BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Chairman, Committee On Merchant Marine And Fisheries House Of Representatives

Information On Ocean Disposal Of Municipal And Industrial Waste

The ocean continues to be used for the disposal of municipal and industrial wastes. Ocean dumping could increase in the future depending on economic and environmental considerations and problems with disposal alternatives. While there is a growing interest in making waste disposal decisions only after considering all available options, more information and research are necessary to help Federal and local officials reach disposal decisions that balance the tradeoffs involving land, air, and water alternatives. The Environmental Protection Agency has undertaken and/or sponsored several projects to improve the state of the art of making waste disposal analyses among available options.

GAO/RCED-83-161
MAY 18, 1983

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RESOURCES, COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-166506

The Honorable Walter B. Jones
Chairman, Committee on Merchant
Marine and Fisheries
House of Representatives

Dear Mr. Chairman:

In your letter of December 7, 1982, signed jointly by Mario Biaggi, Chairman, Subcommittee on Merchant Marine; Norman E. D'Amours, Chairman, Subcommittee on Oceanography; Joel Pritchard, Ranking Minority Member, Subcommittee on Oceanography; Edwin B. Forsythe, Ranking Minority Member, Subcommittee on Fisheries and Wildlife Conservation and the Environment; Norman Lent, Ranking Minority Member, Subcommittee on Panama Canal and the Outer Continental Shelf; and William J. Hughes, Member, Committee on Merchant Marine and Fisheries and in subsequent meetings with your office, we were requested to provide information on several areas relating to the ocean disposal of sewage sludge and industrial wastes. Specifically, you requested that we provide information on the quantities, trends and potential for expansion of ocean waste disposal, and data to manage the ocean dumping permit program. A brief summary of our results is discussed below. Additional details are provided in appendix I.

BACKGROUND

In 1982, about 7.7 million wet tons of sewage sludge and about 1.1 million wet tons of industrial wastes were dumped in the ocean. We found that interest in using the ocean for the disposal of municipal and industrial wastes continues and could increase in the future.

The Environmental Protection Agency's (EPA's) ocean dumping regulations, issued on January 11, 1977, provided that materials which failed to pass the Agency's environmental criteria were presumed to "unreasonably degrade" the marine environment and mandated December 1981 as a phaseout date for all materials not meeting this criteria. Subsequent amendments to the Marine Protection, Research, and Sanctuaries Act of 1972--enacted in 1977 and 1980--required that the ocean dumping of harmful sewage sludge and industrial wastes cease not later than December 31, 1981.

The anticipated phaseout of ocean dumping of sewage sludge did not materialize, however, because in 1981 a Federal district court ruled in City of New York vs. EPA that EPA had acted improperly in banning sludge dumping after December 31, 1981. The court ordered EPA to revise its ocean dumping regulations to remove the conclusive presumption that materials which do not pass the Agency's environmental criteria will "unreasonably degrade" the marine environment. The court also ruled that EPA must consider all relevant statutory factors before reaching a determination on whether a permit should be issued.

FUTURE OF OCEAN DUMPING

The current ocean dumpers of municipal sewage sludge (9 sewage authorities in the New York-Northern New Jersey area) expressed an interest in continuing the practice. This interest was based on economics, a lack of disposal alternatives, and the belief that ocean dumping is environmentally safer than other disposal methods. Representatives of other selected east and west coast communities told us that they had considered the ocean or would consider ocean disposal if and when they experience problems with current disposal methods. In addition, an increase in the amount of sludge produced in the coastal counties could increase interest in ocean disposal.

The National Oceanic and Atmospheric Administration (NOAA) reported in November 1982 that 130 percent more sludge could be generated in coastal areas in the year 2000 than in 1980. NOAA's estimates are based on predictions of operating characteristics of treatment plants in the year 2000 as well as the new plants planned for construction. While NOAA believes its methodology and estimates are reasonable, the projected increase may not be realized for several reasons. For example, if some treatment plants are allowed to provide less than secondary treatment to waste waters under the Clean Water Act, less sludge will be produced. In addition, some of the projected new plants may not be built--thus not generating sludge--due to reduced Federal funding for construction grants. Whatever the increase, it is currently unknown what part of this increase will be considered for ocean disposal.

Opinion varies on the future of ocean dumping of industrial wastes. For example, EPA and NOAA officials, as well as industry representatives, told us that there was no broad interest in ocean disposal by industry. However, a survey of EPA regional ocean dumping coordinators conducted as part of a 1982 EPA-sponsored study on ocean dumping provided a different viewpoint. The

regional coordinators projected increases in the ocean dumping of various industrial wastes, in part because of the tighter controls on land disposal under the Resource Conservation and Recovery Act.

INFORMATION NECESSARY TO MAKE WASTE DISPOSAL DECISIONS

Overall, there is a growing interest in making waste disposal decisions only after considering all available options--ocean, land, and air. This cross-media approach was emphasized in the decision arising from New York City's suit against EPA. That philosophy was also apparent in a January 1981 report of the National Advisory Committee on Oceans and Atmosphere which recommended adoption of an integrated waste management approach and waste disposal in the manner and medium that minimizes human health and environmental risks at a price that the Nation is prepared to pay.

It is generally recognized by the scientific community that no alternative is entirely risk free. Use of sewage sludge on agricultural land raises the possibility that contaminants can be taken up by crops consumed by humans; landfilling can contaminate groundwater; incineration can pollute the air; and ocean disposal can pollute coastal waters.

In evaluating ocean dumping permit applications, EPA is required to balance the environmental consequences of, and need for, ocean disposal with the potential environmental impact of feasible land-based alternatives. However, EPA officials acknowledge that the quantitative data needed to make such a cross-media analysis is not available, and several gaps in information have been identified by Federal officials, the scientific community, and municipal sewage authorities. In general, the consensus of these groups is that more research is required to assess the risks and costs associated with each alternative. In particular, research is needed to understand the fate and effects of pollutants in the ocean, the assimilative capacity of the oceans, and the long-term effects of low levels of pollutants on life in the sea. Studies of land versus sea disposal options are also needed.

We identified several projects currently underway to address some of these information gaps. For example, EPA expects to issue a final report in June 1983 on dump site designation. In addition, EPA is developing a generic methodology to permit a better evaluation of the potential impacts of ocean dumping of a specific waste at a specific site. In 1982, EPA initiated a sludge management project which is an effort to evaluate costs,

benefits, and environmental effects of the disposal and use of sewage sludge across all media--air, land, and water. The goal of the project is to develop a cohesive policy and guidelines for sludge management. This project is scheduled to be completed by September 1983.

In addition, NOAA has developed an operational framework for identifying and evaluating alternative ocean dump sites. NOAA also has a project underway to describe 12 indices of degradation of the marine environment and ecological systems.

OBJECTIVES, SCOPE, AND METHODOLOGY

Our objective was to provide information to the committee on ocean disposal of sewage sludge and industrial wastes. We did not attempt to address all the possible ocean disposal issues but rather to identify current and potential future use of the oceans for sewage sludge and industrial waste disposal and information needs to manage the ocean dumping program. Further, we did not attempt to assess or evaluate ongoing or planned research efforts.

We obtained information on the quantities, trends, and future of ocean waste disposal by contacting current municipal and industrial users of the ocean; identifying and contacting selected potential users of the ocean for disposal of sewage sludge; and discussing the future use of the oceans for waste disposal with Federal, industrial, and municipal sewage authority representatives.

To identify information needs and gaps to manage the ocean dumping program, we discussed research conducted and needed on the short- and long-term effects of ocean dumping and its alternatives with Federal and State officials and representatives of environmental groups and research organizations. A listing of the organizations contacted appears in appendix II. In addition, we reviewed (1) our past reports related to sewage sludge issues, (2) reports, studies, and other documents prepared by or for EPA and NOAA, (3) studies, position papers, and articles on ocean waste disposal issues, and alternative waste disposal options prepared by non-Federal Government parties. A listing of the major documents considered in preparing this report appears in appendix III.

