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WATER POLLUTION

Poor Quality Assurance and Limited Pollutant Coverage Undermine EPA's Control of Toxic Substances

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The Honorable Frank R. Lautenberg
Chairman, Subcommittee on Superfund, Ocean,
and Water Protection
Committee on the Environment and Public Works
United States Senate

Dear Mr. Chairman:

In a January 6, 1992, letter, you asked us to evaluate the quality of the information EPA uses to control the discharge of toxic pollutants to surface water and the extent to which EPA controls these substances. This report presents our findings on these issues.

In our evaluation, we identified the EPA activities that have a direct effect on controlling the release of toxics to surface water and the information requirements for these activities. We also evaluated the extent to which EPA takes steps to ensure that the information used to support these activities is of acceptable quality. In addition, we addressed the extent to which toxic pollutants are controlled through the NPDES permit process and examined the risk implications of discharged pollutants that are uncontrolled.

If you have any questions or would like additional information, please call me at (202) 512-2900 or Kwai-Cheung Chan, Director of Program Evaluation in Physical Systems Areas, at (202) 512-3092. Other major contributors to this report are listed in appendix III.

Sincerely yours,

Eleanor Chelimsky

Eleanor Chelimsky
Assistant Comptroller General

Executive Summary

Purpose

Toxic pollutants threaten the biological integrity of the nation's water. State officials say that toxic pollutants affect the quality of more than 28,000 miles of the nation's rivers. Aquatic life has been affected and human health risk has increased. Contamination by toxic and conventional pollutants has resulted in fishing advisories or bans on more than 1,000 bodies of water. Pollutants discharged from the nation's factories and sewage treatment plants are a major cause of this water and fish contamination.

To protect surface water from pollutants discharged from industrial facilities and sewage treatment plants, the Congress passed legislation in 1972 commonly referred to as the Clean Water Act. The Environmental Protection Agency (EPA) is responsible for setting national standards on the types and amounts of pollutants that industries and sewage treatment plants may discharge. EPA and the states enforce the standards by incorporating toxic limits on facilities' discharge permits. Many factors influence EPA's ability to implement programs authorized under the Clean Water Act. One critical variable is the quality of available information. EPA's program activities are analytical efforts, resulting in decisions about which toxic pollutants to control and at what levels. If its information is not of high quality, toxic pollutant control activities are weakened in consequence.

The Chairman of the Subcommittee on Superfund, Ocean, and Water Protection of the Senate Committee on the Environment and Public Works asked GAO to evaluate the quality of the information EPA uses to control the discharge of toxics to surface water and the extent to which the EPA process controls toxic substances.

GAO (1) identified EPA activities that directly affect the control of the toxic discharges and the information requirements of these activities, (2) determined EPA's steps to ensure that the information it uses to support these activities is of acceptable quality, (3) addressed the extent to which permits control toxic pollutants, and (4) examined the risk implications of uncontrolled discharged pollutants.

Background

For a number of years, EPA has been faced with reports by GAO and others that individual activities it administers to control toxic substances in surface water are producing information of suspect quality. Information about three specific types of entities—the environment, the facilities that discharge toxic pollutants, and the toxic substances themselves—is at the heart of any system for controlling toxics. Yet the quality of that information across EPA's approach as a whole has not been evaluated.

To identify the critical activities that control the release of toxic substances into waterways, GAO submitted to EPA an extended list from the literature and agency documents. EPA identified activities that are directly related to controlling discharges of toxic substances into surface waters. A panel of experts reviewed and validated EPA's list. GAO then interviewed managers for each of the principal activities to identify information requirements as well as the principal sources of that information. Subsequently, GAO compiled data quality assurance criteria from the scientific literature and from EPA's quality assurance guidelines, assigning the relevant, critical quality assurance criteria to each information requirement for each EPA activity. (A criterion was considered critical if its absence, in and of itself, would compromise the quality of the information required by an activity.) GAO then reinterviewed managers and examined data to estimate the extent to which the relevant quality assurance criteria were followed in the design, collection, and analysis of the information. Finally, GAO obtained discharge permit files for 236 industrial facilities and compared a list of their toxic limits with information from three sources about the facilities' actual discharges.

Results in Brief

EPA implements the control of toxic pollutant discharges into waterways through 7 "core" activities spread across a number of programs. GAO identified 13 types of information that are required to analytically support these 7 activities and found that 5 of the 7 fell short in implementing the quality assurance steps that are needed to produce accurate information. This raises questions not only about the quality of the information these 5 activities produced but also about their effectiveness within a strategy for controlling toxic pollutants.

