-6,999	66.5	.18	.98
7,000-9,999	63.5	.17	.93
10,000-14,999	60.1	.15	.86
15,000-24,999	57.6	.14	.80
25,000-over	58.1	.12	.76
St. Louis			
0-2,999	91.3	.97	1.19
3,000-4,999	85.3	.88	1.10
5,000-6,999	79.2	.78	1.00
7,000-9,999	75.4	.72	.93
10,000-14,999	73.0	.68	.89
15,000-24,999	68.8	.60	.82
25,000-over	64.9	.52	.74
Washington, D.C.			
0-2,999	64.6	.82	1.19
3,000-4,999	61.7	.82	1.16
5,000-6,999	53.9	.75	1.04
7,000-9,999	49.7	.69	.96
10,000-14,999	45.5	.64	.88
15,000-24,999	43.2	.58	.82
25,000-over	42.0	.53	.77

Source: Freeman, A.M., based on U.S. Department of Commerce, Bureau of the Census, and U.S. Department of Health, Education, and Welfare, Public Health Service data.

Other pollutants confirm this pattern. Lead, for example, is a potentially poisonous metal commonly found in the atmosphere and in the soil near heavily traveled roadways. Data vary widely among sampling sites, but lead levels in the blood appear particularly high among urban area dwellers. A study of major cities by the Environmental Protection Agency reported that atmospheric lead had increased significantly in the seven years ending in 1969. In Cincinnati, the increase ranged from 13 to 33 percent; in Los Angeles, from 33 to 64 percent; and in Philadelphia, from 2 to 36 percent.

Blood specimens of three groups of persons in the Philadelphia area were taken to determine the amount of lead in their systems. The groups were divided into those who had lived and worked within a 25-block radius of City Hall for 5 years, those who commuted regularly from the suburbs to work in the downtown area, and those who lived in the same neighborhood as the suburban commuters but also worked in the suburbs. For both men and women, lead was significantly highest in the city

dwellers. The suburbanites who worked in the city showed higher lead concentrations than those who lived and worked in the suburbs.

water pollution

Inner city residents are delivered the same water as any other urban residents. But they frequently face added problems. Water pipes in inner city housing are sometimes old and ill-kept and often contain pipe or joint cementing compound made of lead (no longer used in construction). Under such conditions, water containing as much as 920 micrograms of lead per liter has been found in inner city areas, compared to an average of 20 micrograms per liter elsewhere.

Inner city residents have limited access to water recreation. Conclusive data are lacking on how often the urban poor use nearby water bodies. River courses and harbors located within and next to large cities often contain dangerously high levels of bacteria and other pollutants. Yet they often constitute the only source of water recreation easily accessible to the urban poor. The cleaner waters are for many inner city dwellers more distant than a convenient 1-day round trip will allow, and thus out of reach for those not able to afford overnight accommodations.

solid waste

Junk and litter accumulated in streets, on sidewalks, and in vacant lots and doorways are a familiar sight in poverty areas and cannot help having a psychological effect on those who live there. The resident often despairs of keeping his small living space clean when all around him are litter and garbage. He may conclude that since refuse collection is a public service, the abundance of uncollected litter indicates that his neighborhood is being discriminated against. Residents in 9 of 20 cities surveyed by the National Advisory Commission on Civil Disorders listed inadequate sanitation and garbage removal as significant grievances. Many cities able to set their own priorities with Federal funds have placed emphasis on sanitation services such as collecting garbage, buying trash and garbage containers for the city poor, removing abandoned automobiles, cleaning up littered vacant lots, and increasing the number of sanitation workers.

Solving the problem involves more than merely upgrading municipal services. Some New York City poverty areas have garbage pickups six times a week, compared to three times a week elsewhere in the city. In Chicago, inner city poor are served by three collections a week, compared to one collection in the rest of the city. Yet inner city littering and unsanitary conditions continue, and there is widespread disenchantment at the failure of cleanup campaigns to have any lasting effect.

The reasons for this failure to maintain sanitary conditions in

the inner city are complex and interrelated. Frustration over limited opportunities for housing, employment, and education can lead residents of the inner city to withdraw from active efforts to improve conditions around them. This psychological impact is worsened by physical conditions which work against sanitation. Buildings designed in earlier days have been subdivided into numerous crowded living units, with little provision for storage areas, common spaces, or refuse collection systems. Receptacles are often nonexistent, makeshift, or in poor condition—all leading to a situation in which wind, animals, and vandals spread litter throughout houses and neighborhoods. The abundance of vacant lots and abandoned structures, already strewn with refuse, encourage further junk, garbage, and other debris Together these forces work to frustrate even the most willing city sanitation department in working with residents toward a cleaner neighborhood. Also, sanitation collection services have been criticized as perfunctory in some poverty areas. Often such services are confined to curbside collection of packaged refuse, ignoring litter in lots, sidewalks, and gutters.

Strewn garbage, besides being unattractive and odorous, also invites rodents. Rats feed on easily accessible garbage and present a health problem to inner city residents. Greater than the danger of the diseases they carry is the insecurity and fear they inspire, especially in parents with small children.

An estimated 60 to 90 percent of rat bites occurs in inner city neighborhoods. Eighty percent occurs after midnight when most victims are asleep. The problem is intensified by large-scale building demolition in old, inner city areas, where rats are dislodged and then flee to other parts of the city. The presence of rats in an apartment often has nothing to do with the particular building's cleanliness. Substandard housing often is replete with holes in basement walls or around windows and pipes, giving rats entry points from which they fan out through a building.

neighborhood deterioration

Landlord abandonment of buildings, widespread dilapidation, and health effects of lead paint chips on children are all problems characteristic of many inner city neighborhoods. Some inner city areas show their scars openly with vacant stores, burned-out buildings, and boarded-up windows. Deteriorating on the inside, litter-strewn on the outside, block after block of decay provides a depressing setting for life.

When a landlord no longer provides services and upkeep for an occupied building and defaults on taxes or mortgage payments, a building is often on the way to abandonment, a major phenomenon of inner city poverty areas. The economics of abandonment can be traced back to the time immediately after World War II when a rural-to-urban migration swelled the tide of black

families to the Northern and Midwestern cities. The exodus of middle class whites to the suburbs, which started in the 1920's, was already in full swing, and large, older homes in the inner city were subdivided by speculators hoping to capitalize on the growing demand for low-rent housing for the migrants. There was little new building in the depression and war years. Urban renewal, highway construction, and other programs of the post-war period, which resulted in clearing large numbers of living units, increased the pressures as more low-income, nonwhite families competed for the remaining affordable housing. For a time, it was a lucrative market for landlords. They could invest little, give minimum services, and still collect rent.

After further dividing units and reducing maintenance, landlords often begin to run into hard economic going because of higher property taxes, higher mortgage rates, and increased costs attributable to intensive use and an accumulation of unattended maintenance problems. If rents are raised too high, families simply cannot pay; if rents are too low, landlords have little incentive to maintain the buildings. Becoming delinquent in his ever rising city property taxes is often the last attempt by a landlord to make a profit. In some cities, actions on tax delinquency may take as long as 2 to 5 years. Complete failure to provide services is soon followed by an exodus of tenants and thus by abandonment. Often the abandoned units are then illegally occupied by addicts and derelicts and are vandalized. Many are destroyed by fire.

It is estimated that there are more than 100,000 abandoned dwelling units in New York City, between 20,000 and 30,000 in Philadelphia, more than 10,000 in St. Louis, 4,000 or more in Baltimore, and 5,000 or more in Chicago. Abandonment often occurs even in cities with relatively limited supplies of available housing. The percentage of dwelling units for rent or sale in New York City is only 1.7, in Philadelphia, only 2.8. These low vacancy rates, coupled with a heavy rate of abandonment, indicate that buildings are being abandoned even when people need homes. Moreover, the problem is not confined to the biggest cities. Erie, Pa., for instance, has a vacancy rate of 2.3 percent and 5,000 abandoned units.

A survey of seven cities conducted in 1970 by the Urban League and the Center for Community Change indicates the extent to which abandonment is concentrated in the inner city. A study of typical inner city neighborhoods in seven cities showed that five had "serious" abandonment problems. In a St. Louis Model Cities area, 16 percent of all residential structures were abandoned. In a Brooklyn area, 6 to 10 percent of the buildings were found abandoned, and in the Woodlawn area of Chicago, by 1970, abandonment and demolition reached 15 to 20 percent of the total structures existing in 1960.

Two cities which did not have a serious abandonment problem in the neighborhoods surveyed were Atlanta and Detroit. The rea-

sons given were a relatively high incidence of home ownership and banks willing to supply conventional mortgage funds for repair or purchase to any qualified borrower in any part of the city. In both Atlanta and Detroit the causal factor for these observations appears to be the emergence of a strong black middle class. Neighborhood stability was further promoted in Detroit by the fact that economically mixed neighborhoods were in close physical proximity and in Atlanta by the fact that economic groups were mixed within neighborhoods.

As the abandonment rate approaches 5 percent, it appears to accelerate. A New York study documents the speed with which abandonment can overtake structurally sound dwellings. In the Brownsville area of Brooklyn, 448 units—one entire city block—which were classified as sound in the 1960 census, were abandoned by 1969.

Overcrowding in urban areas is another problem confined largely to the inner city. In 1966, poverty areas of Oakland, Calif., recorded 13.2 percent of all households as overcrowded—averaging more than one person per room. More than one-fifth of Oakland's families classified below the poverty level lived in overcrowded housing, compared with 5 percent of the city's nonpoverty families. Overcrowding leads to greater maintenance requirements and faster deterioration.

It is important to understand clearly the dual problems of abandonment and crowding in inner city housing. Abandonment pockmarks neighborhoods with dilapidated structures and rubble-filled lots. It works against the feeling of community that derives from solid blocks of homes and stores. Crowding in housing, on the other hand, affects the home environment. Abandonment and crowding go together because the loss of housing through abandonment means more crowding in remaining structures. Thus occurs the incongruous phenomenon of lower densities per acre in the inner city caused in part by abandonment, but higher densities in some buildings as the poor crowd into the limited remaining affordable housing.

Another element of deteriorating housing in the inner city is lead poisoning. Lead in gasoline, which adds to air pollution, is generally recognized as an environmental hazard, but lead in paint is a less known and more immediate problem for the poor. Lead is present in the paint, plaster, and caulking of some older houses and apartments which are now in decaying neighborhoods. About 30 years ago, nontoxic paint was developed, and today the sale of interior paint in excess of 1 percent lead is illegal in most urban areas. The newer paints, however, only cover the old toxic paints. Flaking and chipping make leaded paint, along with the newer coat, available to the unwitting grasp of a child.

Ingestion of lead occurs mostly among children between the ages of 1 and 3 who exhibit pica, a craving for nonfood sub-

stances. Prolonged or recurrent ingestion of this lead produces abnormal levels of lead in the blood and, in a significant number of cases, lead poisoning. According to a policy statement of the Surgeon General of the U.S. Public Health Service, "A growing body of data from studies in many cities has established beyond doubt that lead intake by children from paint—particularly in the slums of the cities—is an important and widespread problem. Estimates of the number of children in the United States with dangerous blood lead levels range as high as 400,000. Lead poisoning has caused mental retardation and sometimes death."

In the past, lead poisoning among children has largely been undetected and unreported. As late as 1964, before an intensive program of testing was begun in New York City, only 500 confirmed lead poisoning cases were reported citywide. A 1970 New York City test of 87,000 inner city children showed that 2,649 suffered from lead poisoning. Even when poisoning has not been confirmed, tests indicate an abnormally high level of lead in blood among children from urban poverty neighborhoods. In a 1967 Chicago test of 28,000 children under five years of age, 2,380 had elevated levels of lead in their blood.

open space and recreation

Of 491 million acres of public recreation area in the United States, less than 3 percent is within 40 miles, or 1-hour driving time, from the center of metropolitan areas with more than 500,000 population; yet 90 million people live in these areas. No national data have been collected on the availability of parks to people in the inner city. However, a 1970 study of recreation problems in urban impact areas in California showed an inverse relationship between family income and desire for recreation. For example, in families with an annual income under $2,000, the desire to participate in outdoor activities was almost double that of families with an income above $9,000.

And while the Nation's population grows and new parks are being acquired, many areas are suffering a decrease in available urban parkland. Studies now underway for the U.S. Department of Interior and the U.S. Department of Housing and Urban Development show a loss of more than 22,000 acres of urban parkland in the last 6 years, much of the parkland close to the inner city. The studies have disclosed that this land is being taken for highways, utilities, schools, housing, and other projects. Besides removing parkland from present users, this loss frequently brings an even greater number of people into an area to share a reduced supply of parks.

In addition, transportation corridors and industries along river and lake fronts have eliminated or cut off access to many locations suitable for public recreation. And the classic playground

of the urban poor, the street, is now often congested by both increasing traffic and parked cars.

The Open Space Land Program of the Department of Housing and Urban Development (HUD) has encouraged central cities to acquire and develop parks and recreation areas that are easily accessible to the residents. For example, five sites were acquired and developed in Montgomery, Ala., with HUD assistance. They ranged in size from 3 to 5 acres in neighborhoods where median family income varied from $3,500 to $4,200. One park is in an area where 96 percent of the dwellings are substandard, and another is in an older section of the city where there was no place to play except the streets. In Lowell, Mass., four vest-pocket parks were built with HUD grants. One of the parks is in a Model Cities area where the median family income is $4,000 and approximately 40 percent of the dwellings are substandard or dilapidated. Between 1969 and 1970, the percentage of HUD Open Space funds allocated to the purchase of parks in low-income neighborhoods increased from 6 to 33 percent. The President, as part of his "Legacy of Parks" program, has asked Congress to increase the HUD Open Space Program from $75 million to $200 million to assist cities in purchasing open space and developing parks in or near urban areas.

The President's "Legacy of Parks" concept, announced in his Environmental Message to Congress in February, is a multifaceted approach to increase substantially the open space, parklands, and recreation areas of the Nation and to redirect Federal programs in a way that will place the new areas closer to where most people live. The Legacy of Parks seeks to bring "parks to people" through actions which involve both direct Federal involvement and federally supported State and local grant programs.

In 1971, the President established the Property Review Board to evaluate federally owned properties to determine those which are underutilized and could be turned over to State or local governments for park use. Of the more than 60 properties already identified, 13 properties containing 8,905 acres have been declared excess and are being conveyed to the appropriate State or local agencies. Most are in or near large urban areas where they can provide recreation opportunity for residents of the inner city. They include the Naval Devices Training Center, Sands Point, N.Y., with a beach area located 16 miles northeast of Manhattan; 116 acres of the Cleveland Support Facility; Camp Pendleton and Border Field near San Diego, Calif.; and Fort Tilden and Fort Hancock, which will be part of the Gateway National Recreation Area near New York City (see Chapter 1).

The Gateway National Recreation Area proposal, which the President has sent to Congress, will provide a 23,000-acre land and water park capable of serving 20 million visitors annually with indoor and outdoor recreational and cultural facilities, and will be linked with New York City's rapid transit service.

The Administration's proposed amendments to the Land and Water Conservation Fund Act now before the Congress would apportion more money from the Interior Department's fund to the most populous States and would strengthen the Secretary of the Interior's overview powers to assure that urban residents are receiving their share. The amendments would authorize up to 25 percent of any State's allocated funds for indoor recreational facilities where climate and lack of space make moving indoors necessary.

transportation

Automobile ownership often makes the difference between access to outdoor recreation areas and confinement to the limited parklands of many inner city areas. On the other hand, new highways which serve the car owner further diminish urban open space. Highway construction can also cost the city dweller his home, increase the pollution of his air, and add to the noise from which he suffers. In some cases, resistance to proposed new highway construction has knitted inner city groups and environmental organizations into new coalitions. For example, the Greater Boston Committee on the Transportation Crisis, a broadly based coalition of inner city and conservation groups, played an important part in winning the support of the Governor and the Mayor for an extensive review of Boston's transportation needs. Construction on a major segment of Interstate 95, on portions of the Inner Belt Interstate 695 (one section of which would split the Model Cities area in Cambridge), and on several other Boston area highway projects has been halted while the entire range of transportation alternatives is being explored.

If a new highway severs a neighborhood, it decreases casual, social interaction between the two severed sides. It creates a psychological or visual barrier and often a physical obstacle. More than liberal vehicular access and an occasional pedestrian crossing are necessary to overcome the highway barrier. Even when continuous across-highway access is provided—as in the case of elevated structure construction—the highway's uninhabited strip remains a psychological and social barricade.

The presence of a highway near a neighborhood may have other impacts beyond the border or barrier effect. Noise, increased dirt, and fumes tend to make outdoor activities less pleasant and thus, to some degree, diminish the contacts needed to produce neighborhood cohesion.

Heightened surface traffic can also develop from changes in traffic patterns after a new highway is built. Feeder streets in the vicinity of an interchange often suffer enormously increased loads. The effects of this increased traffic may turn the street into a greater barrier to social interaction.

During the past few years, federally aided highway construction

has displaced an average of 60,000 people from their homes and businesses each year. Of the people displaced, three-fourths were urban dwellers. Most displacement occurred in areas of middle- or low-income housing units that cost less than $15,000 or rented for less than $110 a month. Displacement often has a heavier impact on minority groups than on others.

The impact of displacement varies according to how effective relocation efforts are. The Uniform Relocation Assistance Act promises to improve the treatment provided displacees, and the Department of Transportation has adopted a policy of "no displacement without available relocation housing." But adequate relocation facilities are often not considered a substitute for long-standing neighborhood attachment. When the north leg of a proposed Inner Loop in Washington, D.C., was announced, individuals with sentimental attachments to the affected neighborhood began to crowd into adjacent, similar neighborhoods.

Growing opposition to urban highways has caused transportation planners to try to bring community advocates into the planning process. Transportation planners are also paying more attention to the social and environmental impact that the building of roads and mass transit systems has on inner city neighborhoods. For example, in the San Francisco-Oakland region, the Bay Area Rapid Transit System will offer a linear, landscaped park to several communities over a considerable distance by using the space under and adjacent to the elevated tracks.

In recent years, the Department of Transportation, aided by a specific congressional mandate in section 4(f) of the Department of Transportation Act, has developed procedures designed to reduce to a minimum the use of public parkland for new highways. The Supreme Court recently emphasized the thrust of congressional intent to protect parks from encroachments by transportation projects.

