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Project Summary

Assessment for Future Environmental Problems—Ocean Dumping

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The objective of this research is to provide the U.S. Environmental Protection Agency's Office of Strategic Assessment and Special Studies with a technical basis for making decisions on research priorities and resource allocation as these relate to the question of ocean dumping. The problem was organized into four tasks. First, historical trends in waste generation, disposal, legislation and technology (as of 1982) were reviewed to indicate the likelihood that a particular waste type would be ocean dumped in the future. Second, the environmental implications of land-based alternatives were reviewed to provide background on the nature of risks associated with these alternatives. Third, the environmental implications of ocean disposal were reviewed for wastes and their constituents. Finally, based on the information generated in the first three tasks, recommendations are provided on future research needs and these are assigned either high, moderate, or low priority status.

This Project Summary was developed by EPA's Office of Exploratory Research, Washington, DC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Background

Implementation of the Resource Conservation and Recovery Act (RCRA) has focused and will continue to focus attention on various wastes and alternatives for their disposal; for some wastes, ocean dumping may be a better alternative than land-based disposal options. As increased emphasis is given to the use of coal over oil for power generation, there will be an increase in coal ash and slag; the U.S. may wish to consider ocean dumping of this waste as is presently being done by the United Kingdom. For certain wastes there has been increased international (through the Intergovernmental Maritime Consultation Organization [IMCO]) and national interest in incineration at sea.

The U.S. discontinued ocean dumping of low level radioactive waste (LLW) in 1970. However, other countries (e.g., England, Belgium, France, Switzerland, and the Netherlands) have continued to dispose of LLW in the northeast Atlantic under the review of the Organization of Economic Cooperative Development (OECD), Nuclear Energy Agency (NEA). Japan, which is also a member of NEA, is considering ocean disposal of LLW in the Pacific. Although the London Convention and U.S. regulations prohibit ocean disposal of high level radioactive waste, the convention and U.S. regulations also call for the issuance of permits for the disposal of radioactive matter other than high level. In issuing such permits, the contracting parties should take full account of the recommendations of the competent international body in this field, at present the International Atomic Energy Agency. There is still interest in the United States for future ocean disposal of LLW.

Among the factors related to future consideration of ocean dumping as a waste disposal alternative is the assimilative capacity of the ocean for pollutants. It is presumed that the oceans can accept

or assimilate certain pollutants at some rate of disposal in particular areas. Determination of these levels through technical means (e.g., studies of fates and effects combined with appropriate modeling techniques) then provides a basis for permitting or restricting discharges. Preliminary efforts to assess the assimilative capacity of the ocean were made at the Crystal Mountain Workshop held by NOAA in December 1979. A panel on sources attempted to identify anticipated amounts and types of industrial, agricultrual, and domestic wastes for which disposal in the ocean might be considered. Six other panels studied the assimilative capacities of water bodies. Two of those considered problems related to estuaries and the coastal and open ocean. The four remaining panels studied the site-specific problems of Dumpsite 106, Puget Sound, and New York Bight, and the Southern California Bight. While the workshop indicated that evaluating the assimilative capacity of the ocean was useful in determining limits on discharges, the *inadequacies* of present-day models to predict impacts to ecosystems, with respect to long-term, low-level effects, was well recognized. The long-term chronic effect of marine pollution also was identified as a primary concern in the Global 2000 Report to the U.S. President prepared by the Council on Environmental Quality.