We conducted our review at EPA headquarters, its regional office in New York, and its research lab in Narragansett, Rhode Island; NOAA headquarters offices and its offices in New York and

New Jersey; and municipal and industrial waste generators currently dumping wastes in the ocean. Our review was performed in accordance with generally accepted government audit standards.

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We did not obtain agency comments, but the matters presented in this report were discussed with Agency officials.

As agreed with your office, distribution of this report will be restricted until May 25, 1983, unless the contents of this report are publicly announced earlier. After that date we will send copies to the Secretary of Commerce, the Acting Administrator of EPA, and other interested parties.

Sincerely yours,

J. Dexter Peach
Director

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ABBREVIATIONS

EPA	Environmental Protection Agency
GAO	General Accounting Office
NOAA	National Oceanic and Atmospheric Administration

GLOSSARY

Benthos	The organisms aggregately living on or at the bottom of a body of water.
Bioassay	The use of living organisms to determine the biological effect of some substance, factor, or condition.
Heavy metals	Metallic elements--such as mercury and cadmium--with high atomic weights, generally toxic in low concentrations to plant and animal life. Such metals are often residual in the environment and exhibit biological accumulation.
Industrial waste	A broad category of wastes from manufacturing operations or processes. Includes acids, chemicals, poisons and insecticides, heavy metals, and other toxic substances.
Landfill	The disposal of wastes by burying under a shallow layer of ground.
Ocean dumping	The transportation and discharge of waste materials into the ocean.
Pathogens	Any microorganism or virus that can cause disease.
Primary waste treatment	Treatment using screening, skimming, and sedimentation techniques to remove about 30 percent of biochemical oxygen-demanding wastes and about 55 percent of suspended solids.
Pyrolysis	Thermal reduction technique performed in an oxygen deficient atmosphere. Sewage sludge can be burned in this manner after it is sufficiently dried.

Secondary waste treatment	Treatment using biological processes to accelerate the decomposition of sewage and thereby reduce oxygen-demanding wastes by 80 to 90 percent and suspended solids by 75 to 90 percent.
Sewage sludge	A nonhomogeneous residue resulting from chemical and physical treatment of waste water (the more advanced the treatment the more sludge). Consists of both toxic and nontoxic waste materials, with specific concentrations dependent upon the various municipal and industrial sources discharging into the sewage treatment plant. Constituents of sludge include nutrients--nitrogen, phosphorous, and potassium compounds; heavy metals--cadium, copper, mercury, nickel, lead, and zinc; chlorinated hydrocarbons--including polychlorinated biphenyls (PCB) and some pesticides; and pathogenic organisms.
Synergism	The total effect of mixing two or more contaminants is greater than the sum of the effects taken independently.

INFORMATION ON MUNICIPAL AND INDUSTRIAL WASTE DISPOSAL

HISTORICAL PERSPECTIVE ON FEDERAL REGULATION OF OCEAN DUMPING

The Marine Protection, Research, and Sanctuaries Act of 1972--commonly referred to as the Ocean Dumping Act--was signed into law on October 23, 1972. The Congress enacted the Ocean Dumping Act partly in response to the recommendations contained in a Council on Environmental Quality report, "Ocean Dumping, 1970," which concluded that there was a critical need for a national policy on ocean dumping.

The purpose of the Ocean Dumping Act was to protect the ocean from unregulated dumping of material that would endanger human health, welfare, and amenities, and the marine environment, ecological systems, and economic potentialities.

Title I of the Act prohibits the dumping of certain materials including most nuclear and chemical warfare agents and provides for a permit system to be administered by the EPA for all other materials except dredged materials. Dredged materials dumping is regulated by the Corps of Engineers.

Title II of the Act governs ocean dumping research and monitoring by EPA, the Department of Commerce through the National Oceanic and Atmospheric Administration, and the Department of Transportation through the Coast Guard.

EPA initially issued interim permits and required municipal sludge dumpers to investigate alternatives to ocean dumping. Subsequently, EPA's ocean dumping regulations, issued in January 1977, mandated December 31, 1981, as a phaseout date for all municipal sewage sludge which unreasonably degraded the environment; that is, it failed to meet the agency's environmental criteria. A 1977 amendment to the Act statutorily adopted this phaseout date, and a 1980 amendment imposed the same phaseout deadline on ocean dumping of harmful industrial wastes.

The anticipated phaseout of ocean dumping of sewage sludge did not materialize, however, because on November 2, 1981, a Federal District Court judge ruled that EPA had acted unreasonably in banning all sludge dumping after December 31, 1981.[1] He ordered EPA to revise its ocean dumping regulations to remove the conclusive presumption that materials which do not pass the agency's environmental criteria will "unreasonably degrade" the marine environment. The court also ruled that EPA must consider

[1]City of New York v. Environmental Protection Agency, 543 F. Supp. 1084 (S.D.N.Y., 1981).

all relevant statutory factors before reaching a determination on whether a permit should be issued. These factors include

--the need for the proposed dumping;

--the effect of such dumping on human health and welfare, including economic, aesthetic, and recreational values;

--the effect of such dumping on fisheries resources, plankton, fish, shellfish, wildlife, shorelines and beaches;

--the effect of such dumping on marine ecosystems particularly with respect to (1) the transfer, concentration, and dispersion of such material and its by-products through biological, physical, and chemical processes, (2) potential changes in marine ecosystem diversity, productivity, and stability, and (3) species and community population dynamics;

--the persistence and permanence of the effects of the dumping;

--the effect of dumping particular volumes and concentrations of such materials;

--the appropriate locations and methods of disposal or recycling, including land-based alternatives and the probable impact of requiring use of such alternative locations or methods upon considerations affecting the public interest; and

--the effect on alternate uses of oceans, such as scientific study, fishing, and other living resource exploitation, and nonliving resource exploitation.

EPA did not appeal the decision and plans to publish revised regulations. As of May 11, 1983, about 1-1/2 years since the judicial order to revise the regulations, EPA has not published its proposed rule. The latest estimate for publication in the Federal Register is June 1983.

OVERALL HEALTH OF THE OCEANS

Pollution threats to the marine environment come from a variety of sources including direct discharges to estuaries and coastal areas through ocean outfalls, river flows containing contaminants from discharge points upstream, marine transportation activities, barging of industrial and municipal wastes to sea for dumping, and deposits of contaminants from the atmosphere.

Although there are many regions where there are severe problems and many other areas where potential problems may occur,

the overall health of the oceans and most of the U.S. coastal waters is good.

A report[2] by the United Nations Environment Programme, issued in October 1982 after a 4-year survey, reached these conclusions about the world's oceans and coastal waters. Although the study found no significant effects on the ecosystem in the open sea as a result of waste residues, effects were noted in coastal zones. However, the study also found that the levels of most toxic substances in heavily polluted waters as well as in the less polluted open sea areas have in fact decreased in the last decade. The study indicated that this was the result of environmental laws restricting the production and distribution of such substances as DDT and PCBs.

NOAA is the Federal agency responsible for monitoring U.S. coastal waters and performing comprehensive research related to the general health of the ocean. NOAA's Northeast Monitoring Program is an integrated program providing a system of physical, chemical, and biological monitoring of waters at select stations of the northeast continental shelf from the Gulf of Maine to Cape Hatteras. The program is designed to monitor the health of marine communities over long periods of time by tracking the natural fluctuations in communities as well as the impact of man-produced pollutants. Special emphasis is given to nearshore monitoring stations affected by waste discharges.

A NOAA official at the Stoneybrook, N.Y., office told us there are currently no similar large-scale programs for monitoring the Gulf of Mexico and the Pacific coast. Each of these areas however has been the subject of individual, specific projects. For example, NOAA has done work in Puget Sound to identify contaminants of concern and gain an understanding of their biological effects. NOAA has also conducted work in the Gulf of Mexico on organic pollutants in fish. Additionally, NOAA and the State of California are currently developing a monitoring program for Southern California waters. This area has been the subject of study since 1969 by the Southern California Coastal Water Research Project.

