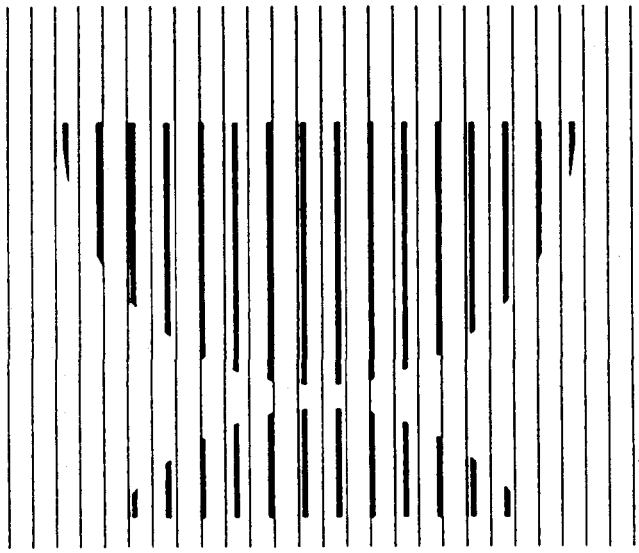
CBO STAFF MEMORANDUM

DECREASING THE DISCHARGE OF BIOACCUMULATIVE TOXIC WATER POLLUTANTS: A POLICY ANALYSIS

December 1992



CONGRESSIONAL BUDGET OFFICE
SECOND AND D STREETS, S.W.
WASHINGTON, D.C. 20515

This memorandum examines a policy to reduce overall discharges of toxic pollutants into water bodies that would allow trading of "discharge credits" among firms. Compared with requiring uniform reductions in discharges across all firms, this policy could achieve reductions in total discharges at a lower cost to industry. The memorandum was written by Terry Dinan of CBO's Natural Resources and Commerce Division under the direction of Jan Acton and Roger Hitchner.

Questions about this memorandum may be addressed to Terry Dinan at (202) 226-2946.

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INTRODUCTION

The 103rd Congress will have the opportunity to amend the Clean Water Act (CWA). An important issue that may arise in this effort is whether the control of toxic pollutants should be strengthened, and if so, how. The main reauthorization bill considered in the Senate during the 102nd Congress, S. 1081, contained a provision that would prohibit the discharge of any pollutant that is highly toxic and highly bioaccumulative, that is, tends to accumulate in fish tissue. An alternative policy would set a goal for a reduced level of discharge of these toxic pollutants and would carry out the reduction through a trading program. Under this trading program, firms that reduce the discharge of these toxic substances below the required level would generate excess "discharge credits" that they could sell to firms that find it costly to meet the required reduction levels. Under the proposed policy, discharge credits could be traded across water bodies and states.

The proposed policy is less restrictive than the provisions in S. 1081 in two ways:

- The proposed policy would establish a percentage reduction requirement for discharges of bioaccumulative pollutants, rather than ban them; and,

- The discharge credit trading aspect of this policy would allow firms that find it costly to reduce their discharges to comply with the policy by an alternative method. They could pay firms that can reduce discharges at a lower cost to go beyond the percentage requirement.

The proposed policy is also significantly different from water pollution requirements under the current Clean Water Act in two ways:

- Current regulations require firms either to meet technology standards for abating pollution or to ensure that their discharges meet certain concentration limits rather than establish percentage reductions in discharges; and,

- Under current regulations, with a few limited exceptions, firms do not trade pollution discharges. This would be the first

national water pollutant trading program in the United States.

The Congressional Budget Office (CBO) believes that the proposed policy would allow industry to achieve a given reduction in discharges at less cost than would a uniform standard, under which all firms have to reduce their discharges by a required percentage and cannot trade. Alternatively, industry could achieve a greater reduction in discharges for any given cost under a discharge credit trading program than under a uniform standard. The proposed policy, however, has some limitations. For instance, trades that do not actually improve water quality may be possible, and the policy may not alleviate some of the problems associated with toxic substances.

CBO evaluated the proposed policy and each of its alternatives with respect to:

- Whether or not they are efficient--that is, are able to achieve a given level of pollution reduction at the least possible cost;

- Whether or not they would resolve current environmental problems created by toxic substances in surface water; and,

- Their administrative feasibility.

OVERVIEW OF TOXIC SUBSTANCES: THEIR EFFECTS AND CURRENT CONTROLS

It is important to have a general understanding of toxic substances and their potential health and environmental effects in order to understand whether or not the proposed policy and its alternatives would be suitable for mitigating these problems.

What Are Toxic Substances?

Toxic pollutants are defined as "those pollutants or combination of pollutants which, after discharge and upon exposure, will, on the basis of information available to the Environmental Protection Agency (EPA), cause death, disease, behavior abnormalities, etc."[1] Explicitly excluded from the definition of toxic substances are conventional pollutants (biological oxygen-demanding material, suspended solids, fecal coliform, and pH) and nonconventional pollutants (such as ammonia and chlorine).

1. 33 U.S.C. § 1362(13).

Toxic pollutants generally include organic chemicals (such as solvents, dioxins, and polychlorinated biphenyls), metals (such as mercury, lead, and copper), and pesticides.[2]

Three important characteristics of a toxic pollutant are its toxicity, its tendency to accumulate in fish tissue, and its persistence (lack of degradation over time). The EPA has developed a toxic weighting system as one measure of toxicity.[3] A toxic weighting factor is derived for a pollutant by dividing its water quality criterion (that is, the level necessary to protect human health or the environment) into the criterion for a selected standard pollutant, copper. These toxic weights indicate how toxic each pollutant is compared with copper.

There are two measures of the tendency of a chemical to accumulate in fish tissue. The bioconcentration factor (BCF) is the ratio of a substance's concentration in tissue to its concentration in ambient water when the food chain is not exposed to the substance (that is, it reflects the amount absorbed through the gills or the epithelial tissues). The bioaccumulation factor (BAF) is this same ratio when both the

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2. General Accounting Office, *Stronger Efforts Needed by EPA to Control Toxic Water Pollution*, GAO/RCED-91-154 (July 1991), p. 8.

3. Environmental Protection Agency, "Toxic Weighting Factors for Pesticide Active Ingredients and Priority Pollutants," Draft Final Report (March 1992).

organism itself and the food chain are exposed. The bioaccumulation of toxic substances can be greatly magnified in organisms that are higher on the food chain because the chemicals absorbed by species at lower levels are transferred to species that prey upon them. The bioaccumulation and bioconcentration factors for a chemical are related as follows: BAF = FM x BCF, where FM is a food chain multiplier.

A measure of the persistence of a pollutant is its half-life, or the amount of time it takes for one-half of the substance to degrade. Pollutants that accumulate tend to be persistent, but not uniformly so. For example, dioxin, a pollutant discharged by pulp and paper mills, may be metabolized by fish over a period of three to five years, but chlordane, a pesticide, will not. The degree of persistence of a toxic substance is not reflected in water quality standards.

Toxic Substances in the Environment

The EPA maintains the Toxic Release Inventory (TRI), which provides information on the releases of pollutants by manufacturing facilities. According to the TRI, 193.5 million pounds of toxic substances were

discharged directly into water in 1989. In addition, 2.5 billion pounds were released into the air and 454.4 million pounds disposed of on land. An unknown amount of these toxic substances find their way into water, deposited from the air or through leaching or runoff. Finally, an additional 557.2 million pounds of toxic substances were discharged to sewers. Publicly owned treatment works process these substances and may discharge them into surface waters, depending on the treatment technology.