One indication of a movement toward greater balance in U.S. transportation is the fact that rapid transit rail systems are being considered, currently planned, or under construction in 16 American cities. Two are now under construction in the District of Columbia and San Francisco. Pittsburgh has such a system in the engineering stage, and 13 other cities are considering or planning such systems: Atlanta, Baltimore, Buffalo, Dallas-Fort Worth, Detroit, Honolulu, Houston, Los Angeles, Miami, Minneapolis-St. Paul, St. Louis, San Juan, and Seattle. The eventual success of mass transit systems is rooted in new design concepts, new sources of funding, and possibly incentives and sanctions involving the use of automobiles in the city. Few localities have yet come to grips with these realities. Federal revenue sharing would help resolve some of the financial obstacles not only by providing a specific fund for mass transit capital expenditures but also by

giving States and localities the choice of distributing other shared revenue among various alternative modes, including mass transit operating expenditures.

comprehensive approaches and citizen action

Inner city residents and Federal, State, and local officials all have found that the fragmented approach—dealing separately with causes and effects—is generally inadequate to deal with the interdependent nature of the inner city environment. Programs have also faltered when they failed to involve the residents themselves. And the way the financial assistance was provided often impeded the effort.

One method of obtaining more funds for meeting inner city problems, but without the restrictions that distort local efforts, is revenue sharing, especially the Administration's proposed General Revenue Sharing and Urban Community Development Revenue Sharing proposals sent to the Congress earlier this year. In requesting $2 billion for Urban Revenue Sharing, President Nixon pointed out that the inflexibility of the present system often means that money cannot be used where the need is the greatest. Federal categorical grant programs, often criticized because they limit the power of cities to decide how to spend Federal assistance funds, proliferated from 44 to nearly 500 between 1960 and 1970. Grant programs have denied cities the choice of setting their own priorities and forced them instead to choose among priorities offered by the Federal Government. Furthermore, many Federal programs require matching funds which are unavailable or which the city prefers to use on other programs not federally assisted.

One Federal program which was designed to be responsive to local priorities and to support a multifaceted attack on inner city problems is HUD's Model Cities Program, which President Nixon characterized as "one of the most important existing stepping stones to revenue sharing," and which grew out of a mounting frustration with traditional categorical grants. The Model Cities Program has afforded some of the participating neighborhoods limited but promising opportunity to engage in comprehensive approaches to environmental problems. Low-income housing construction, home rehabilitation, and demolition of dilapidated structures to make room for new housing are assisted in many Model Cities projects. So are recreation and cleanup projects. Rat control programs are funded in about one-third of the model neighborhoods. A cross section of Model Cities activities would show that trash collection services were extended in Gainesville, Ga.; 31 vest-pocket parks were acquired and developed in St. Louis; a lead paint poisoning prevention program was funded in Washington, D.C.; San Juan, P.R., was assisted

in a major sewage treatment connection project; and in the Fresno, Calif., Model Cities neighborhood, a comprehensive cleanup and maintenance campaign was started, encouraging self-help by providing physical and technical assistance, lending tools to residents, and buying garden equipment.

The Model Cities Program, however, suffers from certain restrictions such as the need to negotiate projects with Washington and the requirement that programs be limited to certain neighborhoods. The activities carried out in the past under Model Cities or other auspices could be continued under revenue sharing where recipients have found them useful.

One comparatively new Federal program devised to help local communities identify their problems in an interrelated way and set their priorities for solving them is the comprehensive, action-oriented Neighborhood Environmental Evaluation and Decision System (NEEDS) in the Department of Health, Education, and Welfare's Bureau of Community Environmental Management. NEEDS is designed to help recognize the cause-effect relationship of environmental and social stresses—whether poor air, poor water, noise, crowding, bad housing, or neighborhood instability —on individual health, both physical and mental.

NEEDS conducts physical surveys and household interviews to determine the particular needs of a community. Locally recruited interviewers are trained and sent out to contact the families, conduct the interviews, and seek community participation. Once information is obtained, a computer analysis is developed to produce information leading to solutions tailored to the specific problems and priorities within the target area. The NEEDS program gives the city the on-going capability to analyze both the severity of existing problems and the areas of potential crisis.

A Federal program which has been administered to permit substantial local flexibility in dealing with related inner city problems is the rat control program also sponsored by the Bureau of Community Environmental Management. As implemented in Philadelphia, for instance, the program attempts to answer other needs of inner city families—as well as to eradicate rats. The key to the program in Philadelphia is its 60 health educator aides, all hired by a Citizens Advisory Board, and all residents of the inner city. After being trained in home care and available local, Federal, and charitable services, the aides go door to door in north central, west, and south Philadelphia neighborhoods. Although rat control is the basis for initial contact of neighborhood residents, the aides also determine the range of a family's problems and seek ways to help.

If, for example, the family desperately needs better housing, the health aide will contact the local public housing agency or some other source of assistance. Or the aide will show people how to contact agencies, go to clinics for health care, prepare garbage for collection, or improve their sanitation. The health aide will

bring in housing inspectors to do what is necessary about rat control, such as calling in eradicators or improving basic sanitation. The program recognizes that "solutions" are long range, that basically attitudes must change and people must be motivated to help themselves.

With varied sources of support, several community-based organizations are developing innovative programs aimed at comprehensive environmental improvement in inner city areas. One example is the Watts Labor Community Action Committee (WLCAC) formed in the wake of the 1965 riot. The Committee's original motive was to beautify Watts and to make it a better place to live. Now in its seventh year, WLCAC has expanded from beautification efforts to a program involving recreation, education, job training, community business development, transportation, housing improvement, and youth activities projects. Money has come from Federal and State agencies, labor unions, and the Ford and Rockefeller Foundations. WLCAC's approach is to build the economic power of the community while upgrading and maintaining its environment. The Committee operates seven supermarkets (stocked largely with produce from a WLCAC-run farm and manned by inner city residents), two gas stations, a credit union, a restaurant, a construction company, and a large U.S. Labor Department residential job center with extensive vocational training programs. WLCAC has also established vest-pocket parks and has sponsored recreation and cleanup activities throughout Watts.

Another comprehensive community-based program is the East Harlem Environmental Extension Service in New York City. It offers repair and maintenance services to inner city landlords at prices considerably below market rates. The Extension Service, which developed from a coalition of community and housing groups and a local hospital, is jointly funded by the City and the State. Forty-five environmental extension agents provide maintenance services. The agents—all from the community and trained locally by personnel from a vocational school, the local hospital, and city agencies—talk with and counsel the residents regarding proper home care. The agents begin with minor household repair and follow up with regular supervision, stressing the relationships among health, housing, rats, and other factors. The service workers are trained in carpentry, electrical wiring, plumbing, plastering, rodent control, sanitation, heating repairs, fire prevention, and other general maintenance subjects as well as tenant-landlord relations. A board composed of community people, with representation from a landlord's organization, oversees the service. The program's success is due largely to its integrated approach, including employment, counseling, and intensive training of community workers as part of an effort to build resident trust, win cooperation, and deliver needed services.

conclusions

This chapter has focused largely on the immediate needs and views of the inner city residents. This is appropriate, for the sometimes bitter experience of the past years has taught the lesson that improvements in the daily environment of people must be sought with their help and guidance, not imposed on them by those who claim to know what is best. However, this focus should not obscure the fact that many of the forces that shape the intimate environment of the inner city resident are often beyond his knowledge and control.

The inadequate services provided by city governments generally can be traced to the inadequate tax base which provides the city's revenues. The major source of income for most cities is the property tax, which is often inefficient and inequitable. As the quality of the city environment deteriorates, middle class residents move out, and income from the property tax declines, leading to more deterioration and plunging the city's fiscal base and public services into further decline.

The lack of funds for essential public services is in many cases made worse by limitations on the use of available funds, such as those which come through Federal grants. Welfare reform and revenue sharing will help alleviate the shortage of money and will be particularly helpful to the cities by permitting them to initiate more flexible approaches to solving urban problems. As President Nixon noted in his proposal for a $5 billion general revenue sharing program, Federal aid to States and localities has not provided an effective answer to State and local problems. The purpose of revenue sharing proposals is to set States and localities free to assign their own priorities.

More and more industries have moved to the suburbs for a variety of reasons, and this poses another difficulty for the inner city. It reduces job availability for residents, and city governments are denied tax income. When local governments in suburban areas accommodate new employers but fail to revise land use plans to make room for lower-income employees, they intensify the pressures on the central city.

The experience of the past 10 years in trying to deal with inner city problems has demonstrated the need for an approach that fully takes into account the interrelationship among many varied factors. As the environmental perspective of all citizens matures to embrace greater concern for the quality of life, it is hoped that the plight of the inner city may command—in government and in the private sector—more broadly based efforts of a Nation growing more intent upon improving the life setting for people, wherever they may live.

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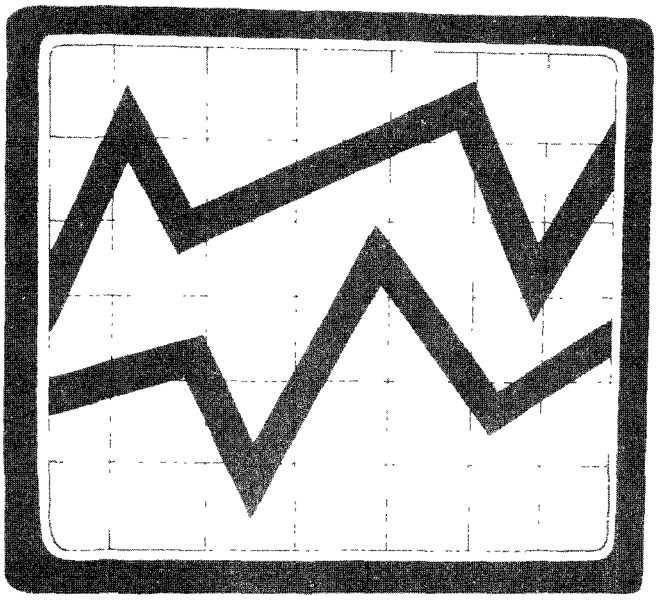


status and trends

Achieving environmental quality is not a revolutionary act, it is evolutionary. Only now are we beginning to marshall the arsenal of data, technology, and concern that leads to change. Many problems exist in making the arsenal adequate to the task.

One of the problems the Council must wrestle with now is stated in its very mandate. The National Environmental Policy Act requires the Council on Environmental Quality "to gather timely and authoritative information concerning the conditions and trends in the quality of the environment," and "to report at least once each year to the President on the state and condition of the environment."

This is an extremely complex and difficult charge to fulfill, because presentation of meaningful data on environmental quality conditions and trends is dependent on several important considerations that are currently satisfied only in part. We lack understanding of environmental phenomena sufficient to permit agreement on all the elements to measure and describe; we lack a comprehensive definition and evaluation of environmental data requirements and priorities; and technology is inadequate to permit collection of some types of data.

the status of monitoring

Monitoring the environment is one of the keys to effective management for environmental quality. One cannot detect environmental changes, desirable or undesirable, natural or man-

made, without established base lines and repeated observations. Such measurements are essential for the identification of environmental needs and the establishment of program priorities, as well as for the evaluation of program effectiveness, and they provide an early warning system for environmental problems which allows corrective action to be taken before the problems become serious.

Recognizing the importance of monitoring to the accomplishment of its responsibilities, shortly after CEQ was created, it contracted for a study on environmental monitoring. This study was the first step in the Council's overall effort to upgrade environmental monitoring, and as such, it reviewed current monitoring efforts and programs; it sought to identify indices and indicators of environmental quality and the data needed to obtain such indices; and it considered alternative methods to obtain and utilize these data. The study was recently completed and the contract report has been circulated to executive agencies for review.

The results of this preliminary study confirm the Council's earlier convictions that to measure status and trends in the environment is an exceedingly complex problem, and that a major effort still remains to be done to identify data requirements.

Because of the variety of types of requirements as well as the variety of definitions or ways of perceiving environmental quality, there is no general agreement on the requirements for or nature of environmental quality indices. The study proposed more than 100 environmental indices to promote the discussion needed to arrive at a generally acceptable set of indices that could be widely used and understood. The large number indicates the complexity of the problem and underlines the need for careful definition of the requirements. The difficulty of determining such requirements and of obtaining data for these indices must not be underestimated. It has taken over 100 years to develop our weather monitoring system. Yet weather is only a small—and a relatively simple—part of the entire array of environmental factors on which information is required.

By next year the choice of appropriate initial environmental indices should be made. It may take several years before a comprehensive set of indices has been determined, and it will take a number of years before truly reliable data can be obtained for all of these indices. Major changes probably will be necessary in such basic matters as selection of monitoring sites, instrumentation, and frequency of samples taken.

CEQ has identified some 56 major monitoring programs in 16 different Federal agencies. Some are quite extensive. For example, approximately 24,000 water quantity (hydrological data) stations and 10,000 water quality (chemical composition) stations operated by local, State or Federal agencies monitor the

Nation's surface waters. The Office of Management and Budget (OMB) estimates that the Federal Government in fiscal year 1971 spent approximately $40 million on pollution monitoring and surveillance activities. This figure does not include extensive pollution monitoring and surveillance activities by State and local governments—part of which are supported by Federal grants to State and local pollution control agencies. Nor does it include activities by industry to monitor its emissions.

In addition, OMB estimates that a total of $810 million was spent in fiscal year 1971 for a variety of other activities to understand, describe, and predict the environment. This includes $343 million for operational activities and $128 million for research and development to observe and predict weather and ocean conditions and disturbances; $74 million for other operational activities; and $124 million for miscellaneous activities such as physical environmental surveys, weather modification research and development, and ecological and other basic environmental research.

The Environmental Protection Agency (EPA) has undertaken a broad study of its environmental data requirements and of its existing monitoring systems. EPA hopes to develop an integrated system to provide data required for pollution control.

The choice of appropriate environmental indices involves many difficult decisions. Apart from the problem of indices, there are problems with many existing monitoring systems themselves: Coverage of systems, both geographically and as to pollutants or parameters measured, is not adequate; sensors are not optimally located; many measurement instruments are not accurate or calibrated so that measurements from one location may not be comparable to another; data collected in various systems often are not comparable; and there are delays in compiling and analyzing data.

All of these difficulties do not lessen the vital need to collect and analyze environmental data. Without valid data we cannot accurately determine the most important problems or the most cost-effective methods of attacking them. Nor can we evaluate the success of efforts to correct problems. Monitoring is not a substitute for action. But in the long run, action without the knowledge provided by adequate monitoring is more likely to be ineffective.

Despite the inadequacies of existing efforts, the Council has attempted to collect and present in this chapter some gauges of environmental quality. This is only one step in an evolving program. The goal is to be able to paint an accurate picture of the status and trends of the Nation's environment. To do that will necessitate deciding upon adequate indicators of environmental quality, determining and evaluating specific data requirements, and improving data collection methods.

This chapter presents data on the traditional pollution problems of air and water pollution, solid waste, radiation, and pesticides. It deals with newer problems, such as toxic substances, and with conservation concerns, such as wildlife. Finally, there are data on factors underlying many of our environmental problems, particularly population and land use.

trends in air pollution

Overall trends in air pollution present a mixed picture. Ambient levels of some of the major pollutants have dropped in urban areas over the past several years. However, estimated nationwide emissions of air pollutants rose in 1969 (see Table 1). (For a more detailed explanation of the tables and figures in this chapter, see the chapter appendix.) The total increase in pollutants by weight, was 3.2 percent above 1968. Air pollution data are not yet available for 1970, and the data we do have often lack the desired degree of reliability.

More of every major pollutant was emitted in 1969. Emissions from fuel combustion in stationary sources, from industrial processes, and from "miscellaneous" sources all increased. The large (18.5 percent) jump under "miscellaneous" was due pri-

Table 1

Estimated Emissions of Air Pollutants by Weight, Nationwide, 1969

(In millions of tons per year)

Source	CO	Particulates	SO_x	HC	NO_x	Total	Percent change 1968–69[1]
Transportation	111.5	0.8	1.1	19.8	11.2	144.4	−1.0
Fuel combustion in stationary sources	1.8	7.2	24.4	.9	10.0	44.3	+2.5
Industrial processes	12.0	14.4	7.5	5.5	.2	39.6	+7.3
Solid waste disposal	7.9	1.4	.2	2.0	.4	11.9	−1.0
Miscellaneous	18.2	11.4	.2	9.2	2.0	41.0	+18.5
Total	**151.4**	**35.2**	**33.4**	**37.4**	**23.8**	**281.2**	**+3.2**
Percent change	**+1.3**	**+10.7**	**+5.7**	**+1.1**	**+4.8**		

[1] Computed by the 1969 method from the difference between 1969 estimates and 1968 estimates. The new method results in higher values for 1968 than those computed by EPA for 1968.

Source: The Mitre Corp. MTR-6013. Based on Environmental Protection Agency data.

marily to the increased number and size of forest fires. The contribution to air pollution from transportation and solid waste disposal declined slightly.

Transportation emissions, primarily from the automobile, generate most of the carbon monoxide. Fuel combustion—the burning of coal and oil—creates the majority of sulfur oxides emissions. Transportation and fuel combustion contribute jointly to emissions of nitrogen oxides.

The greatest single source of air pollution, when measured by pollutant weight, is the automobile. Transportation contributed more pollution than all other sources together, and carbon monoxide alone, primarily from automobiles, outweighed the other four major pollutants combined. However, it is significant that the contribution of transportation sources declined slightly in 1969. We have apparently reached the peak level of automobile pollution, and as older cars are replaced by newer ones with pollution devices, which were first installed in the 1967 models in California and in the 1968 models nationwide, we can expect automobile-related pollution to decline. The 1975 and 1976 emission standards will quicken this decline. But in the long run, if the number of cars on the road continues to increase at the present rate, even the effect of these controls eventually could be negated—unless something else is done.

There are no firm data on the reasons for the slight decline in solid waste emissions. However, it is probably due to a reduction in open burning at municipal dumps.