According to NOAA, marine pollution in the North Atlantic area is confined to relatively localized areas. However, the Mid-Atlantic area, from New York to Cape Hatteras, particularly the New York Harbor area, has undergone considerable degradation as a result of heavy urban and industrial development. In fact, the New York Bight has been found to be one of the world's most heavily polluted open coastal water areas.

NOAA has also reported that along the Gulf of Mexico expanding coastal development increases the impacts on living

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[2]"The Health of the Oceans, "United Nations Environment Programme, Regional Seas Reports, No. 16 (1982).

marine resources. About 10 percent of the entire Gulf Coast is closed to shellfishing because of sewage discharges. In addition, widespread industrial and agricultural development over extended areas are contributing to marine pollution problems in this region. For example, relocation of light and heavy industry from other regions of the United States is resulting in increased discharges of waste chemicals. The Mississippi River, which drains into the Gulf, was identified as a major source of contaminants by the United Nations' study.

On the west coast, there had been concern about effects of large volumes of sewage discharged into the Southern California Bight. However, a task force of university scientists, commissioned by the California State Water Resources Control Board, reported in 1977 that an ecologically degraded area exists in the vicinity of the outfall, but there is no convincing evidence of any general changes in Santa Monica bay due to the outfall. In addition, although concern remains about the potential and actual accumulation of PCBs and chlorinated insecticides, the quantity of these compounds released into the Southern California Bight is now roughly one tenth of the amount discharged 10 years ago.

CURRENT STATUS AND FUTURE OF OCEAN DUMPING

The dumping of sewage sludge is currently confined to one site in the Atlantic and is regulated under the Ocean Dumping Act as discussed on page 1. There is no sludge dumping in the Gulf of Mexico or Pacific region. In addition, a few permittees currently dispose of industrial wastes in the Atlantic and Pacific Oceans.

EPA's draft 1981 annual report shows that a total of 350 permits to ocean dump wastes have been phased out (179), denied (148), or withdrawn (23). In addition, in 1982 one permit was phased-out, three were withdrawn, and none denied. The ocean dumping of industrial wastes has been reduced from 3.4 million wet tons in 1975 to 1.1 million wet tons in 1982, a decrease of 68 percent. However, the dumping of sewage sludge has increased from 5.0 million wet tons in 1975 to 7.7 million wet tons in 1982, an increase of 54 percent. This increase was due primarily to higher levels of treatment provided by existing dumpers.

The amount of sludge and industrial wastes disposed of in the oceans may increase in the future. Current municipal sludge dumpers will continue the practice if they can. Other municipal sludge generators may consider ocean disposal if they experience problems with their current disposal options. In addition, there are indications that some types of industrial waste--in particular fly ash (waste generated by burning coal)--may be dumped in the ocean in the future.

APPENDIX I

Current ocean dumping

As a result of the final judgment entered on November 2, 1981, in City of New York v. EPA, New York City has been allowed to continue dumping sewage sludge at the present 12 mile site. In a related action, six northern New Jersey sewage authorities (Bergen County Utilities Authority, Joint Meeting of Essex and Union Counties, Linden Roselle Sewerage Authority, Middlesex County Utilities Authority, Passaic Valley Sewerage Commissioners, and Rahway Valley Sewerage Authority) sued EPA using claims similar to New York City's. EPA entered into a final judgment that also allows these sewage authorities to continue dumping at the 12 mile site.

According to officials in Nassau County, New York, they also used the results of the City of New York v. EPA suit to obtain injunctive relief to continue ocean dumping at the 12 mile site.

The Department of Environmental Facilities, Westchester County N.Y., also continues to dump its sewage sludge at the 12 mile site. This is based on a consent decree issued in 1979 as a result of EPA action against them for failure to adhere to their schedule to phaseout and cease all ocean dumping by December 31, 1981. Under the decree, Westchester may continue dumping until April 1984 pending completion of a resource recovery plant.

The following table shows, by sewage authority, the amounts dumped at the 12 mile site during 1982.

1982 Sewage Sludge
Dumped at the 12 Mile Site

Sewage authority	Amount (in thousands of wet tons)
Bergen County	289
Joint Meeting of Essex and Union Counties	421
Linden Roselle/Rahway (two separate authorities, joint dumping)	269
Middlesex County	820
Nassau County	456
New York City	3,206
Passaic Valley	1,694
Westchester County	433

We reviewed the results of the lab tests[3] that these sewage authorities submitted to identify the levels of contaminants in the sludges. Our review, and subsequent discussion with EPA's region II Chief of Marine Wetlands Protection Branch, revealed that basically the same contaminants are found in each of the nine authority's sludge. Contaminants found in sludge include petroleum hydrocarbons, cadmium, zinc, copper, lead, mercury, fecal coliform, oil and grease.

The level of contaminants varies from authority to authority. In addition, the level of each contaminant varies in different sample batches for the same authority during the year. The EPA region II official told us this occurs because the sewage inputs differ from day to day. Some factors that can cause the levels of contaminants introduced into the sewer to vary are

--sludge inputs differ from treatment plant to treatment plant in the same sewage authority (sections of New York City that are more heavily industrialized than others will have different levels of contaminants),

--variability on when constituents are introduced to the sewer system (an industry could change the product manufactured and thereby have a different level of contamination), and

--weather effects (during wet weather periods street runoff can increase the level of various constituents to sewer systems and therefore the sludges).

Because lab tests and reports are made only periodically and widely vary even among the same authority, total levels of sewage sludge contaminants by authority were not readily available for sludge dumped in 1982.

Dumping by these sewage authorities (except for Westchester) will continue until EPA takes actions on petitions by New York City and the New Jersey municipalities to redesignate the site. EPA is currently evaluating the petitions for commencement of rulemaking to extend the designation of the 12 mile site. The 12 mile site was designated on May 18, 1979, as an approved municipal sludge dumpsite. At the same time, an alternate site, the 60 mile site, was designated in case dumping at the nearshore site became unacceptable for environmental or public health reasons. Both designations expired December 31, 1981. On December 20, 1982, EPA requested comments on the petitions. The comment period ended

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[3]Each sewage authority that ocean dumps is required to submit to EPA a lab report detailing, among other information, the level of the contaminants in their sludge for the batch sampled on a particular day. New York City reports 2 times a year for each of its 12 plants. The remaining authorities report 4 times a year.

February 18, 1983. However, petitioners were granted an extension to May 2, 1983, to provide additional technical information for their permit applications. An EPA Criteria and Standards Division official told us that, as of May 11, 1983, a final designation date is unknown.

As previously indicated, there are only a few permits for industrial waste ocean dumpers. In 1982 Dupont-Grasselli, located in New Jersey, one of the permit holders, dumped 192 thousand wet tons of an industrial waste known as DMHA. This waste, consisting of about 90 percent sea water, less than 1 percent organic product and the remainder sodium sulfate, was dumped at the 106-mile chemical waste site located due east of Delaware Bay.

Another Dupont company in Delaware also has a permit to dump at this site. However, the company uses its permit only if it cannot market its waste, which is hydrochloric acid and ferric chloride. In 1982 the company did not dump at the site, but in 1981 it dumped 22 thousand wet tons of waste.

The future of ocean dumping

Interest in using the ocean for the disposal of industrial and municipal wastes continues. Whether and to what extent that interest will translate into actual use, however, depends on as yet unanswered questions. For example:

--Will EPA's revised regulations make it simpler to obtain a permit to ocean dump?

--At what sites will dumping be allowed?

--Will some alternatives to ocean dumping either be foreclosed or limited?

Ocean disposal of municipal sludge may increase

The ocean dumpers of municipal sewage sludge we talked to expressed an interest in continuing to ocean dump. Further, if NOAA's projected increases in sludge production in the Nation's coastal counties materialize, or if alternative disposal methods are deemed unacceptable, more communities may also consider ocean disposal.