Introduction

An initial task in this study was to determine classes or types of wastes which might be considered for future ocean dumping. Several criteria were used to select the wastes considered in this study:

1. The study included wastes permitted for ocean dumping by the London Convention (Table 1) but not those prohibited (Table 2). Therefore, wastes such as organochlorines, which are prohibited from ocean dumping but which may be incinerated at sea, are not discussed. The incineration-at-sea alternative, which would be used for wastes generally prohibited from ocean dumping, is not discussed in this report.
2. The study considered classes of wastes that, if disposed of at sea, would be typically ocean dumped (e.g., sewage sludge) as opposed to discharged (e.g., effluent from coastal treatment plants). The former classes of wastes and disposal methods are presently regulated under the Ocean Dumping Permit Program, the latter under the NPDES Permit Program.
3. The study included nonhazardous wastes that, because of their high volume and characteristics, may pose problems for land disposal (e.g., sewage sludge and fly ash); the study did not consider low volume nonhazardous wastes.
4. The study included wastes defined as hazardous under EPA's hazardous waste criteria but which are not excluded from ocean dumping by the London Convention (Table 2).

Survey of U.S. EPA Regions

In an effort to assess likely trends in ocean dumping practices, a survey was conducted of all U.S. EPA Regional Ocean Dumping Coordinators in EPA Coastal Regions I, II, III, IV, VI, IX, and X (Figure 1). The survey results (Table 3) indicate likely trends for ocean dumping based on the historical perspective and current activity in the regions. The significance of these projections must be viewed in light of the history of ocean dumping in each region, as well as the current and projected industrial and population growth of major economic centers within each region.

Discussion

This study was organized into four tasks. First, historical trends in waste generation, distribution among alternative disposal methods, and disposal costs were reviewed, and legislative, technological, and economic factors that may influence these were examined. This task served to indicate the likelihood that a particular waste type would be ocean dumped in the future. Second, the environmental implications of land-based alternatives were reviewed to provide background on the nature of risks associated with these alternatives. These risks would have to be considered during formal cross-media risk analyses. Third, the environmental implications of ocean disposal were reviewed for the selected wastes and their constituents. This review

Table 1. *Materials That Require Special Care or Permits for Ocean Dumping. (Annex II of London Convention)*

1. *Wastes containing significant amounts of the matters listed below:*

   arsenic, lead, copper, zinc } *and their compounds*
   organosilicon compounds
   cyanides
   fluorides
   pesticides and their by-products not covered in Annex I (see Table 112).

2. *In the issue of permits for the dumping of large quantities of acids and alkalies, consideration shall be given to the possible presence in such wastes of the substances listed in Number 1 and to the following additional substances:*

   beryllium, chromium, nickel, vanadium } *and their compounds*

3. *Containers, scrap metal, and other bulky wastes liable to sink to the sea bottom which may present a serious obstacle to fishing or navigation.*
4. *Radioactive wastes or other radioactive matter not included in Annex I. In the issue of permits for the dumping of this matter, the recommendations of the competent agencies in this field should be considered.*
5. *Dredge spoils.*
6. *Substances that, though of a non-toxic nature, may become harmful due to the quantities in which they are dumped, or that are liable to seriously reduce amenities.*
7. *Titanium dioxide (specified by Council of European Communities).*

Table 2. Materials Generally Prohibited from Ocean Dumping[a,b] (Annex I of London Convention)

1. *Organohalogen compounds and compounds that may form such substances in the marine environment, excluding those that are non-toxic, or that are rapidly converted in the sea into substances that are biologically harmless.*
2. *Organosilicon compounds and compounds that may form such substances in the marine environment, excluding those that are non-toxic, or that are rapidly converted in the sea into substances that are biologically harmless.*
3. *Substances that are likely to be carcinogenic under conditions of disposal.*
4. *Mercury and mercury compounds.*
5. *Cadmium and cadmium compounds.*
6. *Persistent plastics and other persistent synthetic materials that may float or may remain in suspension in the sea so as to interfere materially with fishing, navigation, or other legitimate uses of the sea.*
7. *Crude oil, fuel oil, heavy diesel oil, lubricating oils, hydraulic fluids, and any mixtures containing any of these, taken on board for the purpose of dumping.*
8. *High-level radioactive wastes or other high-level radioactive matter, defined on public health, biological, or other grounds, by the competent international body in this field, at present the International Atomic Energy Agency, as unsuitable for dumping at sea.*
9. *Materials in whatever form (e.g., solids, liquids, semiliquids, gases, or in a living state) produced for biological and chemical warfare.*

[a] *This table does not apply to substances that are rapidly rendered harmless by physical, chemical, or biological processes in the sea, provided they do not:*

(i) make edible marine organisms unpalatable, or
(ii) endanger human health or that of domestic animals.