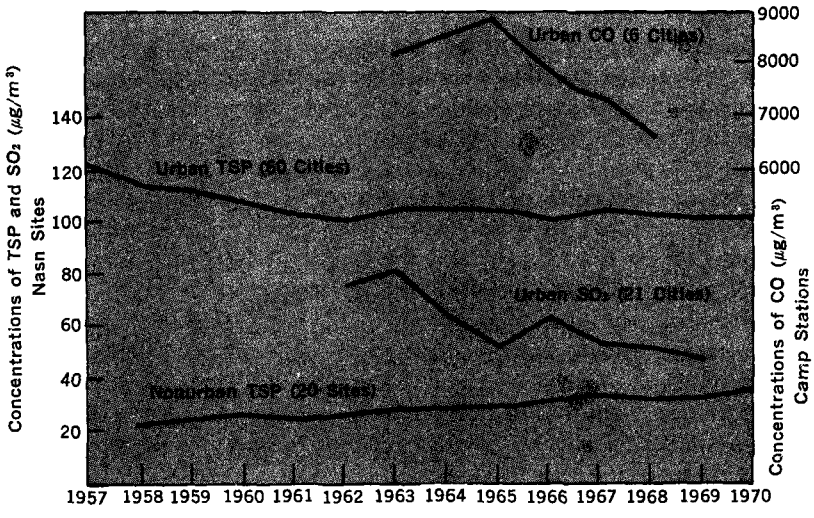
It is somewhat misleading to consider air pollutants in terms of their aggregate weight. We worry about pollutants because of their effects, and, other things being equal, a pound of sulfur oxides is a far more serious threat to health and welfare than a pound of carbon monoxide.

Measuring pollutants by tons emitted also ignores their geographical distribution. We are generally concerned with the concentration of pollutants in a particular place, but measuring total weight of emissions tells us nothing about their concentration. One might expect that the increase in total emissions over the past several years would cause corresponding increases in ambient concentration levels (often referred to as air quality). But, in fact, this has not been the case, as Figure 1 shows. Ambient levels of sulfur dioxide and carbon monoxide have decreased. Levels of particulate matter (TSP—total suspended particulates) have stayed about the same.

The disparity between weight of emissions and ambient levels is due partly to the application of controls in the larger cities where ambient levels are measured. New York City, the State of New Jersey, and other locations have succeeded in lowering emissions of sulfur oxides and particulates through stringent enforcement of standards. Thus the air quality in the urban areas

Figure 1

Trends in Ambient Levels of Selected Air Pollutants



Source: The Mitre Corp. MTR-6013. Based on Environmental Protection Agency data.

has improved, but total weight of emissions has continued to increase outside these areas.

The disparity is also due partly to the method by which ambient levels are measured. The trends in Figure 1 are based on only one sampling station in each city. Thus it is uncertain how well the figures for each city actually represent the air quality in the entire community. The movement of heavy industry to locations outside the central city improves air quality in the city but does not reduce the total amount of pollutants emitted. On the other hand, the figures for total weight of pollutants emitted are based on extrapolations from a variety of data sources and not on actual measurements. Therefore their validity is also uncertain.

The importance of where the monitoring site is located within a particular community cannot be overemphasized. Wide variations in recorded ambient air levels can occur from site to site within the same city, depending on the location of the sites. For example, although EPA's National Air Sampling Network (NASN) sites are generally located in the central city, State and local sites may be closer to major pollutant sources, because such stations are often sited for possible enforcement actions. Thus the NASN data often show much cleaner air conditions than the State and local data.

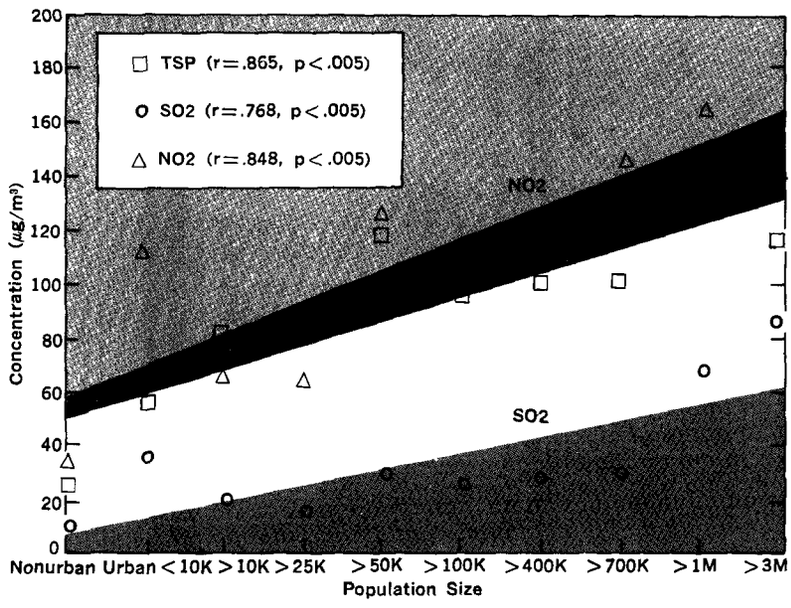
The dispersion of pollutants may create other problems, such as changes in global climate or atmospheric conditions. It has

been hypothesized, for example, that an increase in carbon dioxide levels could raise the global temperature enough to raise the level of the ocean because of melting of the polar icecaps. Measurements at the National Oceanographic and Atmospheric Agency's Mauna Loa Observatory indicate that compared with 1958 through 1968, the rate of increase of atmospheric carbon dioxide nearly doubled during 1969 and 1970. The earlier data point to an average annual increase of 0.7 parts per million. But the recent measurements show that the carbon dioxide content at Mauna Loa has climbed 1.35 parts per million during each of the last 2 years. Scientists now are investigating the reasons for this accelerated rate of change. The complete carbon dioxide cycle must be studied intensely and mathematical models must be developed to simulate the effects of changes in the atmospheric content upon climate.

Figure 1 shows that levels of total suspended particulates are much higher in urban than in nonurban areas. However, the differences seem to be diminishing, perhaps because of greater dispersion of industrial plants and the movement of population out of central cities. Figure 2 shows that the ambient levels of

Figure 2

Relationship of Air Pollution and Population, Second Half 1969—First Half 1970



Source: The Mitre Corp. MTR-6013. Based on Environmental Protection Agency data.

particulates, sulfur dioxide, and nitrogen oxides correlate with population size: the larger the population of the community, the higher the levels of pollution.

Figures 1 and 2 both give values which are aggregated for many communities. However, there are wide variations in levels of air pollution from city to city. The variation can be seen from Table 2, which shows the levels of major air pollutants in six large cities. There are also regional variations in pollution levels because of the type of fuels used and the patterns of population distribution.

Another indicator of variations in pollution levels from city to city and of the problems with using *average* air quality figures

Table 2

Annual Average Levels of Selected Air Pollutants in Selected Cities [1]

Location and pollutant (mg/m³)	1962	1963	1964	1965	1966	1967	1968
Chicago:							
SO_2	282	393	458	341	215	327	307
NO_2	81	77	87	81	105	94	90
CO	[2]NA	9,430	13,915	19,665	14,375	10,120	7,130
Cincinnati:							
SO_2	92	68	100	79	81	55	44
NO_2	56	56	60	66	68	59	60
CO	NA	8,050	7,015	4,600	5,635	6,440	6,440
Denver:							
SO_2	NA	NA	NA	55	29	13	34
NO_2	NA	NA	NA	68	64	70	68
CO	NA	NA	NA	8,280	9,085	8,740	6,210
Philadelphia:							
SO_2	231	181	215	223	238	267	212
NO_2	73	71	71	68	73	81	73
CO	NA	NA	8,165	9,315	7,820	7,245	9,890
St. Louis:							
SO_2	NA	NA	155	123	113	76	73
NO_2	NA	NA	62	64	64	45	43
CO	NA	NA	7,245	7,475	6,670	6,440	5,270
Washington, D.C.:							
SO_2	144	131	126	121	115	126	97
NO_2	56	68	68	66	66	81	68
CO	6,095	7,705	6,555	4,255	3,795	5,635	3,910

[1] Data for 1969 and 1970 not available until December 1971 because of change in computer processing methods.

[2] NA—not available.

Source: The Mitre Corp. MTR-6013. Based on Environmental Protection Agency data.

are so-called "episodes." These are periods when the air pollution in a particular community reaches dangerously high levels. A good example of such an episode occurred in Birmingham, Ala., this year. In previous years, levels of particulate matter, measured in micrograms per cubic meter of air, had averaged 155 during April in Birmingham. From April 15 to 21, 1971, they soared to an average of 372, reaching a peak of 607 during April 19–20. Families living in high exposure areas suffered from increased respiratory irritation symptoms, including cough, burning of throat or chest, and shortness of breath. Calls or visits to physicians were more frequent, and more persons reported restricted activity. Most pollution episodes are due to a combination of high continuous levels of pollution output aggravated by meteorological conditions, particularly inversions, which prevent the pollutants from dispersing.

The data in this section do not provide any easy answer to the question of whether air pollution in the United States is getting better or worse. Overall emissions, measured by weight, are still increasing along with increases in population and production, although the expected reduction in automobile emissions probably will begin to reverse this trend. Ambient air quality levels seem to be generally improving, at least in the places where the sampling stations are located. Most large cities still must make a major effort to reach newly set national air quality standards.

trends in water pollution

The same problems that beset nationwide air pollution figures beset water pollution monitoring. The geographical coverage, the wide variation in local conditions, the assimilative capacity of water bodies, and the interaction of pollutants complicate any attempt to give a picture of the status and trends of water pollution in the United States. Given these difficulties, EPA has relied on statistical extrapolations and on judgments by personnel in the field to arrive at an estimate of the quality of the Nation's water.

The most commonly used measure of the effect of wastes on water quality is 5-day biochemical oxygen demand, referred to as BOD. This is the measure of the amount of oxygen used in 5 days by the biological processes involved in the stabilization of organic matter. Lack of oxygen (produced by high BOD) may make the water unusable for recreation and other purposes. EPA estimates that the BOD of wastes actually discharged into receiving waters in 1968 was only slightly larger than the BOD of wastes discharged in 1957. The total BOD produced—but not necessarily discharged—during this period doubled, due primarily to the great increase in manufacturing activities. But the doubling of the production of wastes was just about canceled by increased waste treatment capacity. ("Production" of BOD is

the amount which would have been discharged if there had not been any treatment.)

Between 1964 and 1968, the increase in BOD produced annually is estimated to have been 8.1 billion pounds. Almost 90 percent, or 7.2 billion pounds, came from increased production. About 12 percent of the increase attributable to industrial production was due to increased demand for products resulting from population growth. The remaining 88 percent was due to increased per capita consumption of goods.

Many other measures of pollution, aside from BOD, are being monitored and are relevant in assessing water quality. For example, BOD does not measure the rate of eutrophication—or aging—of the Nation's lakes and rivers. Nor does it tell the extent to which toxic materials, such as mercury and other heavy metals and pesticides, are entering the water. Nor does it measure the amount of nonbiodegradable chemical wastes polluting the water.

Although the BOD level of wastes actually discharged has remained roughly constant in recent years, the overall quality of the Nation's waters probably has deteriorated because of accelerated eutrophication, increased discharges of toxic materials, greater loads of sediment, and other factors. The increase in these pollutants has been generated by greater use of phosphates in laundry detergents, pesticides and fertilizers in agriculture, chemicals and metals in industrial processes, and increased construction. The Environmental Protection Agency estimates that almost one-third of U.S. stream-miles are characteristically polluted, in the sense that they violate Federal water quality criteria (see Figure 3 and Table 3). Less than 10 percent of U.S. watersheds were characterized by EPA regional offices as unpolluted or even moderately polluted. However, these estimates are quite subjective and are not based on actual monitoring data.

Although the data conflict, it appears that industrial wastes are the largest source of organic water pollution nationwide. Municipal and agricultural wastes are the next two largest sources. However, on the Pacific Coast and in the Plains States, agriculture is the prime cause of water pollution. In the Central States, municipal wastes are the major contributor, and in the Southeast and Northeast, industrial wastes predominate.

Agricultural pollution differs markedly from municipal pollution. Municipal sources discharge a relatively constant addition of pollutants to the Nation's waters. Agricultural pollution from feedlots and crop growing practices send out "slug loads" (large amounts at irregular time intervals) of organic pollutants plus nitrates, sediments, and sediment-associated phosphates which enter water bodies together with rainfall runoff. Irrigation discharges large quantities of nitrates plus millions of tons of other dissolved inorganic salts.

Prevalence of Water Pollution, by Drainage Basin, 1970
Source: Environmental Protection Agency

Data have been collected for several years on the number of fish killed each year by water pollution. These figures generally have shown an increase, from 6 million in 1960 to 15 million in 1968 and 41 million in 1969. However, this increase is accounted for, at least in part, by improved reporting of such kills. Many of the fish killed are "trash fish," such as carp. Because these fish can live in highly polluted waters, massive kills of these species emphasize the severity of the pollution and its impact on the environment.

Another measure of a particular form of water pollution is the number of significant oil spills. The figures for such spills are strongly influenced by changes in reporting requirements. But it is significant that the number of reported spills of over 100 barrels of oil in U.S. waters increased from approximately 67 in 1969 to 92 in 1970. The 1969 spills of over 100 barrels totaled 380,000 barrels of oil. This declined to about 185,000 barrels in 1970. A major part of the difference is traceable to a single spill of 218,000 barrels from the collapse of an onshore storage tank in Seewarren, N.J., in 1969. The dominant influence of very large spills can also be seen by comparing these figures to the 715,000 barrels discharged when the *Torrey Canyon* crashed off the

Table 3

Estimated Prevalence of Water Pollution, by Region, 1970

Region	Percent of stream miles polluted	Percent of watersheds polluted			
		Predominantly polluted [1]	Extensively polluted [2]	Locally polluted [3]	Slightly polluted [4]
Pacific Coast	33.9	14.8	59.3	22.2	3.7
Northern Plains	40.0	37.5	33.3	25.0	4.2
Southern Plains	38.8	27.3	51.5	18.2	6.1
Southeast	23.3	14.3	41.1	16.1	28.6
Central	36.6	23.2	51.8	21.4	3.6
Northeast	43.9	36.1	55.6	5.6	2.8
East of Mississippi River	31.6	23.0	48.7	15.5	12.8
West of Mississippi River	35.5	24.1	47.1	20.7	4.6
United States	32.6	23.7	48.5	17.7	9.9

[1] Predominantly polluted: ≥ 50% of stream miles polluted.
[2] Extensively polluted: 20—49.9% of stream miles polluted.
[3] Locally polluted: 10—19.9% of stream miles polluted.
[4] Slightly polluted: ≤10% of stream miles polluted.
Source: Environmental Protection Agency, Water Quality Office.

English coast in 1967. However, the amount of oil spilled accidentally on a worldwide basis probably accounts for less than 10 percent of all oil introduced directly into the earth's waters. The other 90 percent comes from routine activities of oil tankers, refineries, and gasoline filling stations.

According to the one study conducted recently, dumping wastes in the ocean apparently has declined over the past 2 years in the United States. This study examined ocean dumping (excluding dredge spoils) for the U.S. Pacific Coast. It determined that dumping has decreased sharply from 1 million tons in 1968 to 24,000 tons in 1971. A similar decrease is predicted for the rest of the United States. The decline in ocean dumping seems due to more stringent State and local regulation, particularly by the State of California, and the voluntary cessation of dumping in anticipation of Federal legislation.

radiation

For the general population the most significant amounts of radiation exposure are from natural background sources and medical applications. Background radiation comes from cosmic rays and radioactive material naturally existing in the soil, water, and air as well as within our bodies. The average background level is in the range of 100 to 125 millirems per year. (One millirem equals 1/1,000th of a rem. Rem stands for "roentgen equivalent man" and reflects the amount of radiation absorbed in human tissues and also the quality of the type of radiation.)

The current Federal radiation protection guides call for maximum limits of 500 millirems per year (for whole body exposure) from all manmade sources excluding medical sources for individual members of the general public, and 170 millirems per capita per year for population groups—based upon a suitable sample of those exposed. Keeping exposures as low as practicable below these numerical values is a fundamental aim of radiation protection measures.

Manmade sources of radiation include medical devices and pharmaceuticals, nuclear weapons tests and nuclear power facilities, devices used in industry and science, and radiation-releasing consumer products such as color TV sets and luminous dial watches. The National Academy of Sciences is now conducting an extensive study for the Environmental Protection Agency which will include an analysis of the contribution of various sources to man's total radiation exposure. The study will be completed within the next year.

Environmental radiation levels have declined markedly since the early 1960's because of the moratorium on nuclear weapons tests in the atmosphere (see Figure 4). The peaking in the early

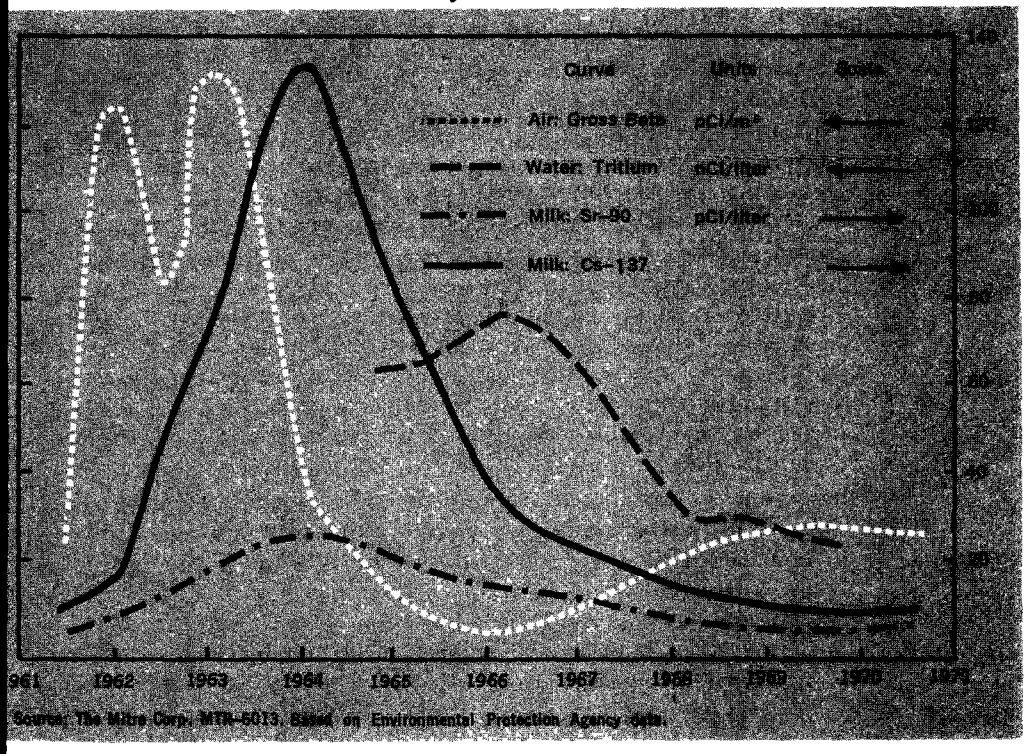
1960's was due largely to an increase in nuclear testing just before the moratorium.