GAO also found that the current permit process does not limit the vast majority of toxics being discharged from the nation's facilities. Although most of these toxicants are "nonpriority" pollutants, they can and do pose human health and aquatic life risks (for example, ammonia and xylene).

GAO attempted to examine the risk implications of uncontrolled pollution cases identified in the facility sample population, but the majority of cases could not be evaluated because the criteria were lacking by which to assess whether discharges posed a human health or aquatic life risk. This is so for most toxicants discharged across the nation.

Principal Findings

"Core" Programs and Their Critical Information Requirements

GAO initially identified 46 EPA water quality protection activities and then refined this list to the 7 that are directly related to the control of toxic pollutants. Taken together, these activities determine the toxic concentrations that are safe for human health and aquatic life, establish allowable discharge limits, identify impaired waterways, and monitor compliance infractions. Thirteen types of information are required to support these 7 core activities. (See figure 1.)

Figure 1: Thirteen Types of Information A-M Required Within Activities 1-7

	Information Type												
	Environmental and Source Monitoring							Technology Assessment		Chemical Assessment		Other Assessments	
Activity	A. Hydrology	B. In-stream Water Quality	C. Concentration in Sediments	D. Concentration in Biota	E. Aquatic Life Exposure	F. Discharges From Individual Sources	G. Removal Technologies	H. Water Use Reduction Technologies	I. Aquatic Life Effects	J. Human Health Effects	K. Fate and Transport	L. Human Health Exposure	M. Economic Data
1. Effluent Guidelines Development						■	■	■					■
2. Water Quality Criteria Development				■	■				■	■		■	
3. Impaired Water and Point Source Identification		■	■	■		■			■		■		
4. Total Maximum Daily Load Development	■	■	■	■		■					■		
5. Water-Quality-Based Permit Issuance	■	■				■					■		
6. "Local Limits" Development						■	■				■		
7. Compliance Problem Identification		■			■	■							

■ Indicates that that type of information is required for that activity.

Adherence to Quality Assurance

Two of the 7 activities (effluent guidelines development and water quality criteria development) have been exceptional in meeting quality assurance requirements, and confidence in the integrity of the information they have produced is thus relatively high. Collectively, these 2 activities have met approximately 93 percent of their related quality assurance requirements. However, the 5 other activities fell short of the criteria GAO used, meeting only 58 percent of their requirements. These activities (impaired water and point source identification, total maximum daily load development, water-quality-based permit issuance, local limits development, and compliance problem identification) are critical to the success of a standards-based toxics control program.

Extent of Control of Toxic Pollutants

GAO reviewed the pollutants discharged from 236 facilities from three industrial sectors (pulp and paper, pharmaceutical, and pesticides manufacturing). The vast majority of the toxic pollutant cases GAO identified (77 percent) were not controlled through the permit process. Priority pollutants (for example, dichlorobenzene and carbon tetrachloride) made up 33 percent of these cases while the remainder were nonpriority pollutants. GAO found that, for the sample of facilities evaluated, the permit process rarely controlled nonpriority toxic pollutants (with the exception of acids, ammonia, and chlorine) and priority pollutants only partially. It should not be presumed that the former are innocuous: nonpriority pollutants can pose human health and aquatic life risks. In calculating the percentage of nonpriority pollutants reported in EPA's Toxic Release Inventory for 1989, GAO found that that group makes up 98 percent of the discharges by mass. These pollutants are reported in the inventory because they are used in commerce and because their release to the environment could pose human health risks.

The Risk Implications of Uncontrolled Toxic Pollutants

GAO used standard modeling methods to estimate the water concentration of uncontrolled toxic substances from the sample population of facilities mentioned above to determine what proportion presented human health or aquatic life risks. For cases that GAO could evaluate, only 8 percent did pose such risks. However, GAO could not evaluate many of the cases (62 percent) because the criteria needed for determining whether their discharge posed a risk had not been established.

Matter for Congressional Consideration

The Clean Water Act emphasizes a standards approach for controlling toxic pollutants. In its reauthorization of the act, the Congress should consider augmenting this approach with additional authority to allow EPA to emphasize pollution prevention as a way of managing toxic pollutant discharges.

Recommendations

To improve EPA's efforts to control discharges of toxic water pollutants, GAO recommends that the Administrator of EPA

- initiate immediate efforts to address the information quality assurance problems GAO identified in the 5 toxic control activities where these problems occur and
- expand the use of the Toxic Release Inventory data base to identify nonpriority pollutants being discharged to water that should be considered for control through the permit process.

Agency Comments

GAO discussed the results of its work, including tentative findings, conclusions, and recommendations, with responsible EPA officials and has incorporated their comments where appropriate. Their major comments and GAO's responses are included in chapter 6.