Eight of the nine permittees in New York and New Jersey that account for practically all sludge dumping at the current site told us that they would continue to ocean dump their sewage sludge if allowed to do so. According to the permittees, this interest was not substantially affected by the possibility that the sludge

dump site may be moved further offshore[4] but was based on economics, a lack of alternatives, and a belief that ocean dumping is environmentally safer than other disposal options.

Except for New York City and Nassau County, N.Y., the current permittees do not project any major increase in their sludge production because they have reached secondary treatment or they do not foresee any changes in their populations or industrial bases. Nassau County officials projected a slight increase as more areas are sewered. New York City's sludge production is expected to increase as a result of upgrading its current treatment plants to provide secondary treatment and the construction of two new treatment plants.

A significant increase in the amount of sludge produced in the coastal counties could increase interest in ocean disposal. As the table on page 25 shows, NOAA projected in November 1982 that 130 percent more sludge would be generated in coastal areas in the year 2000 than in 1980.

NOAA's estimates are based on predictions of operating characteristics of treatment plants in the year 2000 as well as the new plants planned for construction. While NOAA believes its methodology and estimates are reasonable, the projected increase may not be realized for several reasons. For example, if some treatment plants are allowed to provide less than secondary treatment to waste waters under the Clean Water Act, less sludge will be produced. In addition, some of the projected new plants may not be built--thus not generating sludge--due to reduced Federal funding for construction grants. Whatever the increase, it is currently unknown what part of this increase will be considered for ocean disposal.

Aside from the existing dumpers, only Washington, D.C., is actively seeking an ocean dumping permit at the present time. However, three small municipal agencies in New Jersey have made some preliminary inquiries to EPA. Additionally, Orange County, California, is proposing a research project to dispose of sludge in the Pacific through an outfall pipe, as an alternative to

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[4]EPA proposed to designate for continued use the existing interim designated 106 mile site located due east of Delaware Bay as an approved site for dumping of aqueous industrial materials. EPA also proposed to designate the site as an approved site for dumping of municipal sewage sludge for a period of 5 years, during which time studies on the environmental effects of sludge dumping will be conducted. On May 10, 1983, EPA held hearings on designating the 106 mile site on a permanent basis. A date for final site designation is currently not known.

finding a new landfill site. A 1982 survey of EPA's seven regional ocean dumping coordinators revealed that all but one believe that ocean dumping of sewage sludge will increase in the future. Most EPA coordinators believe that municipalities will be able to demonstrate that no reasonable alternatives exist and that the dumping will not unreasonably degrade the environment.

We contacted selected East and West coast communities, which had been identified by NOAA and an official of the Association of Metropolitan Sewerage Agencies as possibly considering ocean disposal of sewage sludge, to find out if they are in fact considering ocean disposal. Their responses are summarized on the table on page 26. As this table indicates, some communities had considered the ocean or would consider ocean disposal if and when problems occur with current disposal methods. These results are similar to the results of a survey of 14 urban coastal sewage districts conducted as part of a 1982 EPA-sponsored study on ocean dumping. This survey found, in general, that municipalities only appeared interested in ocean dumping when land-based alternatives were unavailable, expensive, or prohibited. Sludge barging capital and operational costs, the time and expense associated with dump site selection and approval, and public opinion make the ocean dumping option less desirable.

The survey also found that most of the sewage districts foresaw at least minor increases in sludge volume due to (1) population increases, (2) sewage district enlargements, (3) secondary treatment plant start-ups, and (4) increases in the proportion of the population sewered. However, according to the survey, prediction is often difficult. For example, the director of Public Works, City of Baltimore, Maryland, said that future trends in sewage volume in his district depend on the housing market and population shifts between the city and suburbs. The survey also reported that representatives of several districts remarked on legislative guidelines that make land-based sludge utilization options impractical and may increase the desirability of ocean dumping.

Future of ocean disposal of industrial wastes

Opinion varies on the future of ocean dumping of industrial wastes. EPA and NOAA officials, as well as others, told us that there was no broad interest in ocean disposal by industry. They believe that industry's desire to avoid public controversy or the timeconsuming nature of the permit process itself were the primary reasons. An official of the Chemical Manufacturers Association also said he did not see any pressure mounting to increase the ocean dumping of industrial wastes.

The 1982 survey of the seven EPA regional ocean dumping coordinators provided a different viewpoint, however. Although amounts were not projected, the regional coordinators did project

increases in the ocean dumping of various industrial wastes. For example, the survey found that all the coastal region coordinators believe there will be increased pressure for ocean dumping due to regulatory control of solid wastes under the Resource Conservation and Recovery Act industrial waste pretreatment requirements. According to the survey

> "Ocean disposal of these wastes may be less expensive for waste generators in the long run because of the high cost of long-term monitoring of land-disposal sites. Another possible candidate for ocean dumping is stabilized hazardous waste. This material can be rendered nonhazardous by chemical processing and dumped at sea, thus avoiding the costly siting, closure, and monitoring requirements of landfill."

The survey also found that:

--Most regions believe that there will be an increased demand for dumping low-level radioactive waste at sea.

--One region currently has active permits for high-temperature incineration at sea. The materials being incinerated (e.g., agent orange) are loaded at Mobile, Alabama. This technique is capable of thermally destroying waste pesticides, herbicides, and other chlorinated organic compounds at greater than 99 percent efficiency. Coordinators in two other regions believe that their regions have potential locations for ocean incineration.

--Production of gypsum sludge (from the basic fertilizer materials industry and the neutralization of waste industrial acids) and the need to ocean dump this material is likely to increase and follow the trend of increased amounts of chemical waste.

--One region reported that it may receive requests to dump seafood processing wastes, primarily the wastewater treatment sludge from tuna canneries.

--Waste liquor from paper pulping may be dumped if markets cannot absorb the amount produced. Paper plants located in Washington State may find it less costly to barge this material offshore for dumping than to treat and discharge it. Additionally, one regional coordinator reported that there will be a demand to dump secondary sludge from pulp and paper waste treatment. Mills located in the Puget Sound area may find it economically advantageous to transport this sludge beyond the nearby continental shelf edge for dumping.

In addition, officials in two regions believe that there will be an increased demand for ocean dumping of fly ash (waste

generated by burning coal). The use of coal for generating electricity is expected to increase in these regions, and there will be more fly ash produced than can reasonably be landfilled. Other coastal regions do not anticipate any demand to ocean dump ash; for example, in the west and northwest the coal plants are relatively far inland, resulting in economic disincentives for the ocean disposal option. There is currently one application pending at EPA for disposal of fly ash. Consolidated Edison, located in New York, has applied to dispose of 500 tons of fly ash at the 106 mile site upon conversion of their generators to coal. Disposal would be on an interim basis for 2 to 4 years until a suitable land-based alternative is available. Consolidated Edison has concluded that land-based disposal alternatives are environmentally preferable to ocean dumping. As a result of this application, EPA Region II published in the Federal Register of March 18, 1983, an Intent To Prepare an Environmental Impact Statement; Coal Ash Ocean Disposal Site.

INFORMATION NEEDS TO MAKE WASTE DISPOSAL DECISIONS

Under the Ocean Dumping Act EPA is required to balance the environmental consequences and need for ocean disposal with the potential environmental impacts of feasible land-based alternatives (cross-media analysis). Deciding what to do with sewage sludge is influenced by disposal costs, quantities and characteristics of the sludge, and laws and regulations restricting certain disposal options. The possibility of recovering some of the resources in sludge--which landfilling and ocean disposal do not accommplish--can be a factor.

It is generally recognized that all alternatives for dealing with sewage sludge may have environmental, human health, and economic consequences. However, several gaps in information--relating to both the ocean and its alternatives--have been identified by Federal officials, the scientific community, and municipal sewage authorities. In addition, EPA officials acknowledge that the quantitative data needed to make a cross-media analysis is not readily available.

Information needs on effects of ocean waste disposal

EPA began ocean dumping research in 1974. The program was phased out in 1978, however, because of the anticipated phaseout of all ocean dumping. In addition, EPA officials acknowledge that the initial criteria for its regulatory program were based largely on laboratory findings rather than on thorough direct knowledge of the impacts or lack of impact of previously dumped wastes on parts of the ocean.