The TRI data provide some insights into the quantity of toxic pollutants released; however, there is little comprehensive information available about the effects of toxic substances in water.

Percentage of Monitored Waters with Elevated Levels of Toxicity. The *National Water Quality Inventory: 1990 Report to Congress* provides information on the percentage of monitored surface-water bodies with elevated levels of toxicity (see Table 1).[4] Elevated levels of toxicity are more prevalent in lakes than in rivers (55 percent of the lake acres with elevated levels of toxicity are located in Minnesota), and the problem is particularly prevalent along the shores of the Great Lakes. But the

4. Environmental Protection Agency, *National Water Quality Inventory: 1990 Report to Congress*, EPA 503/9-92/006 (April 1992).

TABLE 1. U.S. BODIES OF WATER WITH ELEVATED LEVELS OF TOXICITY

Water Body Type	Total Waters	Monitored for Toxicity	Percentage with Elevated Toxicity
Rivers (miles)	1,069,221	182,611	15
Lakes (acres)	23,290,321	9,204,721	39
Estuaries (sq. miles)	29,687	10,159	19
Oceans (coastal miles)	17,163	1,837	7
Great Lakes (shore miles)	5,164	4,893	98

SOURCE: Congressional Budget Office based on data from Environmental Protection Agency, National Water Quality Inventory: 1990 Report to Congress, EPA 503/9-92/006 (April 1992).

problem is not limited to Minnesota and the Great Lakes. For example, researchers in Arizona, Connecticut, Delaware, Iowa, Massachusetts, and Washington all found elevated toxic levels in more than 25 percent of their monitored rivers and lakes.

Fishing Restrictions. Fishing restrictions are one possible result of increased toxicity. Research Triangle Institute (RTI) compiles information on fishing restrictions for the EPA using data provided by states for the National Water Quality Inventory as well as additional information collected from states. According to RTI findings, there were 1,009 fishing restrictions in force in the United States between January 1990 and September 1992, with nearly 50 percent of them in two states,

Minnesota and Wisconsin (see Table 2).[5] (See Table 3 for information on the pollutants associated with the restrictions.) The top five pollutants account for 92 percent of all fishing restrictions. Mercury and polychlorinated biphenyls account for 79 percent of the total.

The *National Study of Chemical Residues in Fish* is a recent source of information on the potential health effects associated with bioaccumulative toxic pollutants.[6] This study examined fish tissues for concentrations of 60 compounds. Samples were taken at 314 sites thought to be influenced by a variety of pollution sources and an additional 35 sites representative of background levels. The study was initiated as a follow-up to one on dioxins. Therefore, many of the targeted sites selected were those thought to be producers of dioxins (see Table 4 for a report on the cancer risks associated with fish consumption at these sites for compounds for which cancer potency factors were available). The highest estimated lifetime cancer risk levels are associated with polychlorinated biphenyls. The cancer risk exceeded one in 10,000 at 42 of the 106 sites for which fillet data were available. Significantly, cancer-risk information was not provided for mercury, the number one cause of

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5. Information provided by Patricia A. Cunningham, Center for Environmental Analysis, Research Triangle Institute (November 1992).

6. Environmental Protection Agency, *National Study of Chemical Residues in Fish*, EPA 823-R-92-008a (September 1992).

TABLE 2. STATES WITH THE MOST FISHING RESTRICTIONS IN EFFECT, JANUARY 1990 THROUGH SEPTEMBER 1992

State	Number of Restrictions
Minnesota	388
Wisconsin	255
Michigan	60
New York	48
Florida	33
Indiana	25

SOURCE: Congressional Budget Office based on data from Research Triangle Institute draft data on fishing restrictions. Information provided by Patricia A. Cunningham, Center for Environmental Analysis, RTI (November 1992).

TABLE 3. FIVE LEADING CAUSES OF FISHING RESTRICTIONS, JANUARY 1990 THROUGH SEPTEMBER 1992

Pollutant	Percentage of Fishing Restrictions Pollutant Caused
Mercury	56
Polychlorinated biphenyls	23
Chlordane	8
Dioxin	4
DDT (and its by-products)	2

SOURCE: Congressional Budget Office based on data from Research Triangle Institute draft data on fishing restrictions. Information provided by Patricia A. Cunningham, Center for Environmental Analysis, RTI (November 1992).

TABLE 4. CANCER RISKS ASSOCIATED WITH CHEMICAL RESIDUES FOUND IN FISH

Chemical	No. of Sites with Fillet Data	Risk Level (Cumulative)[a] 10^{-6} (>1 in 1,000,000)	10^{-5} (>1 in 100,000)	10^{-4} (>1 in 10,000)	10^{-3} (>1 in 1,000)
		Targeted Sites			
PCBs	106	89	79	42	10
Dieldrin	106	53	31	6	0
Combined Chlordane[b]	106	44	10	0	0
DDE (by-product of DDT)	106	40	10	0	0
Heptachlor Epoxide	106	9	2	0	0
Alpha-BHC	106	11	1	0	0
Mirex	106	8	2	0	0
HCB	106	5	0	0	0
Gamma-BHC	106	0	0	0	0
Heptachlor	106	0	0	0	0
Dicofol	106	0	0	0	0
Hexachlorobutadiene	106	0	0	0	0
Pentachloroanisole	106	0	0	0	0
Trifluralin	106	0	0	0	0
		Background Sites			
PCBs	4	1	1	0	0
DDE	4	1	0	0	0

SOURCE: Environmental Protection Agency, *National Study of Chemical Residues in Fish*, EPA 823-R-92-008a (September 1992).

a. Basis: 1) EPA (upper-bound) cancer potency factors.
2) Consumption rate of 6.5 grams per day.
3) Average fillet concentrations at the few sites with multiple samples.

b. Combined chlordane is the sum of cis- and trans-chlordane isomers, cis- and trans-nonachlor isomers, and oxychlordane.

fishing restrictions, or dioxin, the fourth leading cause of fishing restrictions.

Sources of Toxic Substances in the Great Lakes. The *Great Lakes Risk Characterization Study* provides information on the source of toxic substances found in the Great Lakes (see Table 5).[7] These data indicate that while industrial and municipal point sources are significant contributors to the toxic problem, they do not account for all of it. Deposits from the atmosphere are reported to have contributed as much to the toxic load found in the Great Lakes as industrial and municipal point sources combined. In addition, nonpoint sources are estimated to have contributed over one-quarter of the toxic pollutants.

Regulation of Toxic Water Pollutants

EPA has developed a list of 126 "priority" chemicals and developed technology-based standards (called effluent guidelines) for 36 categories

7. Environmental Protection Agency, *Great Lakes Risk Characterization Study*, Draft report (March 1992).

TABLE 5. CONTRIBUTION OF SOURCES TO TOXICITY IN THE GREAT LAKES

Source	Load Percentage
Industrial Point Source	16
Municipal Point Source	18
Nonpoint Source	28
Atmospheric Load	38

SOURCE: Environmental Protection Agency, Great Lakes Risk Characterization Study, Draft Report (March 1992).

of industries that discharge toxic substances.[8] In addition, the CWA directs the states to adopt numeric water quality standards for all priority pollutants. The EPA has issued two types of water quality criteria: one set for 109 of the priority pollutants affecting human health and the other for 30 of the priority pollutants affecting aquatic life.

Under the 1987 amendments to the CWA, states were directed to develop lists of "impaired" waters--waters that do not meet established water quality standards, even after technology-based standards have been enacted.

8. General Accounting Office, *Stronger Efforts Needed by EPA to Control Toxic Water Pollution*, GAO/RCED-91-154 (July 1991), p. 52.