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Abbreviations

ASTM	American Society of Testing and Materials
BAT	Best available technology
BOD	Biochemical oxygen demand
EPA	Environmental Protection Agency
GAO	General Accounting Office
ICS	Individual control strategy
NPDES	National Pollutant Discharge Elimination System
PCS	Permit Compliance System
POTW	Publicly owned treatment works
QA/QC	Quality assurance/quality control
STORET	STOrage and RETrieval
TMDL	Total maximum daily load
TRI	Toxic Release Inventory
USGS	U.S. Geological Survey
WET	Whole effluent toxicity

Introduction

Toxic pollutants pose a substantial threat to the biological integrity of the nation's water. Reports prepared by the states under section 304(I) of the Clean Water Act cite toxic discharges from 879 factories and sewage treatment plants around the nation as causing streams to violate water quality standards.[1] State governments have also identified toxic pollutants as affecting the quality of more than 28,000 miles of the nations' rivers.[2] Moreover, state officials have reported that 15 percent of monitored river miles and 39 percent of lake areas were contaminated by toxic substances.[3] Contamination by toxic and conventional pollutants resulted in more than 1,000 bodies of water around the country with fishing advisories or bans.[4]

In an effort to control discharges of toxic pollutants from factories and sewage treatment plants, EPA, the agency with jurisdiction in matters of toxic pollution of waterways, has developed an approach that includes the collection of three different types of information. Under this approach, information about the environment, the facilities that dispose of toxic pollutants, and the toxic substances themselves provides the foundation for controlling toxics. Ensuring information of adequate quality about these elements, then, is critical to the approach's success. Adhering to information and data quality assurance standards is a requisite for attaining such quality. In short, decisions made within the EPA water quality programs can be only as good as the data on which they are based. At minimum, those data should be of high enough quality to appropriately and accurately characterize the event or object of interest. In the recent past, concerns have been raised about the quality of information EPA used in its water protection program.[5]

The Chairman of the Subcommittee on Superfund, Ocean, and Water Protection of the Senate Committee on Environment and Public Works asked us to evaluate (1) how well EPA ensures information and data quality in the water toxic control program and (2) the extent to which the program controls toxic discharges. This report responds to that request.

[1]Bureau of National Affairs, Environment Reporter, June 23, 1989, p. 466.

[2]Environmental Protection Agency, National Water Quality Inventory: 1990 Report to Congress (Washington, D.C.: 1992), p. 88.

[3]Environmental Protection Agency, p. 86.

[4]Environmental Protection Agency, p. 90.

[5]U.S. General Accounting Office, Environmental Enforcement: EPA Cannot Ensure the Accuracy of Self-Reported Compliance Monitoring Data, GAO/RCED-93-21 (Washington, D.C.: March 31, 1993), and Water Pollution Monitoring: EPA's Permit Compliance System Could Be Used More Effectively, GAO/IMTEC-92-58BR (Washington, D.C.: June 22, 1992).

Background

As already noted, dealing with toxic discharges within the framework of the Clean Water Act requires information on the aquatic environment, the facilities that discharge the pollutants, and toxic substances. Collecting this information is not easy, because of both the complexity and variability of the subject matter and the technical and methodological challenges associated with measurement, data collection, and analysis. EPA has created a framework to collect data on all these elements, as described below.

The Aquatic Environment

The nation's surface-water resources are truly immense. They consist of more than a million miles of rivers and streams (enough to extend from the Earth to the Moon four times). There are 61,000 square miles of inland water bodies and 94,000 square miles of the Great Lakes. Taken together, this constitutes an area larger than the combined size of 12 states.

Besides being vast, the aquatic environment is highly complex. It is composed of different "compartments," including the "water column," sediment, and aquatic life. Marshes, wetlands, lakes, rivers, streams, estuaries, and open oceans constitute greatly diverse habitats for aquatic life. Within both the water column and the sediment layers are varied collections of aquatic life, both animals and plants, with interdependent life cycles. Site-specific characteristics of a body of water (such as temperature, pH, and hardness) influence the areas in which different species reside and their sensitivity to stresses from toxic substances and other pollutants.

Discharges Into the Aquatic Environment

For as long as people have lived in villages and towns there has been pollution of rivers and streams. Many of the epidemics of the Middle Ages in Europe were caused by exposure to polluted waters. In the United States, the industrial revolution of the 18th and 19th centuries and the accompanying increases in manufacturing increased discharges, sowing the seeds of a water quality crisis for the nation's lakes, rivers, and streams. The chemical revolution of the 20th century dramatically increased the complexity of these discharges.