There is a general consensus that major information gaps exist in understanding the fate and effects of pollutants in the

ocean. For example, EPA's water research strategy document for fiscal years 1984-86 identified ocean dumping research needs, including procedures to

--select dumpsites;

--conduct hazard risk assessments;

--evaluate the materials to be ocean dumped;

--assess the fate and effects of these materials; and

--monitor dumpsites for chronic, long-term environmental and human health impacts.

NOAA's 5-year research plan states that more research is needed on the pathways and fates of key pollutants such as PCBs and heavy metals. In addition, a 1982 workshop sponsored by NOAA concluded that there is a need to assess pollution effects tracing individual contaminants from their release by man to their ultimate effects. Other areas identified by NOAA as needing more information include

--a description of changes in the ecosystem after dumping has stopped;

--a determination of impacts on the immediate dumping area and how far from the dumping site impacts occur;

--a reassessment of marine and coastal pollutant transport forecasting; and

--additional knowledge on how the sea can transform contaminants by chemical, physical, and biological processes to forms different from those found in sludges.

The latter two areas were included in the fiscal year 1983 Technical Plan for research by NOAA's Office of Marine Pollution Assessment, dated July 1982. No cost estimates were shown in the plan. However, the plan indicated that because of budgetary uncertainties, some of the research efforts may require elimination or reduction in scope. Under current budget proposals, all NOAA site specific ocean dumping research would be halted. In addition, many NOAA laboratories around the country could be closed, and the Northeast Monitoring Program could be curtailed.

In addition to research and information needs identified directly by NOAA and EPA, similar and related needs (such as the long-term and overall impacts of ocean waste disposal) have been identified through conferences, workshops, and by private institutes. For example, in 1979 a group of scientists and engineers met at a workshop to develop quantitative estimates of

the assimilative capacities of coastal waters and to identify research needs of other areas of the ocean and other materials. According to the proceedings[5] of the workshop, it was difficult to define precisely the term "assimilative capacity." There was consensus, however, that it is the amount of material that could be contained within a body of seawater without producing an unacceptable biological impact.

The workshop's overall conclusion was that the waste capacity of U.S. coastal waters was not fully used. However, several areas were identified as needing more information. For example, the workshop recognized the inadequacies of models to predict impacts to ecosystems, with respect to long-term, low-level effects. It also recognized the lack of knowledge concerning the types and amounts of wastes entering the coastal ocean, which impedes the ability to assess assimilative capacities of U.S. coastal waters. The workshop further concluded that descriptions of the wastes are needed to develop testing procedures, both chemical and biological. It also concluded that there is a need to learn more about

--the toxicity of pollutants to marine organisms;

--the fate of discharged materials in the coastal environment;

--national and regional amounts and kinds of wastes being generated; and

--the chemical, physical, and biological data needed for mathematical models to assess the assimilative capacity of a system.

More recently the need to determine assimilative capabilities or total loading capacities of ocean dumpsites was identified as a high priority research item for EPA. In a July 1982 report[6] issued to EPA, the consultant concluded that

> "* * * Until a way is found to ascertain the total capacity of an ocean dumpsite i.e. the limits of it's 'assimilative' capabilities to accommodate stresses... determining when the unacceptable level of 'unreasonable degradation' is reached will remain an unattainable goal."

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[5]"Proceedings of a Workshop on Assimilative Capacity of U.S. Coastal Waters for Pollutants," NOAA (Dec. 1979).

[6]"Improving the Scientific Base for Ocean Dumpsite Designation Regulations," Sidney R. Galler Inc. & Associates (July 24, 1982).

Another unanswered question associated with assimilative capacity concerns the long-term effects of pollutants. According to a representative of the Woods Hole Oceanographic Institute,

> "* * * Biological effects of waste disposal in the sea can only be evaluated in light of adequate information on the chemical composition and dispersion of dumped wastes, their availability to and accumulation by marine organisms, and their persistence in the marine environment."

The representative further stated that estimates of assimilative capacity must be based on the fate of the waste and the immediate and long-term effects on populations of marine organisms. Although the standard bioassay tests used by EPA to establish maximum concentrations of pollutants provide data on lethal exposure and are useful in detecting sensitivity of an organism to a particular pollutant, they do not provide indications of long-term impact or measure important physiological, behavioral, and ecological changes that may occur with sublethal exposure.

Assessing the effects of pollutants on the marine environment requires an understanding of the adaptive and disruptive responses at each level of biological organization. For example, evaluation of pollutant-induced changes in the population dynamics of species, including effects on reproduction, requires among other things an understanding of the natural variability of population parameters and the possible synergism between man-made and naturally occurring disturbances.

A recently published book on ecological stress and the New York Bight[7] identified another problem with the bioassay tests. It noted that the bioassay test results may have little ecological significance and may be at variance with what occurs under natural situations. Several reasons for these variances were cited including:

--Benthic species that thrive in sediments with high levels of toxicants may have adapted physiologically and genetically, while the bioassay individuals may not be resistent.

--The chemical and physical state of a given toxicant may differ in lab tests from the natural form of the pollutant.

--Simple lab tests may not readily detect synergistic interactions between two or more contaminants, delayed

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[7]"Ecological Stress and the New York Bight: Science and Management, Proceedings of a 1979 Symposium," Edited by Garry F. Mayer, 1982.

responses to continuing exposure to subacute toxicant concentrations, and reduced disease resistence, all of which may occur in the field.

Efforts to close ocean disposal information gaps

EPA has recognized that if ocean dumping is to become an acceptable waste management option, there is a need to provide decisionmakers with the information needed to support permit decisions. The overall decision rationale should include a predictive assessment procedure so that the environmental consequences of a disposal decision can be estimated with a prescribed level of confidence. Although studies have been conducted regarding the ocean disposal of municipal and industrial wastes, EPA regulatory and research officials acknowledge that the early years of ocean dumping research were fragmented and not tied to the permit process. While regulatory officials told us that this occurred because most of the research was too academic for their use, research officials told us that regulatory needs often were not made clear to them or communicated early enough so the proper research could be done.

The July 1982 EPA-sponsored study (see footnote 6 on page 13) also identified this lack of coordination as a problem. The study concluded that "***effective management of EPA's ocean dumping research will continue as an elusive hope and the integration of research in the decision making process will remain a serious problem for policy setters in the Agency" until an effective research management organization is established.

Commenting on this report, EPA's Director, Criteria and Standards Division, Office of Water, told us there are several coordinating efforts underway. For example, the agency conducted one workshop in February 1983 bringing together agency officials, scientists, and academia. The workshop was held to develop a consensus, state of the art protocol for the acquisition, organization, and interpretation of information for the purpose of ocean dump site designation. EPA expects to issue a final report in June 1983.

In addition, we were told that EPA has recently convened a task force of EPA headquarters and region II personnel with NOAA personnel to translate the current body of scientific information available into a workable format for EPA to make site specific decisions. The task force plans to develop a site specific monitoring program and predictive modeling system to gage the ecological impact of opening a new ocean site for the dumping of sewage sludge. EPA has also entered into collaborative research agreements on ocean dumping and marine research with NOAA and the U.S. Army Corps of Engineers.

According to EPA's documents on research strategy for ocean disposal, each component of the decision rationale for ocean disposal involves acquisition and synthesis of information in a way which leads to an ultimate regulatory decision. The objective of the rationale is to provide a systematic, scientifically credible basis for estimating the potential impact of waste contaminants on the marine and estuarine environments. To accomplish this, EPA is developing methods and protocols for marine hazard assessment of waste disposal.