Incorporation of Bioaccumulation Factors into Water Quality Standards

The EPA uses a series of laboratory tests to develop criteria for water quality for aquatic life.[9] These tests indicate the amount of a chemical that fish and invertebrates can tolerate for only a short time, known as the acute effects level, and the amount that fish and invertebrates can tolerate over a longer period of time with no adverse effects (the chronic effect level). Bioconcentration and bioaccumulation factors do not directly influence the level at which most aquatic water quality criteria are set. A few pesticides are an exception to this because the FDA has set "action levels" for these pesticides, which indicate a maximum concentration of the substance that may exist in fish that are destined for the market.

The EPA sets criteria for water quality for both the carcinogenic and noncarcinogenic effects of a waterborne chemical on human health. The bioconcentration factor associated with a pollutant is directly incorporated into both of these, but its bioaccumulation factor is not. In most cases the standard for the carcinogenic effect is the lower of the two and is used as

9. Robert April, Chief of the Ecological Risk Assessment Branch, Environmental Protection Agency, personal communication (October 1992).

the standard for human health. The formula used in setting the criteria for carcinogenic effects of water quality is[10]:

$$C\ (mg/l) = \frac{(RL \times 70kg)}{q_1^* (2l + 0.0065\ kg/d \times BCF)}$$

where:

C is the updated water quality criterion (mg/l);

RL is the risk level (10^{-x});

70 kg is the assumed human body weight;

q_1^* is a carcinogenic potency factor (kg day/mg);

2l is the assumed average daily water intake for a 70-kg human;

0.0065 kg/d is the national average fish consumption per person; and

BCF is the measured or estimated bioconcentration factor (mg pollutant/kg fish divided by mg pollutant/l in ambient water).

As indicated in the above formula, increases in the BCF will reduce the criterion for allowable water quality. This methodology was established in 1980, and all but four of the 109 water quality criteria for human health incorporate a BCF value. (The exceptions are lead, mercury, asbestos, and acrolein.) The EPA is currently considering revising the

10. Environmental Protection Agency, "Issue Paper on Revision of Methodology for Deriving Human Health Ambient Water Quality Criteria," Draft Document (August 1992).

method by which bioconcentration factors are incorporated into criteria for water quality. (See the section titled "How Should Discharge Units Be Defined?".)

GAO Observations About Controls for Toxic Pollutants. Water quality criteria have been set for many toxic pollutants, but in a recent study of EPA efforts to control toxic water pollution the General Accounting Office (GAO) concluded that current controls are insufficient.[11] Among the GAO observations:

- The priority list does not include all of the most harmful toxic pollutants. (There are more than 65,000 chemical substances manufactured or processed in the United States, and more than 1,000 new substances are introduced each year.)[12]

- Water quality monitoring is insufficient to identify toxic pollution problems;

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11. See General Accounting Office, *Stronger Efforts Needed by EPA to Control Toxic Water Pollution*, GAO/RCED-91-154 (July 1991).

12. GAO, p. 8.

- National effluent guidelines and criteria documents used to set numerical toxic limits address only a limited number of toxic discharges and have not been developed or updated as necessary;

- Some states have been reluctant to adopt numerical toxic discharge limits;

- Many dischargers, particularly publicly owned treatment works (POTWs), are having difficulty complying with existing discharge limits.

Summary

Toxic water pollutants pose a threat throughout the United States, but the problem is most severe in the Great Lakes. Toxic substances find their way into surface water bodies in a variety of ways including industrial discharges, POTWs, nonpoint sources, and deposits from the atmosphere. Limited monitoring of toxic substances makes it difficult to assess the extent of the threat that they pose to the environment and human health.

Increased monitoring of toxic substances is an important first step that must be taken in order to understand the extent of the problem.

Available data indicate that mercury, polychlorinated biphenyls, dioxin, and the pesticides DDT, dieldrin, and chlordane pose the greatest threats to health. Some of these substances are no longer used in the United States, but persist in the environment. In addition, some may be transported by air from countries in which they are still used. Increased monitoring and additional scientific data could shed more light on the threat posed by other toxic substances.

ANALYSIS OF POLICY OPTIONS

Given the continuing concern about toxic discharges, it may be worth considering options for improving the existing system of controls. One proposal that has been discussed is the idea of using a "tradable credit" approach to reduce the discharge of toxic substances that have high bioconcentration factors. Important design issues for this policy include:

- How should discharge units be defined in order to ensure that trades result in improvements to water quality?

- Are the available data for determining firms' discharges adequate to ensure that the policy goals are met?

- What would be the implications of trading discharge credits across bodies of water versus restricting trades to a single body of water?

In addition to evaluating these design issues, this section discusses the likely cost and water quality improvements that would result from the policy and examines its administrative feasibility.

Description

Under the proposed policy, Congress would set a goal for reducing the discharge of "bioconcentration pounds." Bioconcentration pounds are equal to the pounds of toxic pollutants that are discharged, multiplied by their bioconcentration factors. For example, if a firm discharged 20

pounds of a toxic that has a bioconcentration factor of 500, it would be discharging 10,000 bioconcentration pounds. For the sake of this discussion, CBO has assumed that the goal is set at a 50 percent reduction from a "base" level. The most recent data from the TRI would be used to establish the base for each firm. For example, if a firm was discharging 10,000 bioconcentration pounds in the base year, it would be required to reduce its discharge level to 5,000 pounds. (In reality, this goal could be phased in over time.)

Under the proposed plan, firms would be allowed to trade bioconcentration pound "discharge credits." Firms that can reduce the discharge of bioconcentration pounds for a relatively low price may choose to reduce their discharges more than the required amount (that is, more than 50 percent under this example). These firms would therefore have excess discharge credits that they would be free to sell. Firms that find it costly to reduce the discharge of bioconcentration pounds may choose to reduce their discharges by less than the required amount and buy excess discharge credits from firms that have reduced bioconcentration pounds more than required. Theoretically, this aspect of the policy could result in considerable cost savings over a uniform reduction, in which all firms must reduce their discharges by 50 percent

regardless of the cost. If a competitive market for discharge credits emerged, this policy should be efficient; that is, it should allow the required reduction to occur at the lowest possible cost.

The reduction goal established by this policy would be a requirement above and beyond existing standards established under the Clean Water Act. Each firm's trades would be required to be in compliance with existing effluent guidelines and water quality criteria; firms would not be able to violate these existing standards by buying discharge credits. If firms were in compliance with existing standards, however, no regional restrictions on trading are envisioned; discharge credits could be exchanged across states and bodies of water.

The policy would include only toxic substances that have a BCF of 250 or higher. Each firm that is required to report to the EPA's TRI would be required to comply with the policy. This includes manufacturing firms with 10 or more employees that produce, import, or process more than 25,000 pounds of a TRI chemical or that use 10,000 pounds or more of a TRI chemical. Use of the TRI allows the policy to be carried out relatively quickly using existing data.

How Should Discharge Units be Defined?

There are two ways of measuring the tendency of a toxic substance to accumulate in fish--the BCF and the BAF. Both measures are significantly imprecise. The BCF may be predicted on the basis of the pollutant's properties or may be measured on the basis of experiments with fish. The BAF may be predicted from the BCF and a food chain multiplier (see above), or it may be derived from actual measurements in fish. The fatty content of the fish, the percent lipid, will affect the resulting BCF and BAF measures, with higher percent lipids resulting in higher BCF and BAF levels. The EPA currently uses a 3 percent lipid level in estimating BCF levels, but a program aimed at reducing toxicity in the Great Lakes, the Great Lakes Initiative (GLI), uses a 6 percent lipid level. The EPA is considering revising its water quality criterion procedure to use the lipid content for site- or region-specific species of fish when estimating the BCF.[13]

Under the proposed policy, firms would trade "bioconcentration pounds," defined as pounds of a pollutant multiplied by its BCF. While

13. Environmental Protection Agency, "Issue Paper on Revision of Methodology for Deriving Human Health Ambient Water Quality Criteria," Draft Document (August 1992).