These bodies of water serve as sources of drinking water for about half the nation's population and have recreational uses as well. They are also the repository for wastes from about 64,000 factories and sewage treatment plants. Of these dischargers, about 7,000 are considered "major dischargers" under federal legislation. Industrial processes have developed around the ability to dispose of industrial wastes into adjacent bodies of water. Disposing of wastes in this way is integral to modern industry. Billions of pounds of pollutants are released into the nation's waters every year from these "point sources" of pollution.[6]

Toxic Pollutants

More than 65,000 chemicals are manufactured or used in the United States; over 1,000 new substances are introduced each year. A contrast is often drawn between "toxic" and "conventional" pollutants.[7] The short list of conventional pollutants, so-named because they were traditionally the objects of wastewater treatment and control, consists of the following: biochemical oxygen demand (BOD), coliform, oil and grease, pH, and total suspended solids. The toxic effects produced by conventional pollutants are usually immediately apparent. Too high a concentration of nitrogen or phosphorus in a lake can turn it green with algae. Too high a level of BOD in a lake or stream will deplete it of oxygen and suffocate the aquatic life residing in it.

Toxic pollutants usually have more subtle effects on the health of the ecosystem and those who come into contact with it. These effects can range from harming the reproductive cycle of the wildlife in a stream to causing cancer in people who drink that water. In addition, these substances often produce their toxic effect at very low concentrations that may be beyond the capabilities of laboratory instruments to detect.

Examples of toxic pollutants are some metals such as mercury and chromium; pesticides such as DDT and 2,4,5-TP; and organic chemicals such as PCBs and dioxins. Toxic substances can affect all organisms that dwell in water. When toxic substances settle, they can also harm the organisms that dwell in sediments. Further, there is variation in the amount of time it takes for toxic substances to produce harmful effects. Some toxic substances have an immediate action; others take a longer period of time. A long-term effect of some toxic substances is bioaccumulation, or the transfer of a substance from the environment into living tissues through feeding and bioconcentration (the passing of a substance from water into an organism). In fish, for example,

[6]Discharges from specific locations are called point source discharges. Pollution that does not enter the water from a pipe is "nonpoint" pollution. Examples of sources of nonpoint pollution are farms, fields, and highways.

[7]Within this report, we define a water pollutant as any constituent or property of water that undermines the ability of the body of water to support the uses to which it is put. Thus, even fresh water can be a pollutant in a salt water ecosystem, where the organisms that reside there are adapted to highly saline water.

bioconcentration occurs by absorption through the skin or by uptake through the gills. Living tissues reach higher concentrations than the surrounding water when a substance bioaccumulates. Thus, contaminated fish and shellfish present a health hazard to people who eat them. Determining the magnitude of risk associated with individual pollutants is a highly complicated task involving complex technical studies.

Controlling Pollutants: The Clean Water Act

The Federal Water Pollution Control Act of 1972, known as the Clean Water Act, established the general framework for controlling these pollutants. Surface water can be characterized according to a number of uses. It is a source of drinking water for municipalities. It has recreational uses, such as boating, swimming, and fishing. It is the repository for wastes of numerous dischargers of pollutants such as factories and municipal sewage treatment plants. Much of the act is designed to provide a way to limit discharges in order to minimize the degree to which they interfere with the other uses of water bodies. In general, limits are placed on a pollutant if it is thought to threaten human health or aquatic life.

The general framework of the 1972 Clean Water Act consists of a set of interrelated program activities based on provisions of the act and subsequent amendments to it. The process for controlling discharges of pollutants is administered through the National Pollutant Discharge Elimination System (NPDES). NPDES was created through the act as a way of controlling the pollutants discharged by the thousands of facilities releasing their wastes into surface waters.

The cornerstone of the NPDES framework is a process for issuing permits to point source facilities: That is, discharging any substance into any body of water without a permit is forbidden. When a permit is issued, the pollutants requiring control are identified, limits for their discharge are established, and then through monitoring and enforcement EPA and the states are able to ensure compliance with the permit. So, placing a limit on a pollutant in a permit constitutes the first step in the Clean Water Act framework for controlling discharges from a particular point source.

Permits are to be issued for every facility for up to 5 years. Prominent among the conditions contained within most permits are requirements that the total amount of a discharge be monitored by a discharging facility and that the amount of pollutants released be limited to values established through the permit process. For example, chloroform might be limited through a permit by requiring that it be monitored daily and that no more than 10 pounds be discharged each day. Other pollutants would have similar types of discharge requirements defined on the permit. Although issuing the NPDES permit is the centerpiece of the current approach for limiting discharges into surface waters, a related process uses information provided by several other activities (described in chapter 2).

Implementation of NPDES rests with 39 delegated states and EPA's 10 regional offices. Each regional office retains implementation authority for nondelegated states in that region. Regions and delegated states issue permits with effluent limits and monitoring requirements, track compliance with the permit conditions, and carry out enforcement actions.