Although nuclear powerplants have increased over the last decade in terms of electrical energy output, their contribution to environmental radiation remains relatively small. A 1969 study of 13 operating powerplants concluded that the annual dose to the total population living within 50 miles of these sites averaged about 0.01 millirems. This compares to a typical additional exposure dose of 2 to 4 millirems for a coast-to-coast airplane flight and is well below 1 percent of both the radiation protection guides and typical natural background exposure. As discussed in Chapter 1, the Atomic Energy Commission has recently proposed new regulations limiting radioactivity in effluents from nuclear powerplants.

The largest source of manmade radiation stems from X-rays and other medical uses of radiation. In 1964 the average annual genetically significant dose from diagnostic medical X-rays was 55 millirems per person. The "genetically significant dose" means the average dose to the sexual organs of persons of child-bearing age. It is generally believed that radiation exposure from medical

Figure 4

Selected Radioactivity Trends



Source: The Mitre Corp. MTR-5013, Based on Environmental Protection Agency data.

sources has increased over the past 7 years because of increased use of X-rays. Estimates for the 1970 genetically significant dose based on such factors as hospital examination rates and X-ray film sales range from 60 to 95 millirems. A better value will be available next year after an extensive HEW field survey of X-ray exposures is completed.

pesticides

Since the publication of Rachel Carson's *Silent Spring* 10 years ago, the use of chemical pesticides has stirred intense controversy and concern. The major concerns fall into three categories: acute toxicity to humans, chronic (or delayed) toxicity to humans, and adverse effects on the natural environment.

An acutely toxic effect is immediate injury to a person who comes in contact with chemicals, either accidentally or in crop harvesting or while applying the chemical without exercising proper caution. Delayed health effects, which have been produced experimentally in laboratory animals, are those such as liver injury, damage to the nervous system, or cancer. In man it may be many years before actual symptoms appear.

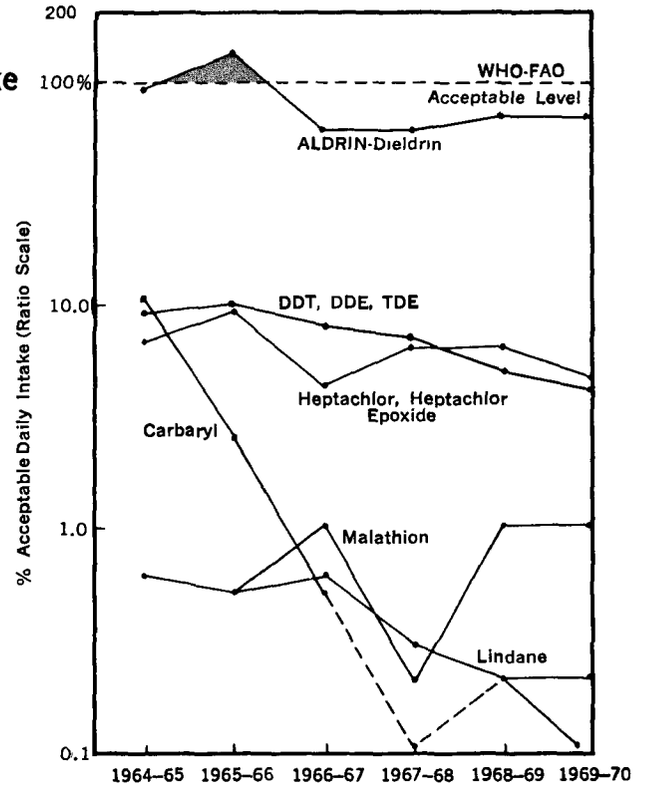
It has been well established that human beings have accumulated pesticide residues in their bodies. The average young American child contains about 5 parts per million DDT. The content in older persons is slightly higher. DDT and other pesticides have been observed to cause measurable changes in body chemistry. However, there is no conclusive evidence that pesticide dosages found in the environment, or even doses several times the normal exposure, lead to any increase in disease or illness.

There is information about the movement of pesticides through the environment and the routes by which man is exposed to particular chemicals, but even these data are scanty. We do not know how much of human exposure to pesticides is via air, water, or food. The amounts of particular pesticides in food are subject to detailed regulation and thus have been fairly carefully monitored. The results of this monitoring are shown in Figure 5. It shows the level of particular pesticides found in a typical diet, as a percentage of the standards established by the World Health Organization. With one exception (aldrin-dieldrin), the dietary intake for each pesticide is well below the allowable standards. This general finding is reinforced by the fact that the foods examined by the Food and Drug Administration (FDA) in recent years have generally contained far less pesticide residue than is allowed by FDA—and now EPA—tolerances.

The principal documented ill effects of pesticides have been on the environment—specifically on birds, shellfish, wildlife, and beneficial insects. Like humans, these creatures can be sickened

Figure 5

Dietary Intake of Selected Pesticide Chemicals



Source: Inner City Fund. Based on U.S. Department of Health, Education, and Welfare, Federal Drug Administration data.

or killed by acute exposure to pesticides. Of 69 bald eagles found dead in 25 States between 1966 and 1968, eight had lethal levels of dieldrin in the brain and another probably died of DDT poisoning. In May 1971, 48 bald eagles were discovered dead in Wyoming. It was determined in the wake of a public outcry that many of the eagles had been killed by thallium, a highly persistent and toxic poison used in animal control.

Less visible, but of greater ecological importance than the deaths of individual creatures, is the impact on whole wildlife populations by chronic environmental exposure to pesticides. This is discussed later in this chapter in the section on wildlife.

U.S. production of pesticides totaled 1,133 million pounds in 1969. Another 6 million pounds was imported, while 409 million pounds was exported, making a net domestic usage of 730 million pounds. This represents a slight decline from previous years.

Pesticides are grouped into classes according to their chemical composition and the type of pest they are designed to control. About half of U.S. pesticides production was insecticides, among them chlorinated hydrocarbons (e.g., DDT, dieldrin, toxaphene,

Mirex), organophosphates (e.g., malathion, parathion), carbamates (e.g., carbaryl), botanicals (e.g., pyrethrins), and inorganics (e.g., lead arsenate).

The three types of pesticides which have caused the most worry in recent years are the chlorinated hydrocarbon and organophosphate insecticides and the phenoxy herbicides. Although the chlorinated hydrocarbon insecticides are low in acute toxicity, they degrade slowly in the environment and are soluble in body fat. Therefore, they persist in the environment and are concentrated by animals and man through the food chain. Low environmental concentrations may be multiplied many times by this phenomenon, resulting in the effects discussed above. The organophosphate insecticides are generally not very persistent. They are, however, much more acutely toxic and more dangerous to formulators, applicators, and persons accidentally ingesting the chemical. They are also more expensive, and because they are nonpersistent require repeated applications to achieve adequate control.

In recent years there has been a trend away from the use of persistent pesticides and toward the substitution of organophosphate chemicals for insect control. There has also been a significant increase in the use of herbicidal chemicals. These trends are partially illustrated in Figure 6, which is based on production of pesticide chemicals. However, the figure does not show the increased use of organophosphates. The data on herbicide use include military use, and thus much of the increased consumption between 1965 and 1968 is from use of 2, 4–D and 2, 4, 5–T in Vietnam. The reasons for the sharp drop in the aldrin-toxaphene group in 1968 are not clear.

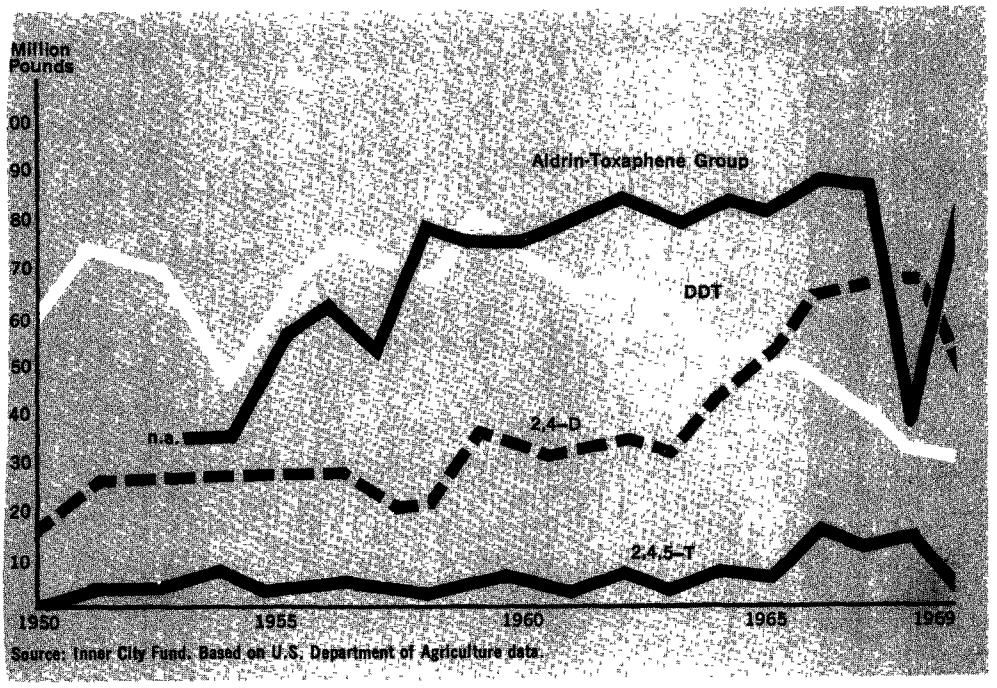
The trend toward using less persistent but more toxic pesticides should eventually alleviate some of the adverse environmental effects which have been caused by pesticides. However, it will probably also result in a higher incidence of accidental poisonings. Several deaths were reported last year in North Carolina as due to exposure to parathion, an organophosphate insecticide used as a substitute for DDT.

toxic substances

Within the past months, increasing concern has surfaced over the problems of metals and small amounts of organic chemicals in the environment. Primary attention has focused on metals—particularly mercury. The increasing consumption of some metals with known toxic properties is shown in Table 4.

High levels of mercury have been reported in both salt and freshwater fish. There is evidence to indicate that the mercury problem may become even more acute and that the levels in fresh water fish will rise over the coming years. There is a great

Figure 6
Domestic Use of Selected Pesticides Estimated from Production Levels, 1950–69



amount of mercury deposited in bottom sediments, and the rate at which these deposits are absorbed by micro-organisms will increase. This is because a larger number of micro-organisms are being produced by the increase in amounts of nutrients entering U.S. waters. Thus more mercury will be available to the fish which feed on the micro-organisms, and in turn, to humans who feed on the fish. Some of the efforts to stem the flow of mercury into the environment have been described in Chapter 1.

Lead, another heavy metal potentially dangerous to health, has been increasing in the environment. A 1971 EPA-supported study found that lead levels in the air have increased significantly over the past 7 years at several locations in Cincinnati, Los Angeles, and Philadelphia. All the sites monitored for lead in these cities showed increases ranging from 2 to 64 percent over the 7-year span. Another study showed lead levels in the air in San Diego, Calif., rising at the rate of 5 percent a year. Another study states that the upper layers of the oceans seem to be polluted with industrial lead and that lead seems to be entering the oceans through rivers at greater rates today than was common in the past. Atmospheric levels of lead may be reaching the point at which widespread adverse health effects are likely, although the

Table 4

Estimated U.S. Consumption of Selected Metals, 1948 and 1968

Metal	Total estimated consumption [1] (in tons)		Percent increase 1948–1968
	1948	1968	
Arsenic (As_2O_3)	24,000	<25,000	<4
Barium (barite)	894,309	1,590,000	78
Beryllium (beryl)	1,438	8,719	507
Cadmium	3,909	6,664	70
Chromium (chromite)	875,033	1,316,000	50
Copper	1,214,000	1,576,000	30
Lead	1,139,895	1,328,790	17
Manganese (ores, 35% or more Mn)	1,538,398	2,228,412	45
Mercury	1,758	2,866	63
Nickel	93,958	159,306	70
Selenium	419	762	82
Silver [2]	3,611	4,983	38
Vanadium	[3] NA	5,495	
Zinc	<1,200,000	1,728,400	44

[1] Includes stocks released to the open market by the Federal Government and imports; does not include exports.
[2] Consumption by industry and arts; monetary consumption not included because much was stockpiled.
[3] Figures not available between 1948 and 1955; consumption in 1948 was about 748 tons, in 1955 about 1,700 tons.

Source: U.S. Department of the Interior, Bureau of Mines.

relationship between atmospheric levels and levels in the blood has not been determined, and the danger posed by current levels of lead in the atmosphere is uncertain.

Overall monitoring of particular toxic substances in the environment requires knowledge of all sources of exposure. Such data have not yet been collected in a systematic fashion. However, steps are underway to build an integrated framework for such monitoring. Also, as our knowledge of heavy metals and other toxic substances expands, new problems will become apparent. For example, it has been suggested that other elements, such as cadmium and arsenic, may concentrate in highly toxic forms in a fashion similar to mercury. The existence of such processes has not been proved, but the possibility illustrates the need for much greater knowledge about the paths of pollutants through the environment.

solid waste

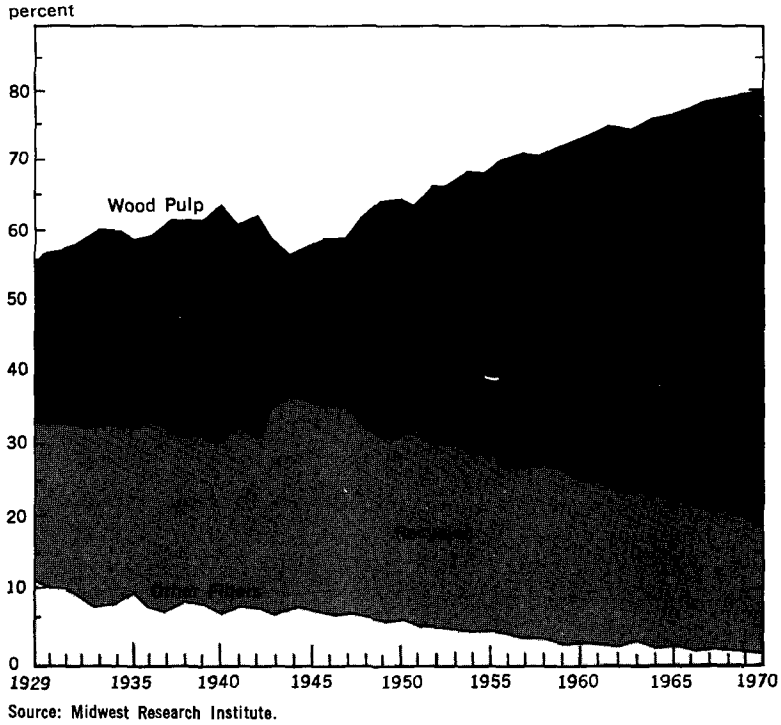
It is generally assumed that the per capita production of solid waste has increased over the past few years. There are few data

to measure this increase—nor are there sufficient data on how adequate the disposal methods are. The figures which do exist relate primarily to the amount of wastes collected. And even these are incomplete and difficult to analyze in a meaningful way. For example, the amount of wastes collected in a community may be increased by outlawing backyard burners. It may be decreased by installing home garbage grinders, although grinders will increase liquid wastes and put greater pressure on the capacity of the community's sewage treatment facilities.

Any truly satisfactory solution to the problems of waste must involve changes in our definition of what "waste" is. We now have the technology to recycle much of the material that is treated as waste and thereby return it to useful purposes. However, market and other incentives in recent years have tended to work against recycling. As a result we reuse less and less as population, per capita consumption, and changes in production processes add increasingly more and more to the amount of material which must be disposed. Figure 7 indicates the steadily decreasing reliance on recycled materials in the manufacture of paper. The trends in many other major industries are similar.

Figure 7

Trends in Composition of Paper



Source: Midwest Research Institute.

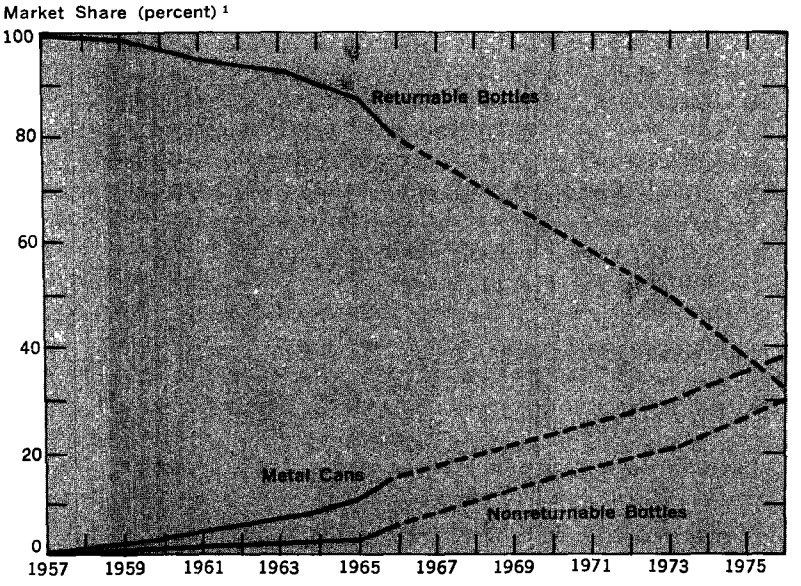
The use of scrap in making aluminum, copper, zinc, and lead increased between 1963 and 1965, reached 40.9 percent of material used in 1965, and then declined to 38.6 percent in 1967, the last year analyzed. Retreaded tires used as a percentage of total tire consumption declined from 27.3 percent in 1958 to 18.5 percent in 1969.