[b] *This table does not apply to wastes or other materials (e.g., sewage sludges and dredged spoils) containing the matters referred to in Numbers 1-7 above as trace contaminants.*

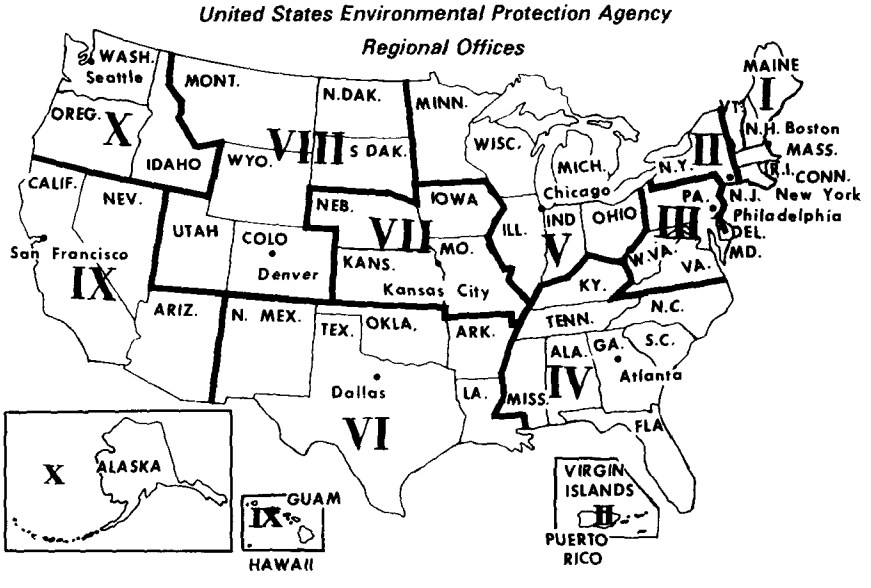

Figure 1. Map of U.S. EPA standard federal regions and regional offices.

aided in identifying technical areas where there was a lack of information, research, or analytical techniques for evaluating environmental impacts associated with ocean disposal.The final task was to provide recommendations for future research.

The following waste types were considered in this program: sewage sludge, dredged material, fly ash, flue gas desulfurization (FGD) sludge, gypsum, acid iron waste, industrial sludges, and low-level radioactive waste (LLW). All of these types are expected to increase in volume in the future. With regard to the probability that these wastes will be ocean dumped in the future, the review of trends in disposal as well as legislative, economic, and political factors suggests the following: sewage sludge (moderate-high probability), dredged material (high probability), fly ash (moderate probability), FGD sludge (moderate probability), fly ash (moderate probability), FGD sludge (moderate probability), gypsum (low-moderate probability), acid-iron waste (moderate-high probability), industrial sludges (low-moderate probability), LLW (moderate probability).

A review of land based alternatives indicated that no alternative is risk free, although some alternatives pose greater risks than others. The information presented underscores the need for a cross-media risk analysis approach to waste management. The following land-based waste disposal alternatives were examined: landfills and land burial (sewage sludge, dredged material, some industrial wastes, LLW); land spreading (sewage sludge, dredged material, some industrial wastes); incineration (sewage sludge, some industrial wastes); solidification (some industrial wastes); and deep well injection (some industrial wastes).