Controlling toxic substances has been one of the major challenges for the Congress and EPA since the passage of the Clean Water Act. The number of toxic pollutants is large, the related risk is often difficult to demonstrate, and measurement is expensive or inconclusive at the low concentrations that pose a threat. In 1977 and 1987, the Congress passed amendments to the act focusing renewed attention on controlling toxics in surface water.

In section 307 of the Clean Water Act as amended in 1977, the Congress directed EPA to focus its regulatory activities on a list (published elsewhere) containing 31 chemical groups (such as halomethanes and polynuclear aromatic hydrocarbons) and 38 individual substances (such as isophorone and thallium). From this requirement, the agency developed a list of 129 individual pollutants for priority attention, but this list has been reduced to 126. These pollutants are termed the "priority pollutants," and EPA has directed most of its attention with respect to toxics within the water protection framework to these 126. According to EPA,

> "The priority pollutant list identifies toxic pollutants of concern on a national basis. It has served as a basis for numerous EPA actions, including the selection of pollutants for development of water quality criteria under section 304(a) of the Clean Water Act; the development of technology-based effluent guidelines under section 301 of the Clean Water Act; the listing of impaired waters under section 304(l) of the Clean Water Act."[8]

EPA has recently been augmenting its approach for controlling toxic pollutants under the Clean Water Act. An important initiative in this area is an approach called "whole effluent toxicity" (WET).[9] The agency has

[8]Environmental Protection Agency, "Water Quality Guidance for the Great Lakes System and Correction; Proposed Rules," 58 Fed. Reg. 20801, at 20843 (April 16, 1993).

[9]Environmental Protection Agency, Technical Support Document for Water Quality Based Toxics (Washington, D.C.: April 1991).

recognized that discharges from facilities often consist of a "chemical stew" of many different pollutants, each with its own "toxic signature," with a combined effect on a receiving water body that is impossible to deduce from the individual components. EPA has found that the toxicity of the "whole effluent" is what poses a human health risk and affects the environment and has, thus, decided that the "stew" itself, and not just the ingredients, is a proper subject for regulation and control through the NPDES process.

In the view of the agency, a WET limit (a limit based on the results of testing the toxicity of the wastewater through a bioassay) "provides a way to evaluate an effluent in the absence of detailed information about the chemicals it contains."[10] However, because WET test results do not specify which substances in the effluent are toxic, they are not prescriptive: That is, by themselves, they do not indicate how to treat the effluent's toxicity to protect human health and aquatic life. Therefore, limits on individual pollutants remain a critical component of the water quality approach in spite of advances in WET testing.[11] Other initiatives EPA mentioned in this area are toxicity identification evaluations and toxicity reduction evaluations, which are intended to assist those holding permits to achieve compliance with WET limits.[12]

Objectives, Scope, and Methodology

Objectives

In the winter of 1992, the Chairman of the Subcommittee on Superfund, Ocean, and Water Protection of the Senate Committee on Environment and Public Works asked us to evaluate EPA's effort to ensure the quality of the information used to control the discharge of toxics to surface water and the extent to which toxic substances that are discharged are listed on water quality permits. In responding to the request, we addressed four questions:

[10]Environmental Protection Agency, Introduction to Water Quality Based Toxics Control for the NPDES Program (Washington, D.C.: March 1992), p. 6.

[11]Environmental Protection Agency, Technical Support Document, p. 1-4.

[12]Environmental Protection Agency, Technical Support Document, p. 114.

1. What are the EPA water quality activities that control discharges of toxic substances from point sources into surface waters and what are their critical information requirements?

2. To what extent do these activities meet critical information quality assurance requirements?

3. To what extent are limits for actual toxic substance discharges included on NPDES permits?

4. What are the effects on water quality of unlisted discharges of toxic pollutants?

Scope

For questions 1 and 2, we examined activities across programs administered by EPA's water quality office that are directly responsible for controlling discharges of toxics from point sources. A number of these activities are overseen by EPA and implemented at the state level.

The scope for question 3 was comprised of facilities selected to include three industrial categories from which EPA's industrial technology division has recently gathered discharge monitoring data. These categories—pulp and paper, pharmaceutical manufacturing, and pesticide manufacturing—are among the most significant contributors of toxic substance discharges in the nation in terms of the amount of toxic pollutants discharged. We addressed question 4 using the same set of facilities.

Methodology

1. Principal Activities and Their Information Requirements

To identify and characterize the activities that EPA has established to control toxic discharges to surface water and their critical information needs, we used program documents and literature reviews to develop a list of activities conducted across a number of water quality programs. We then submitted this list to EPA officials, asking them to identify those that directly affect the control of toxics.