BCFs provide a measure of the tendency of a pollutant to accumulate in fish, BAFs provide a more comprehensive measure, indicating the amount of the pollutant likely to accumulate when both the fish and its food chain are exposed to toxic substances. BCFs and BAFs may vary significantly when the food chain multiplier is large. Table 6 lists the toxic pollutants that have been estimated to have a BCF of 250 by either the EPA or the GLI; it also gives their food chain multipliers, toxic weights, and an indication of whether they are currently covered by the TRI. As indicated in Table 6, the food chain multiplier for toxic pollutants with BCFs of 250 or greater varies from 1 to 98. The EPA is considering using BAF values rather than BCF values in its water quality criteria.[14] Because BAFs provide a better measure of the tendency of a pollutant to accumulate in fish, the policy design may be improved by weighting discharges by their BAFs rather than their BCFs.

Before bioconcentration pounds (or, alternatively, bioaccumulation pounds) could be used as a unit to be traded, the method of measuring them would have to be carefully defined. As can be seen in Table 6, there is a considerable discrepancy between the different estimates of

14. Ibid.

BCFs. For example, the BCF of ideno(1,2,3-cd)pyrene is estimated to be 30 by the EPA and 24,984 by the GLI.

Trading bioconcentration pounds is also limited by the fact that they do not reflect the toxicity associated with each pollutant and therefore the amount of damage that could result from its accumulation in fish tissue. Senate bill S. 1081 from the 102nd Congress proposed to ban all "highly toxic" pollutants that had bioconcentration factors of 250 or greater. If the same definition of "highly toxic" were applied to the pollutants listed in Table 6, only 10 of the 17 relevant pollutants included in the TRI would be considered highly toxic.

Even if this definition of toxicity were applied to determine which pollutants would be covered by the policy, trades of bioconcentration pounds could result in the continued discharge of one pollutant in exchange for a decrease in the discharge of a less toxic pollutant. For example, a facility could continue to discharge one pound of polychlorinated biphenyls in exchange for a 10-pound reduction in the discharge of anthracene (above the 50 percent requirement), even though polychlorinated biphenyls are 68 times more toxic than anthracene.

TABLE 6. POLLUTANTS WITH ESTIMATED BIOCONCENTRATION FACTORS OF 250 OR HIGHER

Pollutant	Bioconcentration Factors (3 percent lipid)			Food Chain Multiplier	Toxic Wt.	In TRI?
		GLI				
	EPA	Predicted	Measured			
Acenaphthene	242	219	241.8	1	0.923	No
Aldrin	4,670	8,637	n.a.	67	50[a]	No
Anthracene	30	564	n.a.	1.2	187[a]	Yes
1,2-benzanthracene	30	6,003	n.a.	33		No
3,4-benzofluoranthene	30	10,743	n.a.	75	2.34	No
1,12-benzoperylene	n.a.	39,474	n.a.		0.661	No
Benzo(a)pyrene	30	8,955	n.a.	67	130[a]	No
Benzo(k)fluoranthene(PAH)	30	10,743	n.a.	75	2.34	No
Beta endosulfan	270	n.a.	n.a.		103[a]	No
4-bromophenyl phenyl ether	n.a.	2,167	n.a.	4.3	0.122	No
Butyl benzyl phthalate	414	811.5	414.3	1.4	0.0265	Yes
Chlordane	14,100	5,682	9354	33	2251[a]	Yes
2-chloronaphthalene	202	248.7	n.a.	1	0.35	No
4-chlorophenyl phenyl ether	1,200	676.5	n.a.	1.3	0.434	No
Chlorpyrifos	n.a.	1,326	n.a.	2.6	137[a]	No
Chrysene(PAH)	30	5,286	n.a.	23	2.17	No
4,4-DDD	53,600	10,359	n.a.	75	6267[a]	No
4,4-DDE	53,600	17,877	34,863	98	6549[a]	No
4,4-DDT	53,600	12,426	13,017	84	6549[a]	No
Dibenzo(a,h)anthracene(PAH)	30	339,474	n.a.	n.a.	51.2[a]	No
Dibutyl phthalate	n.a.	973	n.a.	1.6	n.a.	Yes
3,3-dichlorobenzidine	312	103.89	n.a.	1	7.5	Yes
Dieldrin	4670	1,400.4	6,501	2.6	6947[a]	No
Endrin	3,970	505.8	3,390	1	2442[a]	No
Fluoranthene	1,150	1,710.9	n.a.	3.2	0.155	No
Fluorene(PAH)	30	351.6	876.6	1.1	0.337	No
Heptachlor	11,200	1,452.6	4,407	2.6	4140[a]	Yes
Heptachlor epoxide	11,200	267.6	5,685	1.1	6565[a]	No

Continued

TABLE 6. CONTINUED

Pollutant	Bioconcentration Factors (3 percent lipid)			Food Chain Multiplier	Toxic Wt.	In TRI?
		GLI				
	EPA	Predicted	Measured			
Hexachlorobenzene	8,690	5,004	10,008	23	779[a]	Yes
Hexachlorocyclohexane	n.a.	131.61	278.34	1	n.a.	Yes
Hexachlorocyclohexane(alpha)	n.a.	131.61	278.34	1	n.a.	No
Hexachlorocyclohexane(beta)	n.a.	131.61	278.34	1	n.a.	No
Hexachlorocyclohexane(delta)	n.a.	131.61	278.34	1	n.a.	No
Hexachlorocyclopentadiene	4.34	2,015.1	11.46	4.3	1.1	Yes
Hexachloroethane	86.9	326.7	155.34	1.1	0.29	Yes
Hexachlorol,1-3butadiene	2.78	564	3,525	1.2	1.85	Yes
Ideno(1,2,3-cd)pyrene	30	24,984	n.a.	n.a.	0.661	No
Lindane	n.a.	131	278	1	79[a]	Yes
Mercury	5,500	39,132	n.a.	10	505[a]	Yes
Methoxchlor	n.a.	1,401	3,276	2.6	188[a]	Yes
Mirex	n.a.	2,417	8,205	5.8	n.a.	No
Octachlorostyrene	n.a.	39,474	12,606	n.a.	n.a.	No
Pentachlorophenol	11	1,680	121.89	3.2	0.431	Yes
Phenanthrene	30	564	2,002.2	1.2	0.99	No
Phenol	1.4	2.064	1,036	1	0.00747	Yes
Photomirex	n.a.	606	n.a.	1.2	n.a.	No
Polychlorinated biphenyls	31,200	17,877	5,526	6	12844[a]	Yes
Pyrene	30	1,680	1,667.1	3.2	1.12	No
2,3,7,8-TCDD	n.a.	39,474			1:87E+08[a]	No
1,2,3,4-tetrachlorobenzene	n.a.	727	2,761	1.3	n.a.	No
1,2,4,5-tetrachlorobenzene	n.a.	811	2,053	1.4	n.a.	No
Toxaphene	13,100	1,400.4	12,219	2.6	n.a.	No
1,2,4-trichlorobenzene	14	227.1	405.6	1	n.a.	No

SOURCES: Congressional Budget Office based on data from Environmental Protection Agency, "Origin of Human Health Criteria;" Great Lakes Initiative, "Derivation of Proposed Human Health BAFs for the GLI"; EPA, Toxic Weighting Factors for Pesticide Active Ingredients and Priority Pollutants, Draft Final Report (March 1992).