In some industries, the amount of material recycled has stayed generally constant. However, there has been increasing reliance on reusing wastes produced in the factory and thus a decrease in the waste materials purchased. For the past 15 years, scrap has provided about 50 percent of the total material used in iron and steel production. But the percentage of scrap purchased has declined because of greater utilization of factory wastes.

The same trends away from reuse and toward higher per capita consumption can be seen at the consumer level. The consumption of packaging materials has increased from 404 pounds per capita in 1948 to 578 pounds per capita in 1970. It is expected to rise to more than 660 pounds per capita by 1976. Figures 8 and 9 confirm the visual evidence along our highways—that more and more packaging is nonreturnable, and a portion will end up as litter. The projections indicate that this trend will continue for

Figure 8

Soft Drink Containers by Type, 1957–76

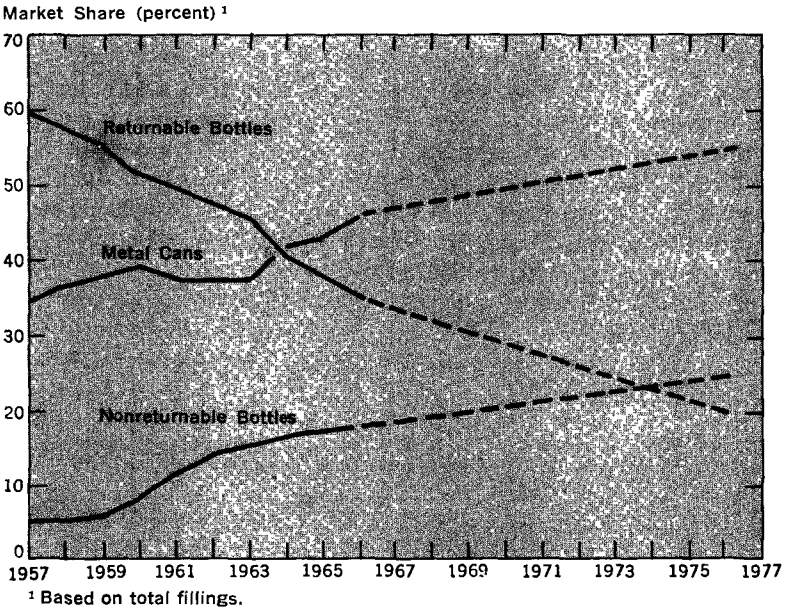


[1] Based on total fillings.

Source: Midwest Research Institute.

Figure 9

Beer Containers by Type, 1957–76



1 Based on total fillings.

Source: Midwest Research Institute

the foreseeable future. But there have been recent efforts to reduce some portion of these wastes by establishing redemption centers from which containers are recycled.

wildlife

All forms of wildlife play some role in the ecosystem, so that their survival, in adequate numbers, may be important to the health and stability of the environment. Removing predators, for example, may result in a population explosion of rodents that the predators formerly helped control. Consequently, the status of the Nation's wildlife is of significance not only for its esthetic, scientific, recreation, or resource values but also for the role it plays in maintaining environmental quality and for what it indicates about that quality.

During the past year there has been increasing recognition of the broader environmental significance of wildlife. In October 1970, the New York State Court of Appeals ruled in favor of the Mason Act (an Act to protect depleted and endangered species of wildlife) on the grounds that it was necessary to protect the animals not only for their esthetic value and for scientific study but for their key ecological role. The court ruled, therefore, that

the protection of these animals is essential for the welfare of society. In June this year at the meetings of the International Whaling Commission, the United States took the position that the status of the world's whale populations is of American concern because of their role in maintaining the health of the marine environment as well as their potential commercial value.

There has been a significant trend toward increased public use of wildlife for nonhunting, noneating purposes—mostly viewing and photographing. The largest area of wildlife habitat on public lands in the country is managed by the Bureau of Land Management, and its visitor use data provide a good indicator of this trend. During the past year there has been more than a 10 percent increase over 1969 in total visitor days, and 88.2 percent of this increase was in visits for nonconsumptive wildlife uses. Hunting visits dropped nearly 2 percent, fishing visits increased 6.4 percent, and nonconsumptive visits increased by 25 percent (Table 5).

Table 5

Use of and Estimated Demand for Bureau of Land Management Lands, 1968–70 and 1980

(In millions of visitor days)

Year	Use			
	Hunting	Fishing	Nonconsumptive	Total
1968	5.2	4.4	....	....
1969	5.7	4.7	6.0	16.4
1970	5.6	5.0	7.9	18.1
1980 estimates:				
Low	7.1	6.2	9.8	23.1
Medium	7.5	8.1	11.3	26.9
High	10.1	9.2	13.5	32.8

Source: Department of the Interior, Bureau of Land Management.

This trend is apparent on other public lands. In America's National Forests big game populations and the hunter visitor days have remained almost static in recent years (Table 6). Sport fishing has shown a similar trend. However, while hunting and fishing use has remained relatively constant, the total use of these lands has increased significantly, indicating again the trend toward increasing nonconsumptive use of wildlife resources.

Traditionally, however, wildlife has been equated with "game." Most use of wildlife, and consequently, most research and management effort, have been associated with harvest. Wildlife provided an important lood source in pioneer times, and sport hunting has been an important recreation activity since then. Today nearly 14 million Americans are hunters of big and small game.

Table 6

Sportsman Use of National Forests, 1966–70 [1]

(In millions of visitor days)

Year	Use		
	Hunting	Fishing	Total
1966	14.1	16.2	30.3
1967	13.1	14.7	27.8
1968	13.2	14.0	27.2
1969	14.0	14.5	28.5
1970	14.1	14.9	29.0

[1] Does not reflect non-consumptive visitor days.

Source: Department of the Interior, Bureau of Land Management.

Fishing is pursued by other millions as a form of recreation, and it also supports a sizable commercial industry. The West Coast and Alaskan shellfish and finfish industries, for example, produce an annual catch valued in excess of $160 million and employ 56,000 people.

The traditional game animals include most of the larger North American mammals—blacktail, whitetail, and mule deer, elk, moose, antelope, caribou, mountain goat, bighorn sheep, wild pigs, and bears. Small game includes squirrels, rabbits, and many furbearers, such as muskrat, raccoon, mink, and fox, which are widely trapped for their pelts. Game birds include ducks, geese, doves, pheasants, pigeons, turkey, quail, grouse, and partridges. In the United States and its adjacent waters, there are about 400 species and subspecies of native mammals and just under 800 species of birds. Consequently, although they receive nearly all the direct research and management attention, the game birds and mammals constitute a very small percentage of the total number of species of American wild birds and mammals.

There is far more information available on the status of game than on nongame species. On a nationwide basis during the past year, the populations of most big game mammals have remained relatively stable, as have most other game species. Exceptions include the mourning dove and the black duck, both of which have been declining in numbers since the 1950's in spite of intensive management.

In most cases data on the status and recent trends of nongame species are relatively poor. Rare and endangered species have received special attention, in part because of the passage of the Endangered Species Conservation Act of 1969. The Bureau of Sport Fisheries and Wildlife published a revised list of endangered native species in October 1970. Compared with the previ-

ous list, five species had been removed but 21 had been added, bringing to 101 the total number of species of birds, mammals, fishes, reptiles, and amphibians on the present list. In the case of mammals, about 17 percent of the total wild species of the United States and surrounding waters are now listed as "rare," "endangered," or "status undetermined." Some mammalogists have estimated that if more complete data were available, about one third of the mammal species of the United States would be on this list.

From the available evidence, it would appear that populations of many—but by no means all—species of nongame wildlife are declining to some degree. The species high on the food chains, particularly the large predatory mammals and birds, appear to be deeply affected. Animal control activities, especially those using poisons, combined with pesticides and other toxic substances in the environment also contribute to the decline. Pesticide residues and other toxic substances are concentrated as they pass up through the food chain. This means that top predators receive particularly high dosages. Either this is lethal in itself or it may affect reproduction by causing a thinning in egg shells of birds. Research in 1970 showed thinning of egg shells in 21 bird species, most of which are fish eaters. Declining populations have been related to this thinning in six or seven species. The nearly total reproductive failure of the Brown Pelican off California and the current decline among Eastern Brown Pelicans has been traced to shell thinning and pesticide residue content. A 1970 survey by Cade and Fyfe (published in the *Canadian Field Naturalist*) of the Peregrine Falcons in North America concluded that the falcon population was continuing its marked decline because of exposure to chlorinated hydrocarbons and that "at the current rate of decline, the peregrine may become extinct in North America in this decade."

The average residue of organic chlorinated compounds in American eagles did not increase in 1970. However, environmental poisons (aldrin, dieldrin, lead, mercury) now rank third as a causal agent in the deaths of these birds.

Animal control activities, particularly those involving the unrestricted use of persistent poisons, pose a serious threat to bird and mammal predators. The eagles poisoned in Wyoming, discussed above under pesticides, illustrate well the nature of this problem.

Habitat changes impact on all wildlife populations. Losses of wetlands, open space, and other environmentally critical areas are discussed below in the section on land use. Drainage programs, channelization, and changes to more intensive agricultural practices continue to reduce or alter wildlife habitat, particularly on the Nation's private lands. Water pollution continues to damage the habitats of fish and some other kinds of

wildlife, and there are increasing numbers of pollution-related fish kills.

Finally, a new and serious threat to wildlife comes from the rapidly increasing use of off-the-road vehicles—large numbers of pickup trucks, four-wheel-drive cars, snowmobiles, dune buggies, motorcycles, trail bikes, and others. The unrestricted use of these vehicles has already seriously altered the fragile desert environments and is affecting all other habitats they touch. They affect wildlife both by tearing up the habitat and by hunting or disturbing it directly. Snowmobiles are particularly destructive to wildlife, because they let their riders chase down and kill, intentionally or otherwise, animals already weakened by winter conditions.

Diversity is an important environmental factor in part because of the stability it gives to ecosystems. As we progressively simplify the ecosystem through such activities as single-crop agriculture, we make our environment more vulnerable to sudden and often disastrous changes. The diversity of wildlife thus serves as a significant component and indicator of environmental quality.

population

Population is a critical environmental factor. Its growth contributes to most other environmental problems. Moreover, the density and distribution of population are intrinsically important in determining the quality of the environment.

The 1970 population of the United States was 204 million. This is double the population in 1920. At the current rate of growth, we will reach 300 million around the year 2008.

The large number of persons now in the child-bearing-age range makes continued population growth all but inevitable. The Commission on Population Growth and the American Future reports:

> Even if immigration from abroad ceased and families had only two children on the average—just enough to replace themselves—our population would continue to grow until the year 2037, when it would be a third larger than it is now.

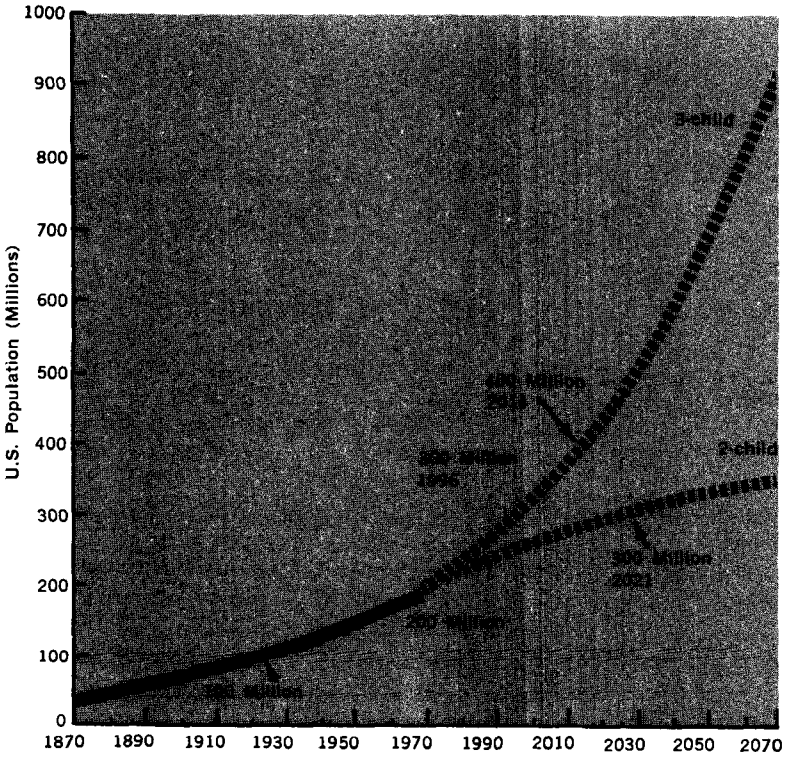
The effects of a three-child family versus a two-child family are shown in Figure 10.

The Commission has also commented on the difficulties of achieving zero population growth now:

> Our past rapid growth has given us so many young couples that they would have to limit their childbearing to an average of only about one child to produce the number of births consistent with immediate zero growth. Ten years from now, the population under 10 years old would be only 43% of what it now is, with disruptive effects on the school system and ultimately on the number of persons entering the labor force. Thereafter, a constant total population could be maintained only if this small generation in turn

Figure 10

Projected U.S. Population: Effects of 3-Child and 2-Child Families



Source: Commission on Population Growth and the American Future.

had two children and their grandchildren had nearly three children on the average. And then the process would again have to reverse, so that the overall effect for many years would be that of an accordion-like mechanism requiring continuous expansion and contraction.

Although stabilization of population at the current levels does not seem possible, there is widespread recognition that population growth is a problem that must be explicitly considered in government planning and policy. It is particularly essential that population growth be considered with respect to its impact on the availability of natural resources. The report of the Commission on Population Growth and the American Future, due next year, should provide a benchmark for further efforts.

land use

The characteristics of land use, whether of the manmade or the natural environment, are an essential part of environmental quality. In themselves they are a major factor in the quality of

our environmental experience. They are also important influences on many other environmental factors ranging from air pollution to the preservation of fish and wildlife.

Two categories of land—wetlands and open space—are under particular pressure from development.

Wetlands are the major food source and habitat for an enormous variety of birds, fish, and other wildlife. At least two-thirds of the world's entire fisheries harvest spends an essential portion of its life cycle in estuarine wetlands or is dependent on species that do. Open space is a critical resource for human enjoyment.

Unfortunately, it is impossible to give an adequate account of trends in these areas. Aggregate data do not show anything more than the general direction of movement. They fail to differentiate among particularly valuable wetland ecosystems and do not express the true losses or gains in animal or plant life as a consequence of destruction or conservation of a particular wetland. The students of a particular animal species may know that the elimination of a relatively few specific areas can eliminate the species. But gross data do not speak to losses of the rare or unique.

Similarly, open space data, even differentiated between recreation lands in urban and nonurban areas, fail to address the problems of convenient access, adequacy of facilities, or proximity to homes. But such data are necessary to indicate the contours of change—whether things are getting better or worse as leisure time, population, and use of outdoor areas increase.

The last comprehensive survey of the Nation's wetlands was conducted in 1955 by the Fish and Wildlife Service of the Department of the Interior. Not only are the figures from the survey now dated, but also it was oriented primarily toward waterfowl productivity and thus may not have covered all wetlands. It reported that 85 percent of the country's wetlands were inland fresh water areas, 5 percent were coastal fresh water areas, and 7 percent were coastal saline areas (see Table 7). The smaller acreage of the coastal wetlands should not obscure the fact that they provide most of the food for marine life. The inland wetlands serve primarily as places for waterfowl to nest and as critical factors in natural flood and drought control.

During the early years when America was first settled, there was an estimated 127 million acres of wetlands. By 1955 an estimated 75 million acres remained, and with each passing year the total acreage of wetlands declines. The two big causes of wetlands loss are drainage of land for agricultural purposes and dredging and filling for housing and other urban development. Between 1959 and 1966, nearly 138,000 acres of wetlands were drained each year for agricultural purposes just in the States of North Dakota, South Dakota, and Minnesota. This loss of wet-

Table 7

Inventory of Wetlands, by Type and by Region, 1955

(In millions of acres)

Region	Inland fresh	Inland saline	Coastal fresh	Coastal saline	Totals	Percent of total
Pacific North	0.3	0.3	<0.05	0.2	0.8	1
Pacific South	.6	1.2	<.05	.2	2.0	3
Central North	3.1	<.05	—	—	3.1	4
Central South	3.2	.1	.4	1.0	4.7	6
Mississippi North	12.0	—	—	—	12.0	16
Mississippi South	15.3	—	3.1	.7	19.1	26
Atlantic North	.8	—	.2	.6	1.7	2
Atlantic South	28.2	<.05	.3	2.6	31.1	42
Total[1]	63.5	1.6	4.0	5.3	74.5	—
Percent of total	85.0	2.0	5.0	7.0	—	100

[1] Totals may not add due to rounding.

Source: U.S. Department of the Interior, Fish and Wildlife Service.

lands, however, has been partially offset by the creation of new wetlands. According to the Department of Agriculture, approximately 239,000 acres of wetlands have been established for improved habitat for wetland wildlife in the United States. However, the wetlands that are created often are ecologically quite different from those lost and may not serve the same ecological functions or provide for the same type of wildlife use.

Gross data indicate that during the period 1954–64, New York and Connecticut lost more than 29 percent and 12 percent, respectively, of their coastal wetlands (see Table 8). An analysis of wetlands destruction resulting in estuarine habitat losses in New York, Florida, and California reveals that more than 200,000 acres valuable as habitat were lost to dredging and filling for various purposes between 1950 and 1969 (see Table 9).

Five hundred and seventy-five million acres of open land was available for public recreation in 1965, when the last comprehensive survey was completed; 447 million acres was Federal land, 45 million acres was State and local public land, and 83 million acres was privately owned.

Acquisitions by the Federal Government of land for National Forests and Parks have grown steadily in recent years: 241,000 acres of open space were acquired in fiscal 1969 through the use of funds from the Land and Water Conservation Fund—com-

Table 8

Loss of Coastal Wetlands, 1954–64

(In thousands of acres)

	1954	1959	1964	Total losses (1954–64)	Percent lost (1954–64)
Maine	96.4	NA	96.4	<0.05	0.1
New Hampshire	9.9	NA	9.8	.1	1.4
Massachusetts	41.6	40.9	40.6	1.0	2.4
Connecticut	17.2	15.9	14.8	2.2	12.8
Rhode Island	2.3	2.2	2.2	.1	5.3
New York	43.2	37.5	30.6	12.6	29.2
New Jersey	257.3	244.3	232.7	24.6	9.6
Delaware	120.1	116.9	115.5	4.6	3.8
Total	588.0	NA	542.6	45.2	7.7

[1] Long Island only.