Our next step was to administer a structured interview to the managers of the "core" activities to determine (1) the types of information (for example, hydrology information about receiving bodies of water and information about pollutants discharged) that are required for conducting the activities and (2) the principal sources of the information. We validated our findings by asking an expert panel to review the core programs and information requirements identified (see appendix I for a list of the experts).

2. The Extent to Which Information Meets Quality Assurance Criteria

We could not evaluate the quality of the EPA data directly, because of the diversity of data used and the amount of variation in the same type of information from case to case. Instead, we used commonly accepted standards of quality assurance to assess the degree to which the EPA process adhered to such standards in collecting, analyzing, and reporting the required information (identified in question 1). This evaluation approach was feasible because EPA's official policy for conducting studies requires that quality assurance criteria be established and followed by every agency data collection effort. According to agency documents, quality assurance is indispensable for producing valid data.[13] For these reasons, we were able to use an evaluation of the EPA quality assurance effort as a surrogate for directly examining data quality.

We developed quality assurance criteria from a review of the scientific literature and EPA's quality assurance/quality control (QA/QC) guidelines. Members of EPA's quality assurance management staff then reviewed the list of criteria for relevance and completeness. We then determined which quality assurance criteria were relevant and critical to each information requirement (from evaluation question 1) for each of the core water quality protection program activities, resulting in separate sets of criteria from our overall set for each requirement. We asked our panel of experts to help us identify the quality assurance criteria relevant and critical to each information requirement. We then interviewed the managers of the activities to determine the extent to which the criteria assigned to each information type were met. We interviewed other individuals in EPA and the U.S. Geological Survey (USGS) to obtain responses to questions that program managers were unable to answer.[14] We obtained detailed explanations for each response during the interviews and independently reviewed supporting agency studies and data bases for particular responses.

[13]Environmental Protection Agency, Minimal Requirements for a Water Quality Assurance Program (Washington, D.C.: 1975), p. 1-3.

[14]We obtained responses to a number of criteria from USGS staff. We also surveyed staff within EPA's 10 regional offices for responses to several criteria.

3. The Extent to Which the NPDES Permit Process Controls Toxic Substances

The third evaluation question addresses the extent to which toxic substances receive even the first level of control provided by the NPDES permit process. We answered this question by comparing reports of actual discharges against Permit Compliance System (PCS) permit files for a sample of facilities and identifying the "unlisted" pollutants—that is, toxic pollutants that were discharged but not listed on the permit and were thus not directly controlled.[15] We obtained the discharge data from (1) studies of discharges conducted by the industrial technology division of EPA, (2) reports of discharges by industrial facilities under section 313 of the Emergency Planning and Community Right-to-Know Act (otherwise known as the Toxic Release Inventory), and (3) NPDES permit applications listing pollutants identified in facilities' effluent.

4. The Impact of Unlisted Discharges on Water Quality

To address our last evaluation question, we analyzed the human health and aquatic life risks associated with the uncontrolled toxic pollutant discharges identified in question 3. In order to determine these risks, we used a method similar to that employed by EPA regions and states when they review permit applications.[16] We developed in-stream concentrations of unlisted pollutants using a water quality model and used reported stream flow data. We obtained these from EPA. The model is a "static" water quality model in which the quantity discharged by the facility is diluted into the stream at either low flow or mean flow conditions.[17] We then compared the resultant concentrations against applicable water quality criteria to determine which of the discharges posed a risk to either human health or aquatic life.

Strengths and Limitations

One strength of the work performed for this evaluation is the comprehensiveness of the effort to determine the principal activities EPA has designed to control toxic discharges. Our review of both literature and documentation was designed to ensure that we would identify every activity implemented in the overall EPA water quality program. Through indepth review of all activities identified, interviews with EPA staff to determine which activities were directly related to toxics control, and with the use of an expert panel to validate our results, we were certain to

[15]The Permit Compliance System is EPA's data storage and retrieval system for NPDES permit files.

[16]We reviewed our methodology with staff from EPA's office of water to ensure its similarity to that employed by permit authorities.

[17]Whether we estimated concentration at low flow or mean flow conditions depended on whether we were comparing the value against an "aquatic life" or "human health" criterion. The general methodology for conducting this evaluation is presented in EPA's Technical Support Document and in Versar, Inc., ReachScan User's Manual (Springfield, Va.: September 1991).

identify the activities that are absolutely essential to the toxics control program.

To address EPA's steps to ensure data quality, our effort again was comprehensive. We used both EPA's quality assurance criteria and other criteria identified through a second literature review, this time in the specialized area of quality assurance. We asked the EPA staff who are responsible for the agency's quality assurance efforts to review our initial list of criteria for appropriateness. The use of an expert panel to examine whether criteria were both relevant and critical to ensure quality in the activities we identified served to further validate our work in establishing the normative framework.