NOTES:

n.a. = not available.

a Defined as highly toxic under S. 1081.

Trades that hold constant the number of bioconcentration pounds discharged into surface waters may not hold constant the level of potential environmental harm. A solution to this problem could be to weight each pollutant according to its toxicity as well as to its tendency to accumulate in fish.

An advantage of including only toxic substances that have BCFs of 250 or higher is that it would limit the number of firms that are covered by the policy, thereby reducing enforcement costs. A disadvantage of this approach, however, is that it is an arbitrary cutoff. For example, a firm that discharged 1,000 pounds of a chemical with a BCF of 240 would not be covered, whereas a firm that discharged one pound of a chemical with a BCF of 250 would.

How Adequate Are Existing Data for Determining Discharges?

Under the proposed policy, only firms that report to the TRI would need to comply and only toxic substances that are included under the TRI reporting requirements would be covered. The TRI is particularly useful in establishing discharge baselines for the policy because it is the only national data base of actual discharge levels and is annually updated.

Using the TRI would allow the policy to be quickly carried out since the data are readily available. The TRI, however, has many limitations.

One disadvantage of using the TRI as a base is that it does not include many of the chemicals that are estimated to have high BCF levels.[15] Of the 53 chemicals listed in Table 6, only 17 are included in the TRI. TCDD,2,3,7,8 (dioxin), which has the highest BCF and the highest toxic weight, is not currently included in the TRI but is being considered. According to EPA, many of the users of dioxin do not use enough to be required to report their discharges.[16] Therefore, even if dioxin were included in the TRI, most discharges of it would not be reported unless the minimum-use requirement were reduced.

An additional disadvantage of using the TRI as a base is that many facilities are not included. Nonmanufacturers, federal facilities, and manufacturing plants with fewer than 10 employees are not required to report even if they use more than the minimum pounds of chemicals necessary to trigger reporting. As indicated in Table 5, nonpoint source polluters and POTWs can be important sources of toxic substances, but

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15. The list of TRI chemicals was created from two reporting lists used by New Jersey and Maryland and can be changed by the EPA.

16. Maria Doa, petition coordinator in the Toxic Release Inventory Branch, Environmental Protection Agency, personal communication (November 1992).

are not required to report their discharges to the TRI. Covered facilities are required to report the amount of chemicals that they discharge to POTWs, but POTWs are not required to report their own discharges.

Furthermore, the accuracy of TRI data is questionable. Many facilities that are covered by the TRI reporting requirements fail to file reports. EPA estimated that 34 percent of facilities that met the reporting requirements failed to report in 1987. GAO estimated this number to be 35.7 percent in 1988.[17] In addition, the very limited investigation by EPA into the accuracy of TRI reports indicates that data may not be accurate or complete.[18]

Finally, if the TRI were used to set the baseline for discharge reductions, new facilities would lack an established baseline. This problem is not unique to the TRI data base but is present whenever past levels of pollution are used to set future requirements. The baseline level for new firms in an industry could be set at the level of discharge that

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17. General Accounting Office, *EPA's Toxic Release Inventory Is Useful but Can Be Improved* (June 1991).

18. According to the General Accounting Office, *EPA's Toxic Release Inventory Is Useful but Can Be Improved*, p. 43, EPA regions had visited only 27 of the more than 19,000 facilities that submitted emissions reports to assess the quality of the data.

would result under existing water quality standards and technology requirements for new sources.

Trading Across Bodies of Water Versus Restricted Trading

As envisioned, firms would be able to exchange discharge credits across bodies of water and between states provided they are in compliance with existing effluent guidelines and water quality criteria. This freedom to trade across watersheds would result in an uneven improvement in water quality. Bodies of water that have low abatement cost firms situated on their shores would improve more than they would under a uniform reduction (that is, all firms reducing their discharges by 50 percent); whereas bodies of water with firms that have high abatement costs would improve less than under a uniform standard.

For example, the Colorado River may improve more than it would under a uniform standard and the Mississippi River may improve less. The provision that firms must meet effluent guidelines and water quality criteria, however, should prevent any body of water from degrading as a result of the policy. The deepest concern associated with

trading across bodies of water is that the trade does not guarantee that toxic discharges would lessen in those bodies of water that need the reductions most, that is, those with elevated levels of toxicity and fish contamination problems.

Restricting trading to within watersheds would have both advantages and disadvantages. An advantage would be that water quality would be expected to improve more uniformly across bodies of water. Firms would be able to reduce their discharge of toxic substances by less than 50 percent only if other firms in the same watershed were to reduce their discharge by more than 50 percent. On average, therefore, the amount of toxic substances discharged into each water body would be reduced by 50 percent, the same as under a uniform standard. In addition to providing more even improvements in water quality, trading within watersheds may be perceived as more equitable, since firms along one body of water such as the Mississippi River, would not pay for improvements in the water quality of another water body, such as the Colorado River. Finally, by trading within watersheds, the policy could be aimed at requiring larger decreases in discharges into bodies of water that have elevated levels of toxicity than into those that do not.

Trading within watersheds has two disadvantages. First, it is difficult to define the boundaries of individual watersheds and to understand the movement of toxic substances once they enter the water. Second, as the area in which trading is allowed is decreased, the number of firms eligible to trade is reduced. Consequently, there is less potential for cost savings through trading, and it is less likely that the market for discharge credits will be competitive. The cost of achieving the desired improvement in water quality in any given watershed will be minimized only if the market for discharge credits is competitive--that is, no individual buyer or seller can influence the price of credits. As the number of potential buyers and sellers shrinks, the chances for individual influence grow. As firms gain influence over prices, the number of trades and associated cost savings diminishes.

Finally, trading within bodies of water may still not solve the problems caused by an individual toxic substance, such as a fish advisory brought on by polychlorinated biphenyls, if trading could take place across pollutants. Further restrictions may be necessary to prevent facilities that are contributing to a fishing restriction from buying discharge credits.

It is significant that firms that discharge toxic substances into the Great Lakes will need to comply with a more stringent set of water quality standards before trading. As a result of the problems caused by toxic substances in the Great Lakes, officials are developing the Great Lakes Initiative, a special set of policies for dealing with toxic discharges. Under the proposed initiative, dischargers into the Great Lakes would have to comply with more stringent health standards and new wildlife protection criteria. Under these more stringent water quality criteria, Great Lakes dischargers would be less likely to be able to benefit through trading than their counterparts in other areas.

Costs and Benefits

A full discussion of costs and benefits associated with this policy is beyond the scope of this memorandum. But a brief discussion of the types of costs and benefits is appropriate, along with a discussion of the method that might be used for a more complete investigation.