The first step in this assessment and a pre-permit activity is characterization and designation of a disposal site. After site designation, the major components of the effort include waste characterization, exposure assessment, and effects assessment. A waste characterization process is conducted for the specific wastes in each permit application. The results of this process provide the basis for an initial evaluation of the suitability of the proposed waste for disposal at the site. The ultimate decision is then based on an assessment of the potential hazard to the environment posed by the particular waste material. This includes (1) exposure assessment--quantifying the relationship between source inputs of waste contaminants and concentration distributions of these contaminants in space and time and (2) effects assessment--developing and field verifying a hierarchy of biological tests that predict the environmental consequences of ocean disposal. This effort was started in fiscal year 1982 and when completed EPA expects that the protocol will provide a generic methodology to assess the impact of a specific waste dumped at a specific site. We were told this protocol is currently being tested in a 5-year case study on dredged materials in conjunction with the Corps of Engineers.

In addition to the efforts being underaken by EPA, NOAA is also conducting related oceanic research. For example, NOAA has developed an operational framework[8] for identifying and evaluating alternative ocean dump sites.

We were told NOAA is also addressing the question of assimilative capacity in both its ocean dumping and long-range effects programs. In general NOAA is studying response curves in ecosystems to determine how much increased loading of contaminants a system can tolerate. Specifically there are three current projects underway: (1) a study of the eutrophication of estuaries, (2) a study of populations in relation to metals loading, that is, the interaction of toxic metals and organics, and (3) a study of the loading of metals at the physiological level. According to a

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[8]"Identifying and Evaluating Alternative Ocean Dump Sites: An Operational Framework for Strategic Assessment and Estimates of Sludge Generated by Publicly-Owned Municipal Wastewater Treatment Plants," NOAA/ORCA (Nov. 1982).

NOAA official, the results of these studies will describe and quantify ecosystem responses to contaminant loadings and could be used by EPA to control loadings at acceptable levels. However, acceptable levels would first have to be defined.

This raises the issue of unreasonable degradation. NOAA officials have stated that the definition of unreasonable degradation requires scientific, social, and legal efforts. To provide scientific input, NOAA has a project underway to describe 12 indices of degradation of the marine environment and ecological systems. Establishing this criteria is an attempt to quantitatively measure pollutant effects in the field and the accumulative effects of toxicants.

These indices are intended to characterize pollutant degradation. Whether or not coastal environments and ecosystems are degraded unreasonably in a legal or societal sense depends on the objective nature of the degradation and subjective perceptions of its acceptability, according to a NOAA document. This is supported by the ruling in City of New York v. EPA under which continued ocean dumping is allowed until there is an evaluation of whether the practice causes unreasonable degradation in the context of all relevant environmental, social, and economic factors as contained in the Ocean Dumping Act. An EPA regulatory official told us that NOAA's scientific indices might be helpful in site management and monitoring.

We also identified another effort to address assimilative capacity. A private researcher, under contract with the National Science Foundation began work in 1982 to assess the concept of assimilative capacity as a structure for scientific research and as a tool for use by Government regulators. The researcher told us that work completed to date shows that although assimilative capacity is a good basis for structuring scientific research, caution must be exercised by the regulator in using assimilative capacity as a measuring tool for evaluating ocean waste disposal. The assimilative capacity of an ocean dump site, in the end, becomes a value judgment for the regulator and sufficient information is not available to make such a decision, according to the researcher. The extent of a site's assimilative capacity is an ethical and political issue subject to public acceptance.

Another effort to address ocean waste management policy is a symposium planned for May 1983 as part of the International Ocean Disposal Symposia Series. According to the NOAA coordinator, the overall objective of the 5-day program is to bring together Federal, State, and scientific ocean disposal experts in an effort to integrate existing scientific knowledge on ocean disposal; identify unknowns and weak points; and to order the scientific information so that decisions on how to safely use the oceans for disposal can be made.

Cross-media analysis is needed in the permit process

The Ocean Dumping Act requires EPA to balance the environmental consequences of and need for ocean disposal with the potential environmental impacts of feasible land-based alternatives. These alternatives include landfilling, land application/composting and incineration. Overall, there is a growing interest in making waste disposal decisions only after considering all available options. The alternatives to ocean disposal, however, are not problem free. There are environmental risks and limitations associated with these alternatives and information and methodology gaps which limit cross-media analyses.

Risks and limitations of alternatives

The use of a land based method of sludge disposal can involve risks and is limited by land availability in some cases. For example, we reported[9] in January 1977 that some former ocean dumpers of industrial wastes were sending their materials to a New Jersey landfill that EPA said was of questionable adequacy for accepting large volumes of industrial liquids. The landfill closed and is now on the list of hazardous waste sites to be cleaned up under the Federal Superfund Program.

Additionally, we reported[10] in 1978 that sludge containing high amounts of cadmium were being sold or given away to the public for possible agriculture use, including home vegetable gardens, and that such a practice represented a potential health hazard.

Cadmium is a toxic heavy metal that has been classified by the Occupational Safety and Health Administration, Department of Labor, as a suspected carcinogen. The danger of using sludge containing high levels of cadmium to grow food crops is that cadmium accumulates in plant tissues. At the time of our report EPA believed that using contaminated sludges on home vegetable gardens may pose the greatest risk to human health and the environment because presently there is no program to ensure proper land management by homeowners. The Administrator at the time said that EPA will develop criteria on acceptable cadmium application levels. As of May 11, 1983, EPA has not yet promulgated regulations on marketing and distribution of sludge-containing products.

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[9]"Problems and Progress in Regulating Ocean Dumping of Sewage Sludge and Industrial Wastes" (CED-77-18, Jan. 21, 1977).

[10]"Sewage Sludge--How Do We Cope With It" (CED-78-152, Sept. 25, 1978).

The sludge dumpers in the densely populated and heavily industrialized New York City-Northern New Jersey area have encountered serious obstacles during their examination of alternatives to ocean dumping.

The three sludge dumpers in New York State--New York City, Westchester County, and Nassau County--encountered obstacles when considering composting as an alternative to ocean dumping. New York City planned to compost its sludge and spread the compost on underdeveloped parkland but became concerned because without adequate controls the City's population would be directly exposed to excessive concentrations of heavy metals and other toxics. Further, future use of that land might be restricted. The City also projected that it had adequate land for only 7 years and that it would have to seek other outlets for its compost after that. The State of New York, however, currently bans use of compost on agricultural land, and some upstate counties have defined sludge and sludge-derived compost as offensive wastes that cannot be disposed of in the counties or transported through them.

Nassau and Westchester Counties also encountered obstacles. In Westchester, area residents opposed construction of the required sludge dewatering facility and the County itself did not approve another site selected for composting the dewatered sludge. County officials anticipate the same strong public opposition to building an incinerator. Nassau County decided not to apply compost to county land because the compost would pose the potential for groundwater contamination. This, coupled with the State's moratorium on use of sludge on agricultural land, led County officials to conclude that there would be no market for their compost.

According to the Director of the Planning Group in New Jersey's Department of Environmental Protection, the sewage sludges produced at the six large northern New Jersey treatment plants contain toxic heavy metals and some organic chemicals at a level that now foreclose both incineration and land disposal. Because these six plants produce 50 percent of sewage sludge in New Jersey, land application is not a practical approach. Landfilling also presents a problem. There are 14 landfills in New Jersey that accept sludge. However, only two of them are available for use by the six sewage authorities. The other 12 are not available to them because either the landfills are reaching capacity or landfills are dedicated to one municipality and will only accept sludge from that municipality or some landfills are in the process of being closed because of leaching, which could contaminate groundwater.

As a result of no land alternatives, the six major sludge dumpers in New Jersey considered incineration. However, this too presented a problem. By 1980, five of the six sewage authorities

had submitted applications to the State for air pollution control permits. Only one application was conditionally approved; the remaining applications were denied for three reasons: (1) projected violation of the particulate emission standard, (2) insufficient after-burning capability to control organic emission, and (3) projected high emissions of heavy metals. Subsequent submissions by the authorities showed better air pollution control and lower particulate and metal emissions. With additional air pollution control devices, the incinerators appeared to meet the particulate standard, but heavy metals remained a problem. At the request of the State of New Jersey, EPA conducted a health effects evaluation of the maximum ground level increase in the concentrations of heavy metals from the proposed sludge incinerators. The EPA report of September 1981 concluded that ground level lead emissions would exceed the national standard for the protection of public health, the secondary standard for particulates would be exacerbated, and the public health risk associated with increases of cadmium and chromium would be unacceptable. Additionally, the ash remaining after incineration might be designated a hazardous waste and require special handling.