Source: Inner City Fund. Based on U.S. Department of the Interior, Fish and Wildlife Service data.

Table 9

Loss of Estuarine Habitat to Dredging and Filling in Selected States, by Purpose, 1950-69[1]

Purpose	New York		Florida		California	
	Acres	Percent of total	Acres	Percent of total	Acres	Percent of total
Industrial and commercial	7,695	43	[2]37,181	22	[2]40,738	86
Housing developments	2,146	12	15,750	10	2,261	5
Navigation	4,986	28	6,099	4	1,773	4
Recreation, recreational harbors	1,359	8	----	----	31	----
Sanitary landfill	974	5	----	----	----	----
Roads and airports	740	4	6,103	4	1,802	4
Marsh dike or drain	----	----	103,771	61	419	1
Total	17,900	----	168,904	----	47,082	----

[1] New York, Florida, and California are representative of States experiencing heavy losses to dredge and fill operations.

[2] Includes multifamily private developments.

Source: Department of the Interior, Bureau of Sport Fisheries and Wildlife.

pared with only 33,800 acres in fiscal 1966 (see Table 10). However, this is only a very partial picture of Federal open space activities. Land for recreation and other purposes is acquired by several agencies of the Government under a variety of legal authorities. To some extent these acquisitions may be offset by Federal disposal of lands by a variety of agencies under a large number of separate legal authorities. The total acreage available for public recreation is shown in Table 11.

The enjoyment of open space does not necessarily require public access. Private farming and forestry activities near urban areas often provide scenic beauty and visual relief. Agricultural activities in metropolitan areas often supply sound and visual buffering and even pollution control. Seventeen percent of all farms in the contiguous 48 States are located within metropolitan counties. As farmland located in these areas is urbanized, the countryside withdraws farther from the central city, and the pattern of urban sprawl is re-enforced.

Among cities there is wide variation in the availability of parks. As shown in Table 12, per capita availability of parks in New York, Chicago, and Los Angeles was 4.6, 2.0, and 4.5 acres per 1,000 residents, respectively. Minneapolis and Nashville had

Table 10

Federal Land Acquisition for Outdoor Recreation Financed by Land and Water Conservation Fund, 1966–69

	1966	1967	1968	1969
Federal acquisitions (1,000 acres):				
National Park Service	4.4	52.6	56.2	117.6
Forest Service	29.4	78.4	87.2	162.4
Bureau of Sport Fisheries and Wildlife	—	—	2.6	.8
Total	**33.8**	**131.0**	**146.0**	**280.8**
Total costs (millions of dollars):				
National Park Service	5.5	26.1	19.2	69.3
Forest Service	2.5	13.6	9.2	16.1
Bureau of Sport Fisheries and Wildlife	—	—	1.2	1.2
Total	**8.0**	**39.7**	**29.6**	**86.6**
Costs per acre acquired (dollars per acre):				
National Park Service	1,250	500	342	590
Forest Service	85	173	106	99
Bureau of Sport Fisheries and Wildlife	—	—	462	1,500
Overall	**236**	**304**	**202**	**308**

Source: U.S. Department of Commerce, Bureau of the Census.

Table 11

Public Recreation Areas, by Location and by Level of Government, 1965

(In millions of acres)

	Urban [1]	Nonurban	Total
Federal	36.0	410.7	446.8
State	4.3	35.4	39.7
County	.7	2.3	3.0
Municipal	1.4	.6	2.0
	42.3	449.0	491.3

[1] Within standard metropolitan statistical areas.

Source: U.S. Department of the Interior, Bureau of Outdoor Recreation.

Table 12

Park Acreage in Selected Cities, 1968

City	Population (1,000)	Area (1,000 acres)	Population density per acre	Parks (1,000 acres)	Parks percent of total area	Park acreage per 1,000 residents
New York	8,171	192	42.6	38.0	19.8	4.6
Chicago	3,567	142	25.2	6.9	4.8	2.0
Los Angeles	2,874	296	9.7	11.9	4.0	4.5
Baltimore	924	48	19.3	6.1	12.8	6.2
San Antonio	722	39	18.5	2.9	7.5	5.8
St. Louis	685	116	5.9	2.7	2.3	4.2
Pittsburgh	564	35	16.1	2.4	6.7	4.1
Atlanta	517	87	5.9	2.3	2.7	4.9
Minneapolis	493	34	14.5	5.3	15.7	11.4
Nashville [1]	458	337	1.4	4.9	1.5	11.5
Oakland	391	33	11.6	2.0	6.0	6.2
Tampa	325	54	6.0	1.1	2.1	3.7
Dayton	281	24	11.7	3.1	13.2	10.5
Peoria	138	24	5.7	[2] 6.6	28.1	46.0
Portland	71	14	5.1	.7	4.7	9.8
Averages [3]	1,347	98	13.7	6.8	8.8	9.0

[1] Data for Nashville-Davidson County consolidated government.
[2] Includes acreage owned by the Park District beyond the district boundaries.
[3] Unweighted.

Source: National League of Cities.

more than 11 per 1,000. The parkland to people ratio is remaining constant or rising slightly in a number of cities, partly because of diminishing populations in some central cities.

A number of important developments have taken place in land use over the past year. These have been described in Chapter 2.

conclusions

Although trends in a number of areas are promising, this chapter has not answered the question of whether overall environmental quality is getting better or worse. Probably any answer which could be given would be deceptive, because of the large number of factors that contribute to environmental quality and because these factors often vary independently, some getting better, others worse. However, we have also not provided definitive answers to the many subsidiary questions which could be asked. Is pollution getting worse? Is available open space increasing? And so forth. For these questions there should be answers, but the data are either not available or are not reliable enough to provide definitive answers. Efforts to collect additional data will have to be preceded by better definition and evaluation of requirements. In many cases, improved instrumentation and better understanding of natural phenomena are also necessary so that the measurements made will be meaningful.

A major part of the responsibility for providing an accurate picture of status and trends in the environment rests with the Council. We intend to place major emphasis in the coming year, working with EPA, NOAA, and other agencies, on improving environmental data collection and analysis. By next year the choice of appropriate environmental indices should be made. However, it will take a number of years before truly reliable data can be obtained for all of the indices. Major changes probably will be necessary in such basic matters as selection of monitoring sites, instrumentation, and frequency of samples taken. Implementation of these changes will then take several years.

appendix

explanation of figures and tables

The following explanations are given for those readers interested in more detail on how the figures and tables were derived.

figures

figure 1: trends in ambient levels of selected air pollutants—The values which are plotted in Figure 1 are listed in Table A–1. The TSP and SO_2 data were derived from EPA's National Air Surveillance Network (NASN) sites. These data were chosen because they were the only available

recent data for several pollutants and a number of sites. TSP values prior to 1967 and SO_2 values prior to 1966 have been published. (Ludwig, J. H., Morgan, G. B., and T. B. McMullen 1970. Trends in Urban Air Quality. *EOS,* Transactions, American Geophysical Union 51:468–475.) The remaining values were supplied by EPA personnel. (McMullen, T. B. 1971. Environmental Protection Agency, Division of Atmospheric Surveillance, Cincinnati, Ohio.)

TSP values prior to 1967 were based on the Whittaker-Henderson smoothing formula as applied to the original data. (Spires, R., and H. J. Levin. 1970. Characteristics of Particulate Patterns, 1957–66. U.S. Department of Health, Education and Welfare, Public Health Service, Environmental Health Service, National Air Pollution Control Administration, Raleigh, N.C.) Unfortunately, data were missing for some of the 60 urban and 20 nonurban stations. When this occurred, site values were supplied by averaging the value for the preceding year and the following year. This procedure appeared more desirable than either dropping stations with a missing or incomplete year or averaging the remaining values without regard to the missing sites. Dropping stations would rapidly decrease the number of sites available for analysis, whereas ignoring missing stations might cause spurious "trends" due to the exclusion of stations with relatively high or low values rather than to any real change.

The CO data were derived from EPA's Continuous Air Monitoring Program (CAMP) sites. The values prior to 1967 were derived from published summaries. (U.S. Department of Health, Education and Welfare, Public Health Service, Environmental Health Service, National Air Pollution Control Administration. 1968. Air Quality Data from the National Air Sampling Network. NAPCA Pub. No. APTD 68–9.)

The existing data for various pollutants, years, and sites are extremely plentiful, but there are many changes in sites and pollutants from year to

Table A–1

Mean Annual Values ($\mu g./m.^3$) for TSP, SO_2, and CO

Year	TSP		SO_2	CO
	Urban	Nonurban		
1957	120.5	----	----	----
1958	114.4	22.8	----	----
1959	110.7	25.6	----	----
1960	109.1	26.0	----	----
1961	103.8	25.7	----	----
1962	101.0	26.4	66.4	----
1963	103.6	28.2	69.4	8360
1964	105.6	28.9	55.1	8590
1965	104.7	29.1	45.4	8930
1966	100.7	30.8	55.8	7900
1967	105.2	34.9	49.2	7450
1968	104.9	30.7	45.1	6530
1969	100.6	32.1	42.5	----
1970	101.7	37.2	----	----
Number of sites	60	20	21	6

Source: The Mitre Corp.

year. Currently there are a number of Federal networks and numerous State and local networks. These networks were established for different purposes; consequently, their data may also differ. The NASN urban sites are located in downtown, central city areas. The nonurban sites are generally located in parks. The CAMP sites are located in center-city areas. However, locations of sites for State and local networks vary. Often there are sites downwind of major polluters. It is important to recognize that such differences in site location will result in major differences in reported concentrations. Many of the State and local readings are higher by an order of magnitude than the NASN data used in this report, especially for gaseous pollutants.

figure 2: relationship of air pollution and population, second half 1969–first half 1970—The values plotted in Figure 2 are derived from NASN data for July 1969–June 1970. The two half-years were used to provide the most up-to-date data, because full-year figures for 1970 were not available. The values used in Figure 2 are given in Table A–2. The population class column in Table A–2 represents the end point of the ranges.

figure 3: estimated prevalence of water pollution, by drainage basin, 1970—The data in Figure 3 are the results of an effort by the Federal Water Quality Administration (FWQA, now the Office of Water Quality in EPA) in the summer of 1970 to make the first nationwide assessment of water quality. Field offices in the nine FWQA regions estimated the percentage of stream miles in each of the 233 second order watersheds in the contiguous United States (in addition to Alaska, Hawaii, Puerto Rico, Guam, the Virgin Islands, and American Samoa) that could be said to be polluted. Pollution was defined as a demonstrable and recurrent breach of any of the physical or chemical criteria applying to water bodies, and not merely as violation of regulatory requirements imposed upon waste dischargers. However, it should be stressed that Figure 3 is not based on actual measurements. It

Table A–2

Values for Pollutant Concentration Versus Population Class

Population class	Concentration (μg./m.³)			Number of sites
	TSP	SO_2	NO_2	
Nonurban	25?	10	33	5
Urban <10,000	57	35	116	2
>10,000	81	18	64	2
>25,000	87	14	63	2
>50,000	118	29	127	9
>100,000	95	26	114	37
>400,000	100	28	127	17
>700,000	101	29	146	9
>1,000,000	134	69	163	2
>3,000,000	120	85	153	2
Slope	9.152	6.103	12.109	
Intercept	41.467	.733	44.000	
Correlation coefficient	.865	.768	.848	
T Statistic	4.874	3.392	4.526	
P Value	<.005	<.005	<.005	

Source: The Mitre Corp.

represents simply the best judgement of the professionals in the FWQA regional offices.

figure 4: selected radioactivity trends—For many years, various national and State networks have been monitoring radiation due mostly to the fallout from atmospheric nuclear testing. (See Federal Radiation Council. 1965. Background Material for the Development of Radiation Protection Standards. Report No. 7.) Trends for several of the national networks have been plotted in Figure 4. When many of these data were plotted, the trend curves exhibited many small, more or less random fluctuations. Therefore, a smoothing technique known as "moving averages" was employed. This involved taking values, say A, B, and C, for three successive time periods, finding their average, and plotting it in B's place. The values were then advanced by one to consider B, C, and D, with their average being plotted in C's place, and so on through the list of values. A minor disadvantage of this technique is that two data points, one at either end of the curve, are lost. However, in this report the trends are not appreciably affected. It should also be noted that all the data in this graph are arithmetic averages without regard to population weighting. For example, a given concentration of Cs-137 in milk for New York City is equally important as the same concentration found in milk for Laramie, Wyo. Details of the networks and the graphical procedures are given below.

pasteurized milk network (pmn)—This network, sponsored by the Office of Radiation Programs, EPA, consists of 63 sampling sites. For each site, a monthly composite of weekly samples is analyzed for several radionuclides (K-40, Sr-89, Ba-140, Sr-90, I-131, and Cs-137). For most of the last decade, only the last three nuclides have consistently shown appreciable values.

Monthly network values appear in *Radiological Health Data and Reports* about 4 months after the reporting month. These values were aggregated into quarterly averages, given in Table A-3, which were smoothed by a moving average of order three.

radiation alert network (ran)—Originally known as the Radiation Surveillance Network, this program is administered by the Office of Air Programs, EPA. The nework samples airborne particulates daily at 73 sites for gross beta activity. Monthly network averages also appear in *Radiological Health Data and Reports*, with about a 4-month lag time. The monthly values were aggregated into quarterly averages, which are listed in Table A–4 along with similar quarterly averages of precipitation data gathered by the same network. After the data were smoothed by a moving average technique of order three, they were plotted to give the time profile as in Figure 4.

The double peak in 1962 and 1963 is characteristic of I-131, a shortlived beta emitter. As tempting as it may be to worry about the rise in the RAN data from 1966 on, apparently these data are in the region of poor detectability (or noise region). Moreover, in 1968 there was a change in the way the site data were reported: The significant digits were reduced from three to one. These two factors render any trend speculation at the observed low levels relatively meaningless.

tritium in surface water network—This network (in existence since May 1964) was established by the Public Health Service in cooperation with the Federal Water Pollution Control Administration (now the Office of Water Programs, EPA). Monthly composites of weekly samples are reported in six-month groupings (with about a year's lag time). For this report, semi-annual averages, given in Table A–5, were smoothed with a moving average of order three. The reliability of these data suffers from the small number of stations involved (10 originally, eight later) and the fact that there were many months when two or three sites did not provide a sample.

figure 5: dietary intake of selected pesticide chemicals—The values plotted in Figure 5 are based on the Food and Drug Administration's

Table A-3

Pasteurized Milk Network, Quarterly Values

Quarter	Concentrations (pCi/liter) [1]		
	Sr-90	I-131	Cs-137
1961—1st	6	0	5
2d	8	0	15
3d	8	30	16
4th	9	61	11
1962—1st	8.7	10	11
2d	14.4	19	42
3d	14.8	40	62
4th	15.1	61	62
1963—1st	15.6	10	70
2d	25.9	0	112
3d	28.4	0	147
4th	24.2	--	123
1964—1st	24.8	--	136
2d	28.9	--	133
3d	22.3	--	94
4th	18.8	--	73
1965—1st	19.5	--	79
2d	20.7	--	72
3d	15.3	--	44
4th	14.6	--	35
1966—1st	13.8	--	35
2d	15.2	--	36
3d	12.5	--	25
4th	11.7	--	20
1967—1st	10.8	--	20
2d	10.9	--	20
3d	9.9	--	15
4th	8.8	--	10.3
1968—1st	8.3	--	10
2d	9.7	--	12.3
3d	9.9	--	12.4
4th	8	--	10.2
1969—1st	7.3	--	9.3
2d	8	--	8.3
3d	7.8	--	9
4th	7	--	7.3
1970—1st	6.7	--	6.7
2d	7.7	--	8.3
3d	7.3	--	10.7
4th	7.3	--	7.7

[1] pCi = picocuries = 10^{-12} curies.
curie = unit of activity = 3.7×10^{10} disintegrations per second.

Source: The Mitre Corp.

Table A–4

Radiation Alert Network, Quarterly Values

Quarter	Concentrations	
	RAN (pCi/m³)	Precipitation (nCi/m²) [1]
1961—1st	----	----
2d	0.14	
3d	4.24	34
4th	7.8	123.5
1962—1st	5.96	84.8
2d	3.87	82.3
3d	2.9	69.2
4th	7.3	89.6
1963—1st	6.3	74.4
2d	6.6	102.4
3d	3.1	51.9
4th	1.14	28.3
1964—1st	1.2	24.2
2d	1.69	33.9
3d	.59	17.3
4th	.50	15.7
1965—1st	.24	11.4
2d	.45	17.5
3d	.14	14.7
4th	.10	10
1966—1st	.10	11
2d	.27	24.3
3d	.11	14
4th	.21	13.7
1967—1st	.59	36
2d	.7	16
3d	.82	15.7
4th	1.01	18.3
1968—1st	.97	10.3
2d	1.12	53
3d	1.3	27.7
4th	1.3	20.3
1969—1st	1	13.7
2d	1	20.3
3d	2	16
4th	1	6.3
1970—1st	1	6
2d	1	10
3d	1.7	8.7
4th	.7	7.3

[1] nCi = nanocuries = 10^{-9} curies.

Source: The Mitre Corp.

Market Basket Survey (also known as the Total Diet Study). The Survey collects food samples from retail grocery stores six times a year in each of five geographic areas. The samples are collected from communities of varying size. The food is prepared for consumption and then analyzed.