Discharges of covered toxic substances to POTWs are more than 18 times greater than direct discharges to water (see Table 7 for a list of the

TABLE 7. DISCHARGES OF TRI POLLUTANTS WITH BCFs OF 250 OR HIGHER

Pollutant	Average BCF[a]	Pollutant Discharged (Pounds)		Bioconcentration Pounds Discharged [b] (Thousands)	
		Water	POTW	Water	POTW
Anthracene	241.9	2,066	20,122	499.7654	4,867.512
Butyl benzyl phthalate	414.5	1,028	56,482	426.106	23,411.79
Chlordane	11,727	4	37	46.908	433.899
Dibutyl phthalate	973	2,641	55,697	2,569.693	54,193.18
3,3-dichlorobenzidine	207.94	241	342	50.11354	71.11548
Heptachlor	7,803.5	2	51	15.607	397.9785
Hexachlorobenzene	9,349	338	30	3,159.962	280.47
Hexachlorocyclohexane	278.34	0	250	0	69.585
Hexachlorocyclopentadiene	7.9	6	1,096	0.0474	8.6584
Hexachloroethane	121.12	421	250	50.99152	30.28
Hexachlorol,1-3butadiene	1,763.89	620	100	1,093.612	176.389
Lindane	278	0	250	0	69.5
Mercury	22,316	1,555	3,272	34,701.38	73,017.95
Methoxchlor	3276	250	0	819	0
Pentachlorophenol	66.4	2,559	8,013	169.9176	532.0632
Phenol	518.7	267,294	5,151,231	138,645.4	2,671,944
Polychlorinated biphenyls	18,363	264	1	4,847.832	18.363
Total		279,289	5,297,224	187,096.3	2,829,522

SOURCE: Environmental Protection Agency's Toxic Release Inventory.

NOTE: Pollutants were included if any of the BCF estimates in Table 6 were 250 or higher.

a. The average BCFs were obtained by averaging EPA and GLI values (see Table 6) and using measured GLI values when available.

b. Bioconcentration pounds discharged are equal to pollutant pounds discharged multiplied by their average BCFs.

pollutants covered by the proposed policy). A policy that included indirect discharges to POTWs, therefore, would have a much greater effect (and higher costs) than one that focused only on direct discharges. Second, discharges of phenol constitute the majority of all discharges. Phenol accounts for 97 percent of all the covered toxic substances discharged to water and POTWs and 93 percent of those substances when measured in bioconcentration pounds. Sources disagree about the bioconcentration factor of phenol. The predicted BCF values used by the EPA and the GLI are 1.4 and 2.1, respectively. The measured value used by the GLI, however, is 1,036. In addition, phenol has the lowest toxic weight of all of the pollutants listed in Table 6 and is far below the cutoff for "highly toxic" pollutants that was used in S. 1081.

Information is not available on the benefits of reducing the discharge of bioconcentration pounds. Among the benefits that could occur, however, are fewer health problems caused by fish consumption, reduced fishing restrictions, and increased recreational and commercial fishing. Other benefits could include decreased adverse effects on water fowl and corresponding increased hunting activity, reduced treatment for drinking water, and reduced need for bottled drinking water.

Insight into potential benefits can be gained by comparing the pollutants that result in fish contamination with the information on those pollutants contained in the TRI and elsewhere (see Table 8). Three of the pollutants--dioxin, DDT, and dieldrin--are not currently in the TRI, although dioxin is being considered for inclusion. DDT and dieldrin are banned from use in the United States. But even though these pollutants are not in use, they still cause fish contamination problems because they persist in the environment and in fish tissue for a long time. In addition, airborne DDT from other countries, especially, Mexico, Central America and Asia, may contribute to fish contamination in the United States.[19]

Three of the pollutants--mercury, polychlorinated biphenyls, and chlordane--are included in the TRI. The ability of the policy to resolve the contamination problems caused by these pollutants is constrained by several factors. First, the use of chlordane is already prohibited in the United States. Therefore a policy designed to reduce toxic discharges should have little effect. Second, discharges into water and POTWs may not be the major sources of mercury and polychlorinated biphenyls. Although information on sources is only available for the Great Lakes Basin, it appears that sediments or deposits from the atmosphere are the

19. Clean Water Report, ISSN 0009-8620 (December 8, 1992), p. 231.

TABLE 8. TOXIC RELEASE INVENTORY STATUS OF POLLUTANTS THAT ARE LEADING CAUSES OF FISH CONTAMINATION[a]

Pollutant	In TRI?	Comments
Mercury	Yes	4,827 pounds discharged into water and POTWs. 76 percent of mercury in the Great Lakes Basin is estimated to be from atmospheric deposition.
PCBs	Yes	265 pounds discharged into water and POTWs. About 50 percent of PCBs in the Great Lakes Basin are estimated to be from releases from sediments and about 30 percent from atmospheric deposition.
Chlordane	Yes	41 pounds discharged into water and POTWs. No longer used in the United States. Still manufactured for export.
Dioxin	No	Under consideration for addition to TRI. Most facilities would not qualify for inclusion in the TRI based on the current quantity limits.
DDT and its by-products	No	All uses banned domestically.
Dieldrin	No	All uses banned domestically.

SOURCES: Toxic Release Inventory: Information provided by Richard Mountfort, Insecticide-Rodenticide Branch, Office of Pesticide Programs, Environmental Protection Agency; VHB Research and Consulting Inc., *Virtual Elimination of PCBs, Mercury, and Persistent Toxics from the Pulp and Paper Industry in the Great Lakes Basin: A Role for Economic Instruments?* Report prepared for the International Joint Commission (Toronto, Ontario: VHB Research and Consulting Inc., June 1991).

NOTES:
POTWs = publicly owned treatment works; TRI = Toxic Release Inventory; PCBs = Polychlorinated biphenyls; DDT = dichloro-diphenyl-trichloro-ethane

a. Includes pollutants that were found to be one of the top five causes of fishing restrictions or resulted in a 1 in 10,000 risk of cancer at sample sites.

source of more than three-quarters of the quantity of these pollutants. Third, the trading across watersheds and pollutants that would be allowed under this policy may not be targeted enough to resolve specific contamination problems at specific sites. For example, a facility that is discharging polychlorinated biphenyls into a lake with a fishing restriction caused by polychlorinated biphenyls could continue polluting by buying discharge credits from a facility that reduced discharges in a different watershed or from a facility that reduced discharges of a different pollutant into the same lake.

Information is not available on the cost of reducing discharges of bioconcentration pounds by any given percentage. A model developed by the U.S. Army Corps of Engineers called the Computer Assisted Procedure for the Design and Evaluation of Wastewater Treatment Systems (CAPDET) has been used by the EPA in developing several of its effluent guidelines. This model might be used to estimate how much it would cost industry to reduce discharges to alternative levels.

A uniform reduction requirement imposed on all firms could be expensive. It is likely that the discharge trading aspect of this policy would substantially reduce the cost of compliance. Differences in the

technology used to abate different substances and differences in the concentrations and size of the waste streams are likely to result in substantial differences in abatement costs among facilities. Under the trading scheme, firms would be able to take advantage of these cost differences in order to minimize their own costs of compliance.

In addition to the cost of reducing the discharge of covered toxic substances, the cost of administering this policy is an important consideration. Although estimating the administrative cost is beyond the scope of this memorandum, the factors that would affect the feasibility and cost of implementing this policy are worth examining.

Administrative Feasibility

If the policy covered only firms that directly discharge the covered toxic substances into water, 263 facilities would be required to comply. If the policy were expanded to include facilities that discharge to POTWs, 540 facilities would be covered. If the policy were limited to include only pollutants defined as "highly toxic" according to S. 1081, 57 or 137

facilities would be covered depending on whether facilities that discharge to POTWs were excluded.[20]

Reporting Requirements. Each facility the policy covered would comply by reducing its discharges by a required percentage or by buying discharge credits. Firms that reduced their discharges by more than the required amount would be able to sell their excess discharge credits. In addition to reducing their discharges or buying or selling discharge credits, firms would be required to comply with the reporting stipulations of the policy. At a minimum, firms would be required to report on:

- The amount of bioconcentration pounds that they discharged in the base year,

- The amount of bioconcentration pounds that they discharged in the current year,

- The amount of discharge credits that they bought and sold, and

20. Lisa Capozzoli, Environmental Protection Agency, personal communication (December 1992).

- The names and addresses of firms that discharge credits were exchanged with.