A limitation with regard to the measurement of data quality is that we could not assess that quality directly. As noted earlier, we looked at compliance with quality assurance criteria as a proxy for direct measurement, because the complexity of direct measurement far transcended the scope of this study. Although compliance with criteria for quality is an indirect measure, such compliance is a necessary (if not sufficient) condition for quality, and it is EPA's official policy concerning all agency data collection.

Finally, our work in answering questions 3 and 4—determining the extent to which the permit process controls toxic discharges and determining the risk of uncontrolled discharges—has the strength of being a national level assessment. That is, the sample of facilities whose permits we reviewed was geographically dispersed across the country. Further advantages were the comprehensiveness of our three data bases (which defined the types of toxic pollutant discharges and their amounts) and the importance of the industrial sectors we chose to examine (pulp and paper, pharmaceutical, and pesticide manufacturing). These three sectors are among the most significant across the nation for discharging toxic pollutants, in terms of both the amount and types of pollutants discharged. However, although our sample was fairly large (236 facilities), our study was not designed to allow its conclusions to be generalized beyond that sample to the total population of the dischargers.

EPA Activities That Limit Discharges of Toxics Into Surface Waters and Their Information Requirements

In this chapter, we address our first evaluation question: What are the EPA water quality activities that control discharges of toxic substances from point sources into surface waters and what are their critical information requirements? To answer this question, we refined the larger number of activities EPA conducts across a number of water quality programs to the 7 "core" activities that are fundamental to EPA's basic approach to control the discharge of toxic water pollutants from point sources. We then identified 13 types of information required by these activities. In this chapter, we describe each activity, the information it requires, and the roles and functions of the information collected and list the data sources for the various information types.

Activities to Limit Discharges of Toxics

EPA is responsible for many activities that are designed to limit discharges of pollutants into surface waters. Through a literature review, we identified 46 activities that EPA conducted within the agency's office of water. We first eliminated the 11 that deal with drinking water or groundwater issues and, therefore, have no direct relationship with controlling toxic discharges from point sources. We then administered a questionnaire and conducted a series of interviews with EPA officials to identify the activities from the remaining 35 that have a direct effect on controlling toxics. In this manner, we arrived at a set of 7 activities that form the nucleus of EPA's approach for controlling toxic discharges from point sources. Our panel of experts then validated this list of 7 activities.

The 46 activities are presented in table 2.1, which distinguishes the 7 that we retained because of their direct influence on controlling discharges of toxic substances from the 39 others. The principal reasons for eliminating each of the 39 are also presented in the table. The 7 activities that are the focus of this chapter are then described in table 2.2.

Table 2.1: Activities Conducted Within EPA's Office of Water

No.	Activity	Status	Principal reason for elimination
1	Assess progress in implementing the Coastal Zone Management Act to control nonpoint source pollution in coastal waters	Eliminated	Administrative activity
2	Assess toxicity control needs for water-quality-based permits	Eliminated	Duplicates water-quality-based permit activity number 28
3	Conduct water quality standards triennial reviews	Eliminated	Regulatory support activity
4	Demonstrate accomplishments in maintaining active state and federal enforcement programs for drinking water	Eliminated	Not related to controlling toxic discharges
5	Develop ecological criteria guidance	Eliminated	Developmental activity
6	Develop stormwater permit strategies	Eliminated	General regulatory activity with small need for data
7	Draft a strategy for addressing contaminated sediment	Eliminated	Developmental activity
8	Draft plans for stormwater permits	Eliminated	Administrative activity
9	Enforce state testing for lead in drinking water	Eliminated	Not related to controlling toxic discharges
10	Establish drinking water laboratory certification regulations	Eliminated	Not related to controlling toxic discharges
11	Establish national primary drinking water regulations	Eliminated	Not related to controlling toxic discharges
12	Establish total maximum daily loads	Retained	
13	Establish water quality criteria	Retained	
14	Focus on reauthorization of Clean Water Act	Eliminated	Nonspecific regulatory activity
15	Identify and track water quality improvements of targeted water bodies	Eliminated	Administrative activity
16	Identify compliance problems	Retained	
17	Identify priority issues in stormwater application process	Eliminated	General regulatory activity with small need for data
18	Implement nonpoint source watershed control programs	Eliminated	Not related to controlling toxic discharges from point sources
19	Improve effectiveness of inspection activities	Eliminated	Regulatory developmental activity
20	Improve quality and timeliness of enforcement responses	Eliminated	Regulatory developmental activity
21	Issue health advisories for drinking water	Eliminated	Not related to controlling toxic discharges
22	Issue administrative compliance orders for drinking water	Eliminated	Not related to controlling toxic discharges
23	Issue drinking water regulations	Eliminated	Not related to controlling toxic discharges
24	Develop effluent guidelines	Retained	
25	Issue fines and negotiate consent decrees for permit violations	Eliminated	Not directly related to toxics control
26	Issue lists of impaired waters and related point sources	Retained	