The Planning Group Director and Assistant Director, New Jersey Department of Enviromental Protection, believe that industrial pretreatment (treatment of industrial wastes before they enter the municipal sewer system) is the key to the sludge problem. The Assistant Director told us this would remove three general groups of toxics: heavy metals, such as cadmium, mercury and lead; organic compounds such as PCBs; and petroleum hydrocarbons. However, he could not provide the percentage amounts for how much of the toxics would be removed or cost estimates for removing them. Once these toxic materials are removed, more sludge management options become available according to the New Jersey officials. Incineration, land application, and even ocean disposal all became more attractive once sewage sludge is "clean."

However, even with industrial pretreatment, there is some question as to how much cleaner municipal sludge will be. In our 1978 report (see footnote 10 on page 18), we concluded that while pretreatment will most probably reduce heavy metal and toxic organic chemical concentrations to safe levels in some sludges, it will not do so for other sludges. This is because such concentrations in municipal sludge can come from domestic as well as industrial sources.

A research paper on ocean disposal indicated that some municipal waste collection systems collect storm or runoff water as well as sanitary wastes. Because of street and land runoff, there may be significant additions of trace contaminants such as heavy metals and herbicides-pesticides which wind up in the sludge. In addition, a New Jersey sewage authority official cited

some contaminates that can come from non-industrial sources and wind up in sludge through the sewer system such as

--deterioration of lead and copper water pipes and waste lines in the home,

--lead emitted from car exhaust fumes, which then settles on the ground and washes off into the sewer system, and

--laundry detergents (e.g., phosphates) and bleaches flushed down the drain.

Sludge disposal problems are not limited to the East Coast. According to the General Manager of the County Sanitation Districts of Orange County California, public pressure has made it all but impossible to site land application composting facilities or landfills for the disposal of sewage sludge. For example, a study to develop a comprehensive sludge management plan for the Los Angeles and the Orange County metropolitan area met public opposition. As a result of this study looking at land application of sewage sludge in the California deserts several counties passed ordinances banning the "importation" of Los Angeles' sewage sludge into their jurisdictions. In addition, according to the Orange County official, at a public hearing on alternative sites for land composting Orange County's sludge, over 700 people attended--all of whom appeared to be totally opposed to any land alternative.

Problems with land based alternatives for other municipalities are presented in the table on page 26.

Information and methodology needed for cross-media analysis

As previously stated, a cross-media approach was emphasized in the decision arising from New York City's suit against EPA. That philosophy was also apparent in the January 1981 report[11] of the National Advisory Committee on Oceans and Atmosphere, which concluded that we must manage wastes, not media, and that the medium-by-medium approach of the 1970's is no longer adequate. The report recommended that the Congress and the executive branch adopt an integrated approach to waste management which would require EPA to modify its existing medium-by-medium approach to waste disposal. The report further concluded that

"* * * wastes should be disposed of in the manner and medium that minimizes the risk to human health and the environment, and at a price that this nation is prepared to pay."

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[11]"The Role of the Ocean in a Waste Management Strategy," National Advisory Committee on Oceans and Atmosphere (Jan. 1981).

As the chart on page 27 shows, Federal, State and sewage authority officials as well as representatives of environmental groups and the scientific community are also in support of this concept.

Although, there is wide support for cross-media analysis, there are some problems in doing such an analysis. These problems include gaps in information and lack of methodology. A representative of the Association of Municipal Sewerage Authorities has stated that he believes there are significant gaps in knowledge pertaining to the use of the oceans, land, and atmosphere. He further stated that research and monitoring studies on these alternatives must be continued and accelerated.

Gaps in information on ocean disposal have already been presented (see pp. 11-15). There are also gaps in information on land-based and incineration disposal options. For example, a report,[12] prepared for New York City, concluded that potential impacts associated with a full-scale pyrolysis operation have not been properly evaluated and will require further study before massive sludge pyrolysis programs are undertaken.

According to information presented at a municipal sludge management conference in 1979 there has been inadequate investigation on the possible transmission of parasitic disease organisms to man and animal as a result of sludge spreading. Additional information presented at the conference concluded that although pathogens surviving the composting process have not shown evidence of a serious health problem, the threat of one cannot be ruled out due to the limited data available. Still another identified gap is the effects of heavy metals in sludge on soil because of the interaction of metals together and with various types of soil.

EPA has recently sponsored two functions on alternatives to ocean disposal of sewage sludge. In February 1983, EPA sponsored a workshop on the utilization of waste water and sludge on land. The workshop was held in coordination with the Corps of Engineers, Department of Agriculture, the National Science Foundation, and the University of California. The workshop consisted of scientific presentations and economics and engineering aspects of land applications of sludge. Generally, the purpose was to determine how much is known and to identify information gaps regarding land application of sewage sludge. A final document on the proceedings is expected to be available in August 1983.

In March 1983, EPA sponsored a conference on thermal conversion of municipal sludge. The objective of the conference was to disseminate information on the design and operation of

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[12]"A Preliminary Assessment of Environmental Considerations for the Disposal of Sewage Sludge in the New York Bight: Present Ocean Dumping conditions and Proposed Land-Based Alternatives," Ecological Analysts, Inc. (May 1980).

sludge treatment and disposal systems--emphasizing thermal conversion systems such as incineration--and to evaluate various types of thermal conversion systems. According to a representative of the consulting firm which coordinated the conference, a summary report of the proceedings will be available in the fall of 1983.

In addition to the information gaps, detailed studies of land versus sea disposal options are as yet unavailable, according to the cochairman of a January 1983 workshop on land, sea, and air options for the disposal of industrial and domestic wastes. The objective of the workshop--sponsored by EPA, NOAA, and the National Academy of Science--was to determine what types of information are needed to assess the disposal options of given types of waste at given disposal sites. Another objective was to determine the environmental, economic, and regulatory criteria for selecting among those options. A final document summarizing the results of the workshop is not expected before June 1983.

During the workshop, representatives from NOAA, EPA, academia, sewage authorities and industry presented position papers in various areas such as marine sciences, economics, land disposal, sewage sludge and risk assessment. We reviewed some of the position papers and found that in general they identified the types of information needed to do a cross-media analysis. For example, one paper discussed the need for an adequate foundation of information on the basic biological and physical processes involved in the transportation and transformation of substances in the environment and the effects of these substances on plants, animals, and humans. Another paper stated that to compare the risks associated with each alternative, information is needed on such parameters as the composition of sludge, oceanic circulation, soil organic content and hydrological character, and the number of people using the fishery, food, or groundwater resources.

For alternative assessment there is a need to look at comparative risk assessments of human health, environment, costs, and social perceptions according to another panelist. It is generally recognized that all alternatives for dealing with sewage sludge may have environmental, human health, and economic consequences.

EPA acknowledges that it currently does not have the answer to the management of a complex and variable waste (sewage sludge) whose disposal may involve any medium in an environmentally protective and cost effective manner. However, EPA has two projects underway. A sludge management project was initiated in early 1982 in an effort to evaluate costs, benefits, and environmental effects of the disposal and use of sewage sludge across all media--air, land, and water. Specifically, the project is structured around a comparative assessment of environmental hazards, costs, and benefits of various disposal/reuse options

utilizing selected contaminants or sludge properties as indicators of environmental concern.

The objective of the project is to develop a cohesive policy on sludge management. Specific outputs will include comprehensive guidelines, a series of recommendations concerning revisions to existing regulations or development of new ones, and recommendations for a continuing program in the sludge management area. Expected completion is September 1983.

According to a background document on the project, the task force to carry out the project includes representatives from all major EPA programs and functions. In addition, other Federal agencies, States, industry, citizens groups, and others are involved informally.