The fate and effects of ocean dumped wastes were reviewed in general and a more detailed review was provided on the fate and effects of specific classes of contaminants. Special attention was given to specific constituents because 1) major concerns regarding long-term effects of ocean dumping arise from questions related to the persistence and biological fate and effects of particular contaminants within the wastes; 2) many wastes have a number of contaminants in common (e.g. chlorinated hydrocarbons, heavy metals) and by focusing on these it is possible to formulate research recommendations that address one or more types of wastes; and 3) some wastes are highly variable and an evaluation of the effects of such wastes requires an understand-

ing of the major constituents: nutrients, metals, halogenated hydrocarbons, polynuclear aromatic hydrocarbons, and radionuclides.

Recommendations for future research are presented for twelve general categories of studies. Relative priorities (high, moderate, low) are assigned for each category of study for each waste type. For example, studies on uptake, storage, and depuration of metals are assigned a high priority status for industrial sludge but moderate priority status for other waste categories. The categories of studies assigned high priority status for two or more types of wastes include physical fate of particulate materials; uptake, storage, depuration of halogenated hydrocarbons; effects of sediment alteration on benthic larval settlement; site monitoring; inventory of waste constituents; and methodologies for cross-media risk assessment. Particulate recommendations within these and other lower priority categories of studies are presented.

Table 3. *Results of Telephone Survey of U.S. EPA Regional Ocean Dumping Coordinators*

Waste	USEPA Regions 1	2	3	4	6	9	10	Remarks
Sewage Sludge	*I*	*D**	*I*	*I*	*I*	*I*	*I*	**Region 2 believes 1977 regulations will prevail and continue to prohibit this disposal.*
Dredged Material	*S*	*S*	*S*	*S*	*I*[1]	*I*[2]	*I*[2]	*[1]S.W. Ind. Growth [2]Deepening Projects.*
Fly Ash	*I*	*I*	*S*	*S*	*NR*	*S*	*S*	*Region 10 has very little now.*
RCRA Driven Chemical Waste	*I*	*I*	*I*	*I*	*I*	*I*	*I*	*Also avoiding pretreatment requirements.*
Gypsum Sludge	*NR*	*I*	*I*	*NR*	*I*	*S*	*NR*	*Gypsum sludge parallels the increase in chemical waste.*
Low-Level Rad Waste	*I*	*I*		*I*	*I*			
Ocean Incineration	*I*	*I*	*NR*	*I*	*I*	*NR*	*NR*	*Ships being built for operation in any region.*
Construction/Demolition Debris	*I*	*S*	*S*	*NR*	*NR*	*NR*	*I**	**Primarily from Alaska.*
Cannery Waste	*NR*	*NR*	*NR*	*NR*	*NR*	*1*	*NR*	*Only reported in Region 9.*
NSSC Liquor	*NR*	*NR*	*NR*	*NR*	*NR*	*NR*	*I*	*Only reported in Region 10.*
Secondary Sludge from Pulp and Paper	*NR*	*NR*	*NR*	*NR*	*NR*	*NR*	*I*	*Only from Region 10.*
Phosphate Mining	*NR*	*NR*	*NR*	*I*	*NR*	*NR*	*NR*	*Reported only in Region 4, uncertain whether O.D. permit will be required*
Drilling Muds	*NR*	*NR*	*NR*	*I*	*I*	*I*	*NR*	*Likely only where nearby deep water is available.*
Deep Ocean Mining	*NR*	*NR*	*NR*	*NR*	*NR*	*I**	*NR*	**May or may not be an Ocean Dumping permit.*
Tires	*I*	*I*	*I*	*D*	*NR*	*NR*	*NR*	*Principally as proposals to construct fish reefs.*
Vessels	*S*	*S*	*S*	*S*	*NR*	*NR*	*S*	*Vessels will continue to be scuttled for various reasons.*

I = Increase
D= Decrease
S= Same
NR= Not Reported

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***Marvin Rogul** was the EPA Project Officer (for present contact see below).*
The complete report, entitled "Assessment for Future Environmental Problems—Ocean Dumping," (Order No. PB 84-126 770; Cost: $16.00, subject to change) will be available only from:
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