The results obtained from this network are published periodically in the *Pesticides Monitoring Journal*. The latest results, covering through June 30, 1969, will appear in the September 1971 issue of the Journal. (Duggan, R. E., et al. Pesticide Residue Levels in Foods in the U.S from July 1, 1963, to June 30, 1969.) The values plotted in Figure 5 and the figures on which they are based are given in Table A–6.

figure 6: domestic use of selected pesticides estimated from production levels, 1950–69—No nationwide figures are collected routinely on use of pesticide chemicals. Figure 6 is an attempt to approximate use for selected pesticides by taking the amount of a particular chemical produced in a given year, subtracting the net amount added to producers' inventories (or adding the amount lost from such inventories, if a net loss occurred), and subtracting the amount of exports The data for the figure were obtained from U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service. The Pesticide Review [1963–70] and The Pesticide Situation for [1963–70] (issued annually) The values plotted in Figure 6 are given in Table A–7.

figure 7: trends in composition of paper—The figure is from Midwest Research Institute. 1970. Economics of Salvage Markets for Commodities Entering the Solid Waste Stream. Report to U S. Department of Health, Education, and Welfare. Bureau of Solid Waste Management (now in EPA) (unpublished)

Table A–5

Tritium in Surface Water Network, Half Year Values

Half year period	Tritium concentrations (nCi/liter)
1964	3.67
	2.98
1965	2.74
	3.30
1966	4.65
	3.76
1967	2.31
	1.85
1968	1.69
	81
1969	2.35
	81
1970	66

Source: The Mitre Corp.

Table A-6

Dietary Intake of Selected Pesticides

Compound	FAO/WHO acceptable daily level mg./kg.	1964-65			1965-66			1966-67			1967-68			1968-69			1969-70		
		Daily mg.	Intake mg./kg.	Percent accept. intake*	Daily mg.	Intake mg./kg.	Percent accept. intake*	Daily mg.	Intake mg./kg.	Percent accept. intake*	Daily mg.	Intake mg./kg.	Percent accept. intake*	Daily mg.	Intake mg./kg.	Percent accept. intake*	Daily mg.	Intake mg./kg.	Percent accept. intake*
Aldrin	.001	.001			.002			.001			T			T			T		
Dieldrin	.005	.005			.007			.004			.004			.005			.006		
Total	**.0001**	**.00009**		**90.0**	**.00013**		**110**	**.00005**		**60.0**	**.00006**		**60.0**	**.00007**		**70.0**	**.00007**		**70.0**
Carbaryl	.02	.150	.0021	10.5	.026	.0006	2.50	.007	.0001	.500	—	—	0	.003	.00004	.200	—	—	0
DDT		.031			.041			.020			.019			.016			.015		
DDE		.018			.028			.017			.015			.011			.010		
TDE		.013			.018			.013			.011			.005			.004		
Total	**.01**	**.0002**		**9.00**	**.0010**		**10.0**	**.0008**		**8.00**	**.0007**		**7.00**	**.0005**		**5.00**	**.0004**		**4.00**
Lindane	.0125	.004	.00007	560	.004	.00006	4.80	.005	.00007	560	.003	.00004	320	.001	.00002	160	.001	.00002	160
Heptachlor		.001			—			.001			<.001			<.001			<.001		
Heptachlor epoxide	.002				.003			.001			.002			.002			.001		
Total	**.0005**	**.0002**	**.00003**	**5.60**	—	**.00005**	**10.0**	—	**.00007**	**14.20**	—	**.00001**	**6.20**	—	**.00001**	**6.20**	—	**.00001**	**4.20**
Malathion	.02	—	—	0	.009	.001	500	.010	.0002	1.00	.003	.00004	.200	.012	.0002	1.00	.003	.0002	1.00

mg./kg. = mg. daily intake ÷ 63.1 kg. (average weight of 16 to 19-year-old male).

* Percent accept. intake = [mg./kg. (actual) ÷ mg./kg. (FAO-WHO)] × 100.

Source: Inter City Fund.

figure 8: soft drink containers by type, 1957–76—Figures 8 and 9 are taken from Darnay, A., and W. E. Franklin, 1969. The Role of Packaging in Solid Waste Management 1966 to 1976. Public Health Service Pub. No. 1855. Figure 8 appears on page 43 of the report, Figure 9 on page 45.

In both figures, the 1957–66 data are from industry sources. The 1967–76 projections were developed by Darnay and Franklin.

figure 9: beer containers by type, 1957–76—See Figure 8.

figure 10: projected U.S. population: effects of 3-child and 2-child families—Figure 10 is from page 10 of An Interim Report from the Commission on Population Growth and the American Future. The 1890 to 2020 values are based on U.S. Bureau of the Census figures. Beyond 2020, values are based on projections made by the Commission.

tables

table 1: estimated emissions of air pollutants, by weight, nationwide, 1969—The 1969 estimated emissions in Table 1 are EPA data based on a revised computation procedure which includes additional sources, improved emission factors, and better information on control technology. The most significant changes are:

(1) Motor vehicle emissions are now estimated by a new test cycle, which results in much higher emission values for carbon monoxide.

(2) Aircraft emissions are now estimated for cruise altitudes as well as below 3,500 feet.

Table A-7

Values for Domestic Use of Selected Pesticides [1]

(In thousands of pounds)

Year	Aldrin-toxaphene group [2]	DDT	2,4-D	2,4,5-T
1950	NA	57,638	17,609	1,261
1951	NA	72,688	23,494	2,822
1952	NA	70,074	25,298	2,937
1953	38,050	62,500	26,634	4,645
1954	35,420	45,117	27,251	2,906
1955	54,400	61,800	28,000	2,500
1956	61,670	75,000	28,000	4,000
1957	52,500	71,000	20,500	1,800
1958	78,634	66,700	21,300	3,800
1959	73,331	78,682	34,102	6,508
1960	75,766	70,146	31,131	5,859
1961	78,280	64,068	31,067	5,444
1962	82,126	67,245	35,903	8,102
1963	79,275	61,165	33,199	7,179
1964	83,151	50,142	43,986	8,912
1965	80,568	52,986	50,835	7,244
1966	85,646	49,503	63,903	17,080
1967	86,283	40,257	58,955	15,381
1968	39,710	32,758	59,404	16,804
1969	49,721	30,255	49,526	3,218

[1] Production less exports +- net change in stocks; producers' level only.
[2] Includes aldrin, chlordane, dieldrin, endrin, heptachlor, and toxaphene.

Source: U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service.

The percentage increase of 1969 over 1968 was based on a recomputation of the 1968 figures using the new method.

table 2: annual average levels of selected air pollutants in selected cities—The values in Table 2 are from the Continuous Air Monitoring Program (CAMP) network operated by EPA. The network consists of one site located in the downtown area of each of six major cities. Measurements for each of six major pollutants (SO_2, NO, NO_2, CO, total hydrocarbons, and total oxidants) are taken every 5 minutes. The values given in the table are the annual averages based on these figures.

table 3: estimated prevalence of water pollution, by region, 1970—Table 3 is based on the the same FWQA survey discussed above under Figure 3.

Column 1 gives the region. Column 2 gives the total percentage of stream miles polluted within the region. Columns 3 to 6 classify the drainage basins within the region according to the percentage of basins suffering from given degrees of pollution. For example, the first value under column 3 shows that 14.8 percent of the basins within the Pacific Coast region have 50 percent or more of their stream miles polluted.

table 4: estimated U.S. consumption of selected metals, 1948 and 1968—This table also appeared on page 2 of the 1971 CEQ report, Toxic Substances.

table 5: use of and estimated demand for bureau of land management lands, 1968–70 and 1980—The nonconsumptive use projections are estimates based on the combined hunting and fishing increase projections. The low 1980 estimates for hunting and fishing are based on a projection of the existing ratio of public domain use to license sales, which for hunting was 2.3 visitor days per license and for fishing was 0.9 visitor days per license. The medium estimates are based on a projection of the 1968–70 increase in visitor days, and the high estimates on the 1964–70 increase. A visitor day for hunting, for example, is the equivalent of 1 person hunting for 12 hours or 12 persons hunting for 1 hour.

table 6: sportsman use of national forests—The term visitor day is used in the same way as in Table 5. The 1967 decrease in fishing is the result of a new inventorying system and thus reflects improved data rather than a decrease in use.

table 7: inventory of wetlands, by type and by region, 1955—The areas included in the regions in Table 7 are shown on the map below.

table 8: loss of coastal wetlands, 1954–64—The definition of coastal wetlands used in the report on which this table was based is approximately equivalent to the coastal saline and fresh saline categories in Table 7. The States included in Table 8 are covered in the Atlantic North region of Table 7, but Atlantic North also includes Maryland and all of New York.

table 9: federal land acquisition for outdoor recreation financed by land and water conservation fund, 1966–69—The 1968 acreage figures and the 1969 cost figures under National Park Service include acquisition of land by the Bureau of Outdoor Recreation for Redwoods National Park. It should be noted that acquisitions under the Land and Water Conservation Fund are only a portion of total Federal acquisitions for recreation purposes. However, data are not available on total acquisitions.

table 10: public recreation areas, by location and by level of government, 1965—The figures in Table 10 are based on unpublished 1965 inventory conducted by the Bureau of Outdoor Recreation.

table 11: park acreage in selected cities, 1968—With respect to the last column in the table, it may be noted that the National Recreation and Parks Association recommends a standard of 10 acres of subregional (easily accessible) park acreage per 1,000 residents.

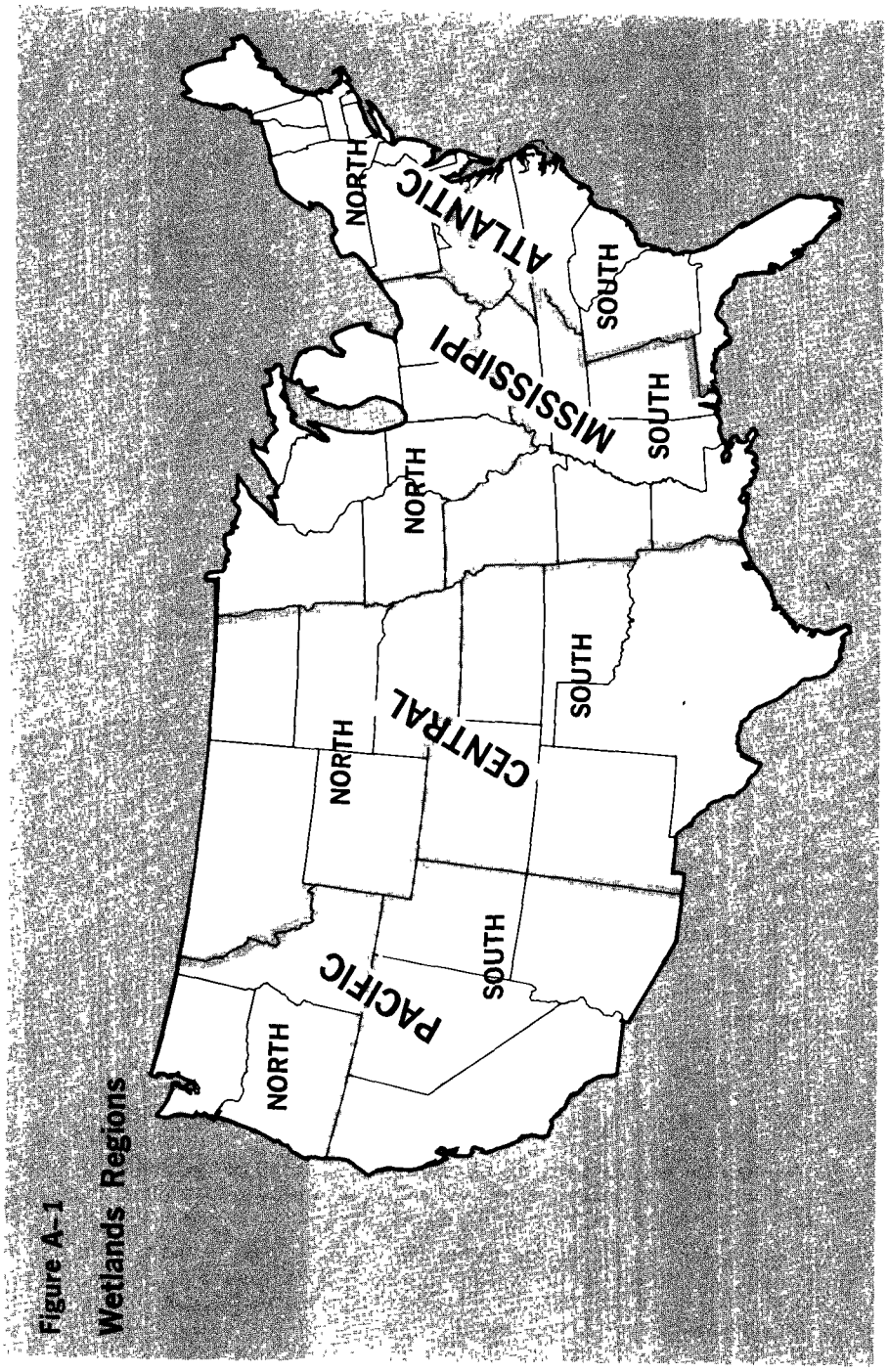
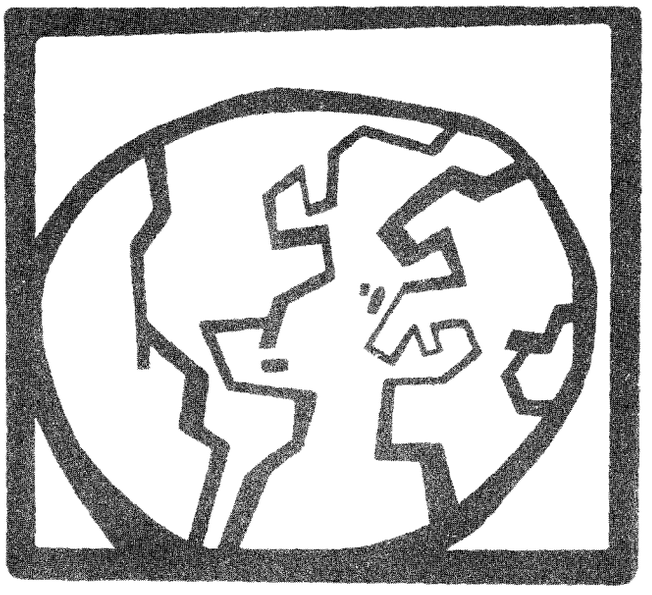


Figure A–1
Wetlands Regions

8



the environment, 1971—a perspective

Environment as an issue is in the process of maturing. The scattered concerns of a few years ago over air and water pollution, pesticides, and highways, and localized problems such as the Florida Jetport and the Santa Barbara oil spill are now coalescing into a broader understanding of the relationship of the environment to man's total well-being and to the quality of life. With this growing understanding has also emerged a greater appreciation of just how complex and multifaceted the problems are. Those who thought that the task of achieving environmental quality could be accomplished overnight either have learned better or lost interest. But the challenge of achieving a higher quality of life has become part of the American vision. And the goal of achieving environmental quality is becoming an integral part of our institutions and our values.

The changes being shaped by the drive to achieve environmental quality are visible in a wide variety of areas. Governmental institutions, the law, and the economy have all begun to adjust to a new set of goals. The "rules of the game" by which society makes decisions are shifting to take environmental factors into account. The methods by which environmental goals are to be achieved have also shifted as we learn more about regulations and incentives and about the uses and abuses of technology.

changes in government institutions

Institutional changes are one sign of an issue's growth in importance and public recognition. As an issue is perceived in its entirety, rather than by its components, a need exists to reflect this change in organization. In the past, when new problems were perceived as discrete policy issues rather than as subparts of other goals, new departments and agencies were created. This process is evident in the reorganization proposals recently submitted to the Congress by the President.

The same process has also been true of environmental quality. Air and water pollution control programs were once the stepchild of health agencies. Solid waste management had no larger image than the local garbage collector and the city dump. Pesticides were considered part of agricultural activity, while radiation was dealt with in the overall context of atomic energy. Increasing noise and the spread of toxic substances through the environment were generally ignored since no agency was responsible. The nature of many of the problems of improper land use, especially in critical areas, was largely unrecognized.

As the public and responsible officials began to perceive the totality of the environment and the interrelationships of pollutants in all media—air, water, and land—they also saw the need for organizational change. Major changes occurred in 1970 with the creation, early in the year, of the Council on Environmental Quality and, at the end of the year, of the Environmental Protection Agency.

The Environmental Protection Agency has a larger budget than some of the existing Cabinet departments. The Council on Environmental Quality is located within the Executive Office of the President which gives it vital leverage in the policymaking process. The National Oceanic and Atmospheric Administration (NOAA) consolidates oceanographic and atmospheric monitoring and forecasting programs conducted previously in a number of agencies. Early in 1971, the President proposed creation of a Department of Natural Resources to complete reorganization of environmental and natural resource activities, and to unify Federal energy and land management programs. The new department would include NOAA.

Similar organizational changes have taken place at the State level. New York's Department of Environmental Conservation, Washington's Department of Ecology, the institutions established by the Illinois Environmental Protection Act of 1970, as well as developments in several other States represent innovative approaches to unifying environmental programs.

The new unification of environmental programs should lead to more than mere administrative tidiness. Form and substance are intertwined. Bringing together programs previously

viewed as discrete entities enables administrators to consider the interrelationships and priorities within environmental activities and to act accordingly. By looking at the total burden of pollutants on the environment, and not only in media packages of air, water and land pollutants, unification provides a basis for different strategies aimed at controlling pollution throughout their distribution in the environment—from extraction, through production, distribution, use, and final disposal.

Unification also permits an intensity of concentration on a problem not otherwise possible. When air or water pollution programs were merely part of health or conservation departments, the department head could focus on them only momentarily among many other matters. In a unified agency, the full time of management can be concentrated on environmental protection. Institutionalizing responsibility for environmental quality through creation of unified organization provides the vehicle for a sustained and vigorous commitment to improvement in the quality of life.

Just as the United States has moved to organize its institutions for more effective environmental management. other nations such as Canada, France, Germany, Great Britain, and Japan have taken steps to establish central authority for environmental matters. This development has had international significance in facilitating more effective cooperation among nations.

Governmental changes have not been limited to unifying programs. The geographic scope of environmental efforts has expanded to include other nations. And at the State level there have been a number of organizational innovations aside from unification.

Action has begun on the international level to deal with problems, such as marine pollution, which require joint efforts with other countries. The United States and Canada are developing a bold program for dealing with the pollution of the Great Lakes. A number of efforts have been initiated to meet environmental problems through the NATO Committee on the Challenges of Modern Society and through the Organization for Economic Cooperation and Development. Active preparation is underway for the U.N. Conference on the Human Environment to be held in Stockholm in 1972.