EPA is also conducting a case study, using two municipal sewage authorities that are currently ocean dumping, to assess sludge management alternatives using a combination of the economics of cost-benefit analysis with risk analysis. This case study will be issued as part of the task force study on sludge management.

APPENDIX I

Summary of Sludge Produced by Publicly-Owned Municipal Wastewater Treatment Plants in Coastal Counties, 1980 and 2000 (Note a)

	Sludge produced			1980 Disposal Practices			
	1980	2000 (note b)	Percent change	Ocean dump	Land-fill	Land appl.	Other (note c)
EAST COAST							
Connecticut	37	71		0	32	3	2
Delaware	23	50		0	23	0	<1
District of Columbia	106	82		0	106	0	0
Florida d/	61	212		0	47	5	9
Georgia	5	9		0	4	0	1
Maine	15	24		0	13	1	1
Maryland	105	209		0	94	9	2
Massachusetts	47	105		0	21	1	25
New Hampshire	4	13		0	4	0	0
New Jersey	178	431		135	41	<1	2
New York	152	656		130	17	0	5
North Carolina	4	15		<1	2	2	<1
Pennsylvania	69	219		40	11	0	18
Rhode Island	12	37		0	10	0	2
South Carolina	7	26		0	3	<1	4
Virginia	30	92		0	11	19	<1
Total	855	2,251	163	305	439	40	71
GULF COAST							
Alabama	11	18		0	8	1	2
Florida d/	50	193		0	36	11	3
Louisiana	33	77		0	23	1	9
Mississippi	13	17		0	13	<1	<1
Texas	114	211		0	86	<1	28
Total	221	516	133	0	166	13	42
WEST COAST							
California e/	648	1,142		117	308	14	209
Oregon	44	87		0	23	19	2
Washington	80	261		0	47	11	22
Total	772	1,490	93	117	378	44	233
Grand Total	1,848	4,257	130	422	983	97	346

[a]All coastal counties as defined by the Federal Office of Coastal Zone Management.

[b]All values in thousands of tons/year of sludge production and disposal are rounded. Sludge is computed as dry solids.

[c]Other disposal practices include: incineration, lagooning, dumping into abandoned mines, and sale as soil conditioner.

[d]Does not include inland Florida counties.

[e]Sludge indicated as ocean dumped in California is actually discharged to ocean waters through ocean outfalls.

Source: "Identifying and Evaluating Alternative Ocean Dump Sites: An Operation Framework for Strategic Assessment and Estimates of Sludge Generated by Publicly-Owned Municipal Wastewater Treatment Plants" (NOV. 1982), NOAA.

APPENDIX I

Sewage Sludge Ocean Dumping Plans of East and West Coast Municipalities

Plans for Ocean Disposal

Municipality/authority	Yes/No	Projected amounts	Earliest date	Reason for the Decision
South Essex Sewerage District, South Essex, Mass.	Yes	58,400 Wet tons per year	Several years away	South Essex is experiencing problems with alternatives.
Jacksonville Dept. of Public Works Jacksonville, Fla.	No	Not Applicable	Not Applicable	Other alternatives available.
Office of the Water Commissioner Philadelphia, Pa.	No	Not Specified	Not Applicable	Return to ocean if problems develop with alternatives.
San Diego Water Utilities, San Diego, Calif.	Yes	511,000 Wet tons per year	1989	Ocean disposal will be the most economic alternative when the current site is no longer available.
San Francisco Dept. of Public Works, San Fransisco, Calif.	Yes	123,000 wet tons per year	1988	Ocean disposal will be the most economical alternative if landfilling becomes too expensive in 5 years.
East Bay Municipal Utility District Oakland, Calif.	Yes	300,000 500,000 wet tons per year	1985	Ocean disposal is an option depending on costs and if unexpected problems occur with composting.
Municipality of Metropolitan Seattle Utility Authority, Seattle, Wash.	No	Not Applicable	Not Applicable	Ocean disposal would be more expensive than current methods.
Sewer Utility Div., Dept. of Public Works, Tacoma, Wash.	No	Not Applicable	None	Current disposal methods work well.
Wastewater Engineering Division, Baltimore, Md.	Yes	Not Specified	Several years away	Ocean dumping is environmentally sound and more economical than land spreading.

Statements in Support of Cross-media Analysis

Official	Statement
Chairman, Conference of Coastal Agencies, Assoc. of Municipal Sewerage Authorities	There is no single method for disposing of or utilizing sewage sludge.
Representative of the National Wildlife Federation	No single sludge management alternative can be evaluated in isolation without comparison to other approaches that might be used instead.
NOAA officials, Stonybrook, N.Y.	Waste should be disposed of in the media that can best handle it.
Representative of the Environmental Defense Fund	The Government needs a coordinated effort and philosophy on waste disposal.
Representative of a New Jersey sewage authority	Someone needs to make a decision as to what is economically and environmentally more sound--ocean dumping or sludge disposal on land.
Researcher from Seamocean, Inc.	The rational management approach is to examine all of the feasible land, air, and water options for each waste and select the best disposal alternative.
EPA testimony	Disposal of wastes produced should be in a location and manner so as to minimize impacts and maximize cost effectiveness.
New Jersey Department of Environmental Protection official	An acceptable strategy on sewage sludge must be developed to provide a comprehensive basis for decisionmaking that evaluates land-based and ocean disposal site alternatives.

ORGANIZATIONS CONTACTED

DURING THIS REVIEW

FEDERAL AGENCIES

Environmental Protection Agency
- Headquarters, Washington, D.C.
- Region II, New York City
- Environmental Research Lab, Narragansett, R.I.

National Oceanic and Atmospheric Administration
- Headquarters, Rockville, Md.
- N.E. Office, National Ocean Service, Stonybrook, N.Y.
- N.E. Fisheries Center Lab, Sandy Hook, N.J.

United States Army Corps of Engineers, N.Y.
United States Coast Guard, Third Coast Guard District, N.Y.
Brookhaven National Labs, U.S. Fish and Wildlife Service, Dept. of Interior, N.Y.
National Academy of Sciences, Washington, D.C.

STATE AGENCIES

New Jersey Department of Environmental Protection
New York State Department of Environmental Conservation

MUNICIPALITIES/SEWAGE AUTHORITIES

Current ocean dumpers

- Department of Public Works, Nassau County, N.Y.
- Department of Environmental Protection, City of New York, N.Y.
- Westchester County, New York-Yonkers Joint Sewer Districts, N.Y.
- Joint Meeting of Essex and Union Counties, N.J.
- Linden Roselle Sewerage Authority, N.J.
- Rahway Valley Sewerage Authority, N.J.
- Bergen County Utilities Authority, N.J.
- Middlesex County Sewerage Authority, N.J.
- Passaic Valley Sewerage Commissioners, N.J.

Others

- Office of the Water Commissioner, City of Philadelphia, Pa.
- San Diego Water Utilities, San Diego, Calif.
- Department of Public Works, San Francisco, Calif.
- East Bay Municipal Utility District, Oakland, Calif.
- Metropolitan Seattle Utility Authority, Seattle, Wash.
- Department of Public Works, Jacksonville, Fla.

South Essex Sewerage District, South Essex, Mass.
Sewer Utility Division, Department of Public Works, Tacoma, Wash.
Wastewater Engineering Division, City of Baltimore, Md.
Bureau of Sanitation, Los Angeles, Calif.

INDUSTRIAL WASTE PRODUCERS

E.I. Dupont De Nemours and Co., Grasselli Plant, N.J.
E.I. Dupont De Nemours and Co., Edge Moor Plant, Del.

OTHERS

Association of Metropolitan Sewerage Agencies
American Littoral Society
Chemical Manufacturers Association
Environmental Defense Fund
Greenpeace, U.S.A.
National Wildlife Federation
SCRIPPS Institute of Oceanography
Sea Grants Extension Service, Rutgers University, N.J.
State University of New York at Stonybrook, Marine Science Research Center, Stonybrook, N.Y.

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