(continued)

No.	Activity	Status	Principal reason for elimination
27	Issue regulations to control pollutants in urban runoff	Eliminated	Not related to point source control
28	Issue water quality permits	Retained	
29	Make revisions to permits codifying changes made by 1987 Clean Water Act amendments (antibacksliding provisions)	Eliminated	Duplicates number 28
30	Manage state revolving funds	Eliminated	Administrative activity
31	NPDES regulatory revisions contained in 1987 Water Quality Act	Eliminated	Nonspecific regulatory activity
32	Prepare sewage sludge use and disposal regulations	Eliminated	Regulatory development activity
33	Propose revisions to monitoring requirements for drinking water	Eliminated	Not related to controlling toxic discharges
34	Reduce noncompliance with existing drinking water standards	Eliminated	Not related to controlling toxic discharges
35	Reduce exposure of population to contaminants in drinking water	Eliminated	Not directly related to controlling toxic discharges
36	Regulate sources of toxic discharges to publicly owned treatment works from indirect dischargers	Retained	
37	Regulate substances not on drinking water priority list	Eliminated	Not related to controlling toxic discharges
38	Revise stormwater implementation rules	Eliminated	Program in development
39	Revision of denial or restriction of disposal sites	Eliminated	Not directly related to controlling toxic discharges
40	Set federal NPDES fees in states where EPA administers NPDES program	Eliminated	Administrative activity
41	Strengthen the scientific basis of water quality standards to protect critical aquatic resources	Eliminated	Not directly related to controlling toxic discharges
42	Track fish consumption advisories	Eliminated	Administrative activity
43	Track pretreatment programs	Eliminated	Administrative activity
44	Track sludge facilities	Eliminated	Administrative activity
45	Track stormwater permit activity	Eliminated	Not directly related to controlling toxic discharges
46	Water quality standards revisions for Indian tribes	Eliminated	Not of national scope

Table 2.2: Activities Designed to Control Discharges of Toxic Substances

No.	Activity[a]	Objective
1	Effluent guidelines development (no. 24)	Develop national standards, setting out baseline requirements for pollution removal within individual industries
2	Water quality criteria development (no. 13)	Develop statements of the maximum permissible concentrations of individual toxic pollutants in water that will not harm human health and aquatic life
3	Impaired water and point source identification[b] (no. 26)	Identify water threatened by point source discharges of toxic substances and the facilities causing the impairments
4	Total maximum daily load development (no. 12)	Estimate the amount of a pollutant that can be safely discharged from all sources (including natural sources) into a body of water
5	Water-quality-based permit issuance (no. 28)	Issue the legal documents containing the conditions and limits controlling a point source discharger's release of pollutants into a body of water based on the expected effect of the release on water quality
6	"Local limits" development (for reducing discharges of pollutants into sewage treatment plants) (no. 36)	Restrict the amount of pollutants that "indirect dischargers" can release into sewer systems
7	Compliance problem identification (no. 16)	Determine whether a discharger is meeting its permit conditions; used as a basis for possible future enforcement action

[a]Numbers in parentheses identify activities listed in table 2.1.

[b]This was a one-time exercise mandated by the Water Quality Act of 1987. Section 304(l) called for three lists to be prepared by each state. Only one of them featured streams with impairment primarily from toxic pollution from point sources (the others being broader delineations of impaired water bodies). We used the preparation of this list, and not the two others, as the activity.

Across these 7 activities, the essential data for implementing EPA's approach are gathered and processed. In many cases, information that has been collected and decisions that have been reached within one activity are then used within another. For example, water quality criteria (activity 2) are used to generate water-quality-based permits (activity 5). In terms of their information function, the core program activities can be grouped into four categories by the role each plays in the overall process: (1) uniform guideline development, (2) geographic targeting, (3) permit development, and (4) compliance assessment.

The overall process for controlling toxics from point sources begins with uniform guideline development: the development of general practices for making decisions with respect to the thousands of facilities subject to NPDES. In this first category, EPA develops national guidelines or criteria—specifically effluent guidelines and water quality criteria (activities 1 and 2 in table 2.2). They provide the rationale for determining what substances should be limited on permits and what those limits should be. The second step in the process is to identify specific facilities that require expedited review of