One of the unsolved problems in environmental organization is how to reconcile the regional scope of many environmental problems with existing political boundaries. Action at the State level is coming to grips with this difficulty. Maryland has established a public corporation, the Maryland Environmental Service (MES), which is empowered to contract with municipalities or industries to build and operate solid and liquid waste treatment and disposal services and to install or operate abatement facilities when a municipality, firm, or individual fails to comply with

a pollution control enforcement order. Along with somewhat similar arrangements in New York and Ohio, MES provides a sound mechanism for regional solutions to pollution problems. Vermont has instituted statewide controls over land use, and a number of other States have begun to exercise control over particular types of land use such as use of wetlands and siting of powerplants, public facilities, and housing developments. And throughout the Nation there have been developed new organizational and legal methods to give private citizens the right to participate directly in improving environmental quality.

changes in the law

Another basic American institution—the law—is also changing to provide greater protection of the environment. This development has been most vividly demonstrated by enactment of the National Environmental Policy Act (NEPA), in which Congress declared "that it is the continuing policy of the Federal Government . . . to create and maintain conditions under which man and nature can exist in productive harmony" (sec. 101(a)). New Federal and State environmental regulatory laws and court interpretations of other statutes have recognized the private citizen's interest in his environmental condition by empowering the individual citizen to sue to prevent environmental damage and to force government to act in accordance with the new environmental policies.

The new environmental rights have also placed new obligations on citizens. If these rights are not to atrophy they must be responsibly exercised. The success of certain new governmental procedures, such as the environmental impact statement process of NEPA, depends heavily on citizen participation. If NEPA is to have maximum effect, an alert citizenry must be prepared to invest the time and effort in helping to make it work.

Chapter 3 describes a wide variety of successful environmental activities carried out by private citizens, ranging from the purchase of environmentally valuable land to the prosecution of lawsuits and from rewriting a State's air pollution control laws to promoting antilitter campaigns.

The vital role played by citizens must be joined with effective governmental efforts if we are to achieve effective control of pollution and other environmental threats. The pervasiveness of sources of environmental degradation, the wide scope of government activities that impact on the environment, the inherent limitations of the courts, which can only deal piecemeal with highly complex environmental issues—all require that government develop systematic approaches to achieving compliance, particularly approaches which rely on the use of market incen-

tives. These factors also require government to build environmental quality considerations into the major actions it takes. Only government possesses the resources and legal power to insure uniform and systematic compliance with environmental standards. Actions by government to build environmental considerations into its basic decisionmaking mechanisms are being stimulated by outside groups. The new legal authorities and court interpretations which provide authority for citizens to act as their own "environmental ombudsman" are a powerful impetus to the improvement of government's performance.

changes in the economy

A basic factor in the achievement of our environmental goals is economics. Much is said about the cost of environmental improvement; weight also must be given to the cost of continued environmental degradation. The annual cost of air pollution alone is roughly estimated at about $16 billion.

The industrial community has already made a sizable investment in pollution control equipment, and the amount of such investments is increasing. The cooperation of private industry will continue to be a necessary part of any solution to environmental problems. However, such cooperation must be backed up by governmental regulation, especially by charges and taxes, because in a competitive economy, compliance by an individual firm always presents the possible danger of putting that firm at a disadvantage with firms which have not made the necessary environmental control investments.

The costs of meeting air and water quality standards and providing solid waste disposal over the 1970 to 1975 period have been estimated at about $105 billion. The costs of meeting air and water quality standards—the areas in which the largest increases will occur—is estimated at $62 billion. Of that amount, 42 percent is public costs—paid by taxes and service charges—and 58 percent will be costs to industry. But in either case, the costs will ultimately be shared by all the American people—either as taxpayers or as consumers. These cost estimates are not comprehensive and are clearly tentative. They are presented in this report to stimulate further discussion and analysis on the costs of achieving environmental quality. They are most likely understated—probably significantly so. Ongoing governmental and private studies will provide the basis for improved estimates of total costs.

The costs of pollution control seem large in the aggregate but not nearly as significant when compared to such measures of economic activity as the gross national product, value of shipments by industries, or even total capital spending. However,

costs will be large for a few industries and for some individual firms.

Pollution control can be seen as an opportunity as well as a problem. It will provide new markets here and abroad for U.S. control equipment and engineering competence as other nations begin to upgrade their environmental standards.

Transitional problems will occur. Some industries, although probably very few, will have greater difficulties with competition in international markets. Some industries and firms will suffer domestic competitive disadvantages. Some marginal plants will be abandoned for newer, more efficient and less polluting technology. And individual workers at such plants may suffer from the transition. Although in most cases these adjustments are not expected to be great and are not dissimilar to other adjustments constantly being made by U.S. industry, it is important to evaluate what measures might be necessary to ease the transition.

In considering strategies to deal with possible transitional problems, it is important to keep in mind the general principle that the cost of preventing environmental damage from the manufacture or use of a product should be reflected in the price of the product. This principle is important if we are both to accomplish improvements efficiently and to place the costs equitably on the producers and users of polluting products.

It is also of vital importance that the costs of environmental improvements be considered in the context of the benefits to be gained and that the most cost-effective solutions to environmental problems are utilized. The costs of pollution control rise steeply as higher levels of abatement are attained, and thus the benefits to be achieved must be carefully weighed. Also, there may be great differences in costs depending upon the type of control strategy adopted. The use of economic incentives provides a promising method for achieving environmental goals in the most efficient manner.

regulations and incentives

There has been much discussion about the use of economic incentives as an alternative or a supplement to current regulatory authorities. Some have proposed tax writeoffs or other assistance to industry as a spur to pollution control. But unless the level of assistance is extremely high, it will offer no incentive for industry to invest in "nonproductive" pollution control facilities. Nor will it lead to investment by marginal firms which often cannot afford the additional costs of control facilities.

Others have proposed a pollution charge on the amount of effluents or emissions damaging the environment. Such a charge would provide a positive incentive to industry to reduce its pollution. It would lessen the burden on government by allow-

ing industries to adjust to pollution controls in the most efficient manner, and it would reduce the delays inherent in regulatory procedures.

The differences and shortcomings of both the regulatory process and economic incentives can be overcome by using them to supplement each other rather than as alternatives. The basic aspects of regulatory authority—standard-setting and backup enforcement—can be preserved while the automatic enforcing aspects of the pollution charge can provide a strong economic incentive to achieve the standards. In those areas where higher levels of purity are required than the charge can stimulate, backup enforcement authority would provide the necessary muscle to achieve compliance.

The Administration has adopted this strategy in proposals under development for a tax on lead in gasoline and a sulfur oxides emissions charge. These proposals, which supplement existing regulatory authority, demonstrate how both regulatory authority and economic incentives can be used together to achieve environmental objectives.

Such economic incentives are consistent with the principle that the polluter should pay the cost of operating in a way that avoids or minimizes environmental damage. This principle is akin to the legal principle, embodied in the common law of nuisance: that no person has a right to use his property in a manner that unreasonably interferes with another's right to use and enjoy his own property, or that interferes with general public rights involving such resources as air or water.

Except in cases in which process changes and other actions to control pollution are accompanied by greater production efficiencies, the inclusion of the costs of preventing environmental damage in the costs of manufacturing goods will result in some higher costs to the consumer. There is no way, short of unwarranted price controls, that the government can force the manufacturer to absorb these costs entirely. The government does not control the price of goods, and therefore manufacturers will pass on to consumers the costs of producing the goods, including the costs of environmental protection. Thus, in most cases, the citizen will pay the costs of such improvement, either as a consumer or as a taxpayer. But when he pays a higher price for goods because the price reflects the cost of pollution control, it can be said that he is really paying the fair price, because a product is underpriced if it does not include the costs of environmental control.

the development and assessment of technology

A development similar to including environmental costs in the price of goods has been the move to shift the burden of

proof of showing lack of adverse environmental impact with respect to new products or new sources of pollution from the public to the private sector. In the past, the prevailing assumption has been that air, water, or land resources could be used as a dumping ground for wastes until the government proved that a given discharge or disposal was harmful. Increasingly this assumption is being reversed—it is up to the manufacturer to show that the wastes or his product will not be harmful before society will allow him to introduce it into the environment. Two of the President's new environmental legislative proposals—The Toxic Substances Control Act and the Marine Protection Act—are based on this principle. The concept must be implemented carefully so as not to thwart technological innovation, and we must also keep in mind the impossibility of conclusively proving that a product is safe. However, the change in the burden of proof reflects the increased recognition of the public's environmental rights and also the need for an increased emphasis on adequate assessment of changing technology.

As the pace of technological innovation has steadily accelerated, so has the need to assess its full impact. New technology changes many aspects of society in significant but often unrecognized ways. If we are not to become victims of our own inventions, we must not only assess the impact of technologies but also exert sufficient control to minimize or avoid their adverse impacts.

Technology assessment is not a new practice. It has been applied for years in our food, drug, and pesticide control laws. Existing air and water pollution control laws are based in part on a recognition of the adverse side-effects of technology. However, we have come to recognize the need for two important elements in technology assessment.

First, such assessment must take place *before* a new technology is widely dispersed. The air and water pollution laws represent after-the-fact recognition of adverse effects, and this makes it much more difficult for them to curb such effects. This has been recognized by recently enacted and proposed amendments to these laws which authorize standards applicable to new plants at the time of construction.

Second, technology assessment must include consideration of secondary and tertiary effects of an innovation. The automobile not only brought about air pollution and congestion but it also changed land use patterns, the nature of urban life, and the structure of the family. The introduction of the one-way container added a new dimension to solid waste and litter problems. In many cases the secondary and tertiary effects of changing technologies may be more significant than the direct effects.

Clearly there must be linkages between technology assessment and mechanisms to control the impact of technologies. If we

develop tools to predict more accurately the consequences of technological developments, we must also develop policy mechanisms to act upon these findings.

The environmental impact statement process of NEPA provides one such link. Many large-scale technology developments are partially or entirely supported by the Federal Government. Mass transit development and nuclear and other energy sources, for example, are supported by government subsidies. Cloud seeding, saline water conversion, and new peaceful uses of atomic energy are direct government projects. The National Environmental Policy Act, through the environmental impact statement process, provides a framework for technology assessment of these governmentally financed activities, as will proposed new legislation, such as the Toxic Substances Control Act.

Undue emphasis should not be placed on the adverse consequences of new technology. Technological innovation has been and will continue to be necessary if we are to achieve environmental and other goals. It is clear, for example, that new sources of energy will be necessary to meet air quality standards over the long run. Ultimately, our transportation systems will have to change, placing greater emphasis on mass transit and possible new sources of power. The development of the breeder reactor, fusion power, coal gasification, and unconventionally powered vehicles all require technological breakthroughs enabling us to meet longer term environmental quality goals.

The challenge ahead is to assess the potentially detrimental effects from the introduction of new technology and at the same time to encourage the development of needed new technology. We can neither place blind reliance on technology to solve all of our problems nor can we ignore the need for technological improvements to meet the goals of our society, including environmental goals. A balanced approach to the two-edged sword of technological innovation is critical.

efforts and accomplishments

It is not fashionable to view environmental problems with anything less than alarm. Indeed, many have told us that we are facing an ecological doomsday unless we take radical steps. However, the chapter on Status and Trends provides some grounds for optimism, although the data base is too imprecise for any firm conclusions. Measurements of air quality in urban areas indicate some general improvement although the total amounts of air pollutants actually emitted nationwide have increased slightly. Control efforts, plus industry dispersion, are largely responsible for this pattern. Construction of municipal waste treatment plants has prevented further serious deterioration in water

quality in the face of signficant increases in population and industrial production. The use of persistent pesticides has been declining for several years. These patterns indicate that with concerted effort, we can make progress in dealing with environmental problems.

However, some problems are emerging with portentous implications. The accumulation of mercury in our waters is a serious problem that may become even worse as organisms continue to concentrate mercury through the food chain. The increases in complex toxic materials—both heavy metals and organic chemicals—may be serious long-term threats to human health and the life cycle upon which all men depend. Eutrophication is a problem that will require significant efforts to control and reduce nutrient inputs into many lakes and rivers, and special actions may be necessary to restore water bodies in many parts of the country. Many aspects of land use, such as wetlands development and urban sprawl, pose serious problems.

The blight that characterizes so much of our urban environment has been with us at least since the beginning of the industrial revolution. It has only been comparatively recently that environmentalists have devoted attention to urban problems, especially those in the inner city, the decaying, older areas where so many of the urban poor live in inferior conditions. However, most Americans work and play in urban areas; it is the setting which is most immediate and familiar to us. Indeed, ecology is defined as the interrelationship between an organism and its environment and the environment for most human organisms in industrial society is the large metropolitan area. Further, many of the traditional environmental problems, such as air pollution and basic sanitation, are most acute in the central city. If we are to make our environment livable, we must make our cities livable. If we are to achieve a desirable level of environmental quality, we must make our cities desirable places in which to work and live.

It would be helpful to be able to show a direct cause-and-effect relationship between the developments described in the first three chapters and accomplishments as described in the Status and Trends chapter. But the relationship between efforts and accomplishments is often unclear. Many factors aside from governmental efforts exert a strong influence on environmental trends—the state of the economy, the development of new technology, the preferences of consumers. Time is another complicating factor: It may take several years between the initiation of a governmental effort, such as giving a grant for a waste treatment plant, and any actual effect on environmental quality. Most importantly, the data now collected on environmental status and trends is not adequate to provide reliable evidence for the evaluation of governmental programs.

The established base which our new institutions have given us should improve evaluation of programs and increase "feedback" on the success or failure of our efforts. The critical challenge to the government in the coming years, particularly in pollution control where the legislative mandate is well established, will be to improve the effectiveness of the implementation of the legislation. The best laws can be subverted by poor implementation, and there is much room for improvement in the manner in which Federal programs are executed. Better information is critical to this improvement, because only through accurate data on environmental conditions can we tell whether Federal programs are accomplishing their intended purpose.

Our view of environmental conditions is a product of three factors: the actual conditions which exist, the methods we use to determine these actual conditions, and the values which we place on the results.

It is difficult to tell how much the data in the Status and Trends chapter really tell us about actual conditions, because all of them are filtered through a complex and very imperfect set of processes whose purpose is to describe the real world. The tables and graphs are not the real world. They are but the final outcome of selecting a few dimensions from an almost unlimited number of environmental variables, selecting a few sampling sites from an almost unlimited number, collecting and analyzing the data on the basis of often very inaccurate techniques, and then aggregating and statistically analyzing the collected data on the basis of a number of crude assumptions. How close the results of this process come to reflecting actual conditions is uncertain.

We are also handicapped by our lack of knowledge about fundamental scientific questions. Much needs to be done to improve our knowledge about the effects of various environmental insults. There is also a great deal we do not understand about the basic ecological processes which determine the fate and importance of pollutants. For example, the cycles governing the balance of the basic components of the atmosphere and the mechanisms through which these components are absorbed or changed by earth and ocean are, for the most part, unknown.

Aside from the processes of collection and analysis, our view of actual conditions also is filtered through the values which we hold. Whether the data from the monitoring effort is viewed with alarm or with complacency depends on the standard of judgment applied—in other words on the values we hold concerning what actual conditions *should* be. Thirty years ago the data on status and trends would have been of little or no interest to most people, because our knowledge and our values had not yet come to include the importance of environmental factors.

environmental quality and the quality of life

Our knowledge and our values have changed significantly and are continuing to change. What is developing in this country is a greater awareness both of man's dependence and of his independence.

We are realizing our dependence on the intricate web of nature of which we are part. We have discovered that man's continued existence depends on the functions of microscopic bacteria and fungi and on the grand natural cycles which govern the flow of the major elements through the environment.

Man is also coming to understand his relationship with the urban environment he has created—from the parks and open space to the quality of its buildings and the character of its neighborhoods. The harshness of much of the inner city environment and the cruel effects of improper sanitation, air pollutants, and household hazards such as lead in paint have been recognized. If we are to be concerned about the quality of life, it will not be possible to escape the city and cloak ourselves in pastoral romanticism. For as we concern ourselves with the quality of our natural environment, we must give equal attention to the quality of our manmade environment.

We also have begun to realize that we have an opportunity and a challenge to determine the shape and future course of our development. The application of scientific knowledge and the continuing alteration of our physical surroundings are not predetermined. They are ours to mold and to decide. This freedom will be no easier to protect and exercise than our other freedoms. But the decisions as to what kind of world we want to live in are ours to make, providing that they are made with the knowledge and awareness of the constraints which nature has set.

Much of the current concern over environmental problems has sprung from a negative reaction to the degradation we have inflicted upon our surroundings. Much of it has sprung from a fear that we will destroy ourselves if environmental insults go unchecked. These reactions and fears are legitimate—environmental degradation degrades us, and the possibility of an ecological "doomsday," although often exaggerated, does exist.

But it is important to consider the positive side of the struggle for environmental quality. Our environment is literally what surrounds us—what we see and feel and smell every minute of every day. If life is to be worth living, the environment must do more than sustain life. It must provide the esthetic satisfaction and the sense of human dignity which give meaning and purpose to existence.

Many governmental programs are devoted to providing the necessities for sustaining life. Many are devoted to helping particular segments of the population. But the environmental prob-

lem is everybody's problem—we are all affected by bad air, polluted water, or despoiled land. And the environmental opportunity—the possibility of protecting and shaping our surroundings so that they accord with our vision of the good life—is ours to take if we have the will and persistence.

There are those who doubt that we will have the will and persistence, and who believe that concern with the environment is simply a passing fad. But the evidence is to the contrary. The problems are real. All of us are paying the costs of a degraded environment daily, through being surrounded by dirt and ugliness. Our values and perceptions have come to demand better. We have realized that our resources are limited, and that our natural surroundings cannot tolerate the unlimited burdens placed on them by an industrialized society. As leisure time and educational levels have increased we have placed a higher value on recreation, esthetics, and the things which make for a better life.

The environmental ethic is becoming a permanent part of our governmental institutions. It has found a permanent place in our legal principles, and it is beginning to become an accepted part of our economic calculations. The environmental issue is still in the process of maturing, and like all vital and lasting issues it will undergo many transformations in its definition and in the way its problems are approached. But maturation should not be mistaken for transience. The pursuit of environmental quality has become a firm national commitment. Through fundamental changes in institutions, laws, and values we have embarked on a new course which will affect both national policy and personal values.

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