Information on discharge credit purchases and sales would facilitate enforcement by allowing the government to cross-check information between firms. The Environmental Protection Agency found that this kind of cross-checking enhanced enforcement efforts in a program that was designed to phase down the lead content of gasoline.[21]

Level of Government to Administer the Policy. Some federal involvement in administering the policy may be necessary because firms would be able to buy and sell discharge credits across states and regions. Firms would report their purchases and sales of discharge credits to the federal government. The federal government may wish to pass information about firms' allowable discharges of bioconcentration pounds (once the purchase and sale of discharge credits are taken into account) on to the states and assign them to enforce the policy. The states would be best suited for enforcing the policy for direct dischargers (point sources) if the new level of allowable discharges were written into firms' state-issued discharge permits. If all reporting and enforcement were to

21. John Holley, Environmental Protection Agency, personal communication (February 1990).

take place at the state level, firms would be required to report their purchases and sales to their own state and to the states in which the firms they traded with were located.

Should New Discharge Limits Be Incorporated into Discharge Permits?

Current environmental standards for direct dischargers (point sources) are enforced through National Pollutant Discharge Elimination System (NPDES) permits. The EPA or individual states issue NPDES permits once every five years. The permits define the maximum allowable discharge of pollutants for point sources. Incorporating the bioconcentration pound limits into the NPDES permits has the potential advantage of using the existing enforcement system and may therefore reduce overall administration costs and enhance compliance. But this approach may also have its limitations.

Several EPA regional officials have expressed concern about adding additional complications to the permitting process.[22] A primary concern was that including bioconcentration pound reductions would further complicate the permitting process, which is already slow and frequently

22. Officials expressing concern included Kevin McSweeney, Chief of the Waste Water Management, U.S. EPA Region 1, and Patrick Durack, Chief of the Water Permits and Compliance Branch, U.S. EPA Region 2.

challenged. Permits must be renewed every five years, but 23 percent of major permits and one-third of minor permits have expired. Legal challenges and lack of resources at the state level have prevented them from being renewed.[23]

Requiring that firms incorporate their bioconcentration pound limits into the NPDES permits could discourage them from exchanging discharge credits for several reasons:

- Obtaining approval to change their level of discharge would be time-consuming. Technically, firms can request a permit modification at any time, and the process should take from three to six months. In reality, however, because of resource limitations and the current backlog for permit renewals, requests for modifications may not be dealt with.

- The need to incorporate changes in bioconcentration pound discharges into NPDES permits increases the uncertainty about whether the exchange of discharge credits agreed to by two firms will be approved and, if so, when. The additional source

23. Patrick Durack, Chief of the Water Permits and Compliance Branch, U.S. EPA Region 2, personal communication (October 1992).

of uncertainty may discourage firms from relying on such agreements.

- Current provisions in the Clean Water Act prevent the relaxation of permit limits. This provision may discourage firms from decreasing their discharges more than required (and selling their excess discharge credits). Should their circumstances change in the future (or the price of discharge credits fall), companies could be prevented from increasing their discharges.

If bioconcentration pound discharge limits are not incorporated into NPDES permits, enforcement efforts would rely on the TRI data base. As described above, concerns about the accuracy of TRI would be a primary consideration.

Should Indirect Dischargers Be Included in the Policy? Indirect dischargers (firms that discharge to POTWs) discharged more than 18 times more pounds of toxic substances in 1989 than direct dischargers. If the policy covered all pollutants with BCF values of greater than 250, including indirect dischargers would increase the number of affected firms from 287 to 540. If the policy were limited to only those pollutants

defined as "highly toxic" according to S. 1081, including indirect dischargers would increase the number of covered firms from 57 to 137.

Indirect dischargers do not obtain NPDES permits, but under a pretreatment program must obtain discharge permits from local governments. These permits assign concentrations or loadings to significant industries that discharge to POTWs. If indirect dischargers were included in the program and their bioconcentration pound limits were incorporated into their pretreatment program discharge limits, the delay and uncertainty associated with incorporating bioconcentration pound limits into NPDES permits could apply.

In addition, the policy would involve a third layer of government. The federal government would be involved in collecting information on discharge credit purchases and sales, state governments would be required to enforce the policy for direct dischargers, and local governments would be required to enforce the policy for indirect dischargers. The alternative, as in the case of direct dischargers, is that bioconcentration pound discharge limits are not written into permits and the TRI data base is used as the basis for enforcement actions. In this case, the federal

government would be responsible for enforcement for both direct and indirect dischargers.

Transactions Costs. The costs of identifying potential buyers and sellers of discharge credits and negotiating and completing a transaction make up the transactions costs. High transactions costs tend to discourage the exchange of discharge credits and reduce the potential cost savings associated with the policy's trading provision. The time and cost of obtaining regulatory approval to complete a transaction is one element of transactions costs. If bioconcentration pound discharge limits must be written into NPDES and pretreatment permits, transactions costs are likely to be high. If these limits are not required to be incorporated into permits and firms are able to enter into profitable exchanges without obtaining prior governmental approval, these transactions costs are likely to be low.

Structure of the Market for Discharge Credits. In order to minimize the total cost of achieving the desired decrease in the discharge of bioconcentration pounds, the market for discharge credits must be competitive; that is, no individual buyer or seller should be able to influence the price of discharge credits. Further analysis is needed to

determine whether the market for discharge credits would be competitive. If trading was restricted to individual watersheds, the number of firms in individual trading regions may not be large enough to ensure a competitive market.

Summary

The proposed policy would provide an efficient method for decreasing the discharge of pollutants that have high bioconcentration factors. The trading aspect of the policy allows firms to take advantage of differences in abatement costs among firms in order to minimize the total cost of achieving the reduction goal.

This policy would bring about the desired reduction in discharges of bioconcentration pounds into domestic surface waters. The proposed policy design, however, could result in trades that do not improve water quality at the national level. Redefining the discharge units may help ensure that the policy would actually reduce the overall potential for harm from toxic water pollutants. Because the policy would set a percentage reduction goal for the United States as a whole and allow trading among

bodies of water, it would result in uneven improvements in water quality throughout the United States. In addition, the policy would not necessarily resolve some of the pollutant-specific and water body-specific problems with toxic substances that states currently face.

The number of firms covered by the policy could range from 57 to 540 depending on the design that is chosen. Enforcement of the policy would be limited by the quality of the data in the TRI. In order for the potential cost savings of discharge trading to be realized, it would be important to minimize the amount of government intervention in the trading process. Requiring that firms report not only their purchases and sales of credits, but the identity of the firms that they traded with, would allow for cross-checking that could enhance compliance.

POLICY ALTERNATIVES

There are three alternatives to the discharge credit trading program described in this memorandum. The first alternative, a revised trading program, retains the same general concept as the original trading program, but attempts to resolve some of the problems raised in this

memorandum. The second alternative, a tax policy, retains the same general goal of establishing a national policy to reduce the discharge of bioaccumulative pollutants, but uses a system of taxes to achieve it. The third alternative, a watershed management approach, is totally different. It would not have a uniform national goal, but would be focused on solving pollutant problems in individual watersheds.

A Revised Trading Program

The design of the discharge credit trading program might be improved to resolve some of the problems raised in this memorandum, such as trades that do not improve water quality or are not focused on resolving regional fishing restrictions. First, firms might trade bioaccumulation pounds rather than bioconcentration pounds since bioaccumulation provides a better measure of environmental and human health risks resulting from pollutants.

Second, bioaccumulation pounds might be weighted by toxicity (using the toxic weights established by EPA or an alternative measure) to prevent firms from continuing to discharge more toxic pollutants in

exchange for reductions in the discharge of the same quantity of a less toxic pollutant.

Third, the toxic substances that are covered could be expanded beyond those currently included in the TRI. A thorough review of toxic substances should be taken to determine which ones are both highly toxic and likely to accumulate in fish. At that point, they could be added to the TRI. Dioxin, which is a leading cause of fishing restrictions in the United States, is an important pollutant to add to the list.

Finally, firms that are currently discharging a pollutant that is contributing to a fishing restriction could be prevented from using permits as a way of avoiding the reduction in discharge of that pollutant. For example, a firm that was discharging polychlorinated biphenyls into a lake with a PCB fishing restriction would not be allowed to buy permits in order to avoid meeting the required reduction in its PCB discharges (namely, 50 percent). This firm could, however, be allowed to sell permits for reductions that it made above the 50 percent requirement. Another option is that trading ratios could be set to provide an additional incentive for firms to reduce the discharge of pollutants that are contributing to a fishing restriction. For example, the PCB-discharging

firm described above could be allowed to sell two credits for each reduction of one bioaccumulation pound that it made beyond its 50 percent requirement.

This revised policy might achieve a general goal of reducing the discharge of bioaccumulative pollutants while avoiding some of the problems discussed in this memorandum. The benefits (and the costs) of achieving this general goal, however, are not known. In order for this policy to be efficient--that is, to bring about the desired goal at a minimum cost--discharge credit trading should remain as free as possible from government intervention. Requiring that trades be incorporated into facilities' discharge permits would probably pose a significant barrier to trades and could greatly increase the cost of the program. The administrative burden of this alternative trading policy would be similar to the proposed policy discussed above, although expanding the TRI list would require additional federal expenditures.

A Tax On Bioaccumulation-Toxic Pounds

A tax could be charged on each pollutant that a firm discharges, with the pollutant weighted by its bioaccumulation factor and toxicity. For example, if a tax of 10 cents per pound were levied on a firm that discharged 10 pounds of a pollutant that had a toxic weight of 50 and a bioaccumulation factor of 100, the firm would pay $5,000 in taxes.

Like the discharge trading program described above, this policy would encourage firms with relatively low abatement costs (that is, abatement costs that are below the tax) to reduce their discharges and would not force firms with high abatement costs to do so. This policy, therefore, has the potential to decrease toxic discharges at a minimum cost. As under the trading program, this policy would result in uneven improvements in water quality across bodies of water. The quality of bodies of water surrounded by firms that have low abatement costs would tend to improve, but the quality of bodies of water surrounded by firms with high abatement costs would not.

Unlike the trading program, a tax could generate significant amounts of revenue for the federal government. This would mean, however, that

the policy would be more costly for the industries affected by it. In addition, a tax is likely to be somewhat easier to administer than a trading program. In order to successfully carry out either the trading policy or the tax, the federal government would have to determine the discharges of each of the facilities that are covered. If the tax was levied, however, the government would not have the additional responsibility of tracking and verifying the exchange of discharge credits.

Although the tax would generate federal revenue and may be somewhat easier to administer than a discharge credit trading program, it may not be as well suited for dealing with regional differences in the effects of pollutant discharges. Ideally, the level of the tax would be set to reflect the amount of environmental harm caused by each bioaccumulation-toxic pound. As discussed above, however, the amount of harm may vary across bodies of water. For example, PCBs added to a lake that is already burdened with a fishing restriction will probably inflict more harm than additional PCBs in a lake with very low levels of PCBs or more absorptive capacity. It may be more difficult to impose different tax rates for these individual cases than to establish restrictions on trades.

Finally, there is a key difference between a tax and a program of trading discharge credits: the tax sets an upper limit on the cost that firms could incur but leaves the amount of decrease in discharge of pollutants uncertain; a trading program guarantees that the desired reduction in discharge is met, but leaves the cost of obtaining it uncertain. Ideally, the policymaker would set the fee or reduction requirement at a point where the additional cost that society incurs to reach the last unit of reduction is equal the additional benefit. Unfortunately, there is often uncertainty about both the additional costs and the additional benefits.

A Watershed Management Approach

Problems with toxic pollutants vary significantly across watersheds. Areas with pulp and paper mills may face dioxin problems, and other areas may face problems with mercury contamination. Trading programs are complex under these circumstances because defining a common unit to be traded can be difficult. It is also difficult to accept that the status quo in one area may be maintained by buying improvements in another area.

Alternatively, states might be required to address toxicity problems at the watershed management level. This policy might require that states increase monitoring of toxic substances. It would be important to monitor pollutants at more sites, with greater frequency, as well as to include a greater number of pollutants that have the potential to accumulate in fish. In addition, the policy might establish deadlines for states to resolve toxicity problems. It might encourage the use of economic incentives, such as fees or trading programs, in solving those problems for situations where they might be applied at the watershed level. This might be the case in large watersheds where numerous facilities contribute to a particular problem. Finally, the policy could encourage states to address a wider range of sources of toxic pollutants than is covered by the discharge credit trading program described in this memorandum. For example, states may reduce pesticide runoff by requiring farms to apply specific management practices.

A disadvantage of a watershed management approach is that it can be difficult to define a watershed. In addition, because watersheds cross state boundaries, this approach would require increased cooperation among states. Finally, this approach relies more on state efforts and therefore provides less assurance that national policy goals will be met.

The advantage of a watershed approach is that it directs solutions at specific problems and may minimize excess costs.

CONCLUSIONS

Toxic pollutants pose a potential threat to aquatic environments, wildlife, and human health. Improved monitoring is necessary to determine the full extent of the problem. Monitoring could be conducted more frequently, at more sites, and for more pollutants.

The program of discharge credit trading described in this memorandum provides one option for addressing concerns about toxic pollution. By trading pollutant discharge credits that are weighted according to the pollutant's bioaccumulative factor and its toxicity, this policy could bring about a decrease in the discharge of bioaccumulative pollutants and ensure that the amount of toxicity associated with discharges does not increase.

This policy may not, however, solve some of the specific problems with toxic pollutants that communities now face. Many of these problems

involve an individual pollutant and a specific body of water. A national policy that allows trading across pollutants and across water bodies may not be well suited for dealing with these types of problems. Placing regional restrictions on trading, such as not allowing firms that discharge a pollutant that contributes to a fishing restriction to purchase discharge credits, could help address this limitation, but would still not direct the policy toward solving these kinds of problems. A watershed-based approach may be better suited to solving toxic problems that are specifically related to individual pollutants and bodies of water. A watershed approach may not, however, ensure that national goals for toxic reduction (such as a 50 percent decrease in the discharge of bioaccumulative toxic substances) are met.

The trading aspect of this policy is likely to result in significant cost savings compared with a uniform standard, such as requiring all firms to reduce their discharges of bioaccumulative pollutants by 50 percent. Differences in the technology used to abate different substances, concentrations of the waste streams, and size of the waste streams are likely to result in substantial differences in abatement costs among facilities. Under the trading scheme, firms would be able to take advantage of these cost differences to minimize their own costs of

complying with the policy. Minimizing government intervention in the trading process would be important in realizing these cost savings.

This memorandum has attempted to provide a better understanding of the nature of problems with toxic pollutants and sheds some light on the ability of the proposed policy to address these problems. It has not, however, provided quantitative information on either the benefits or costs of this policy. That would be an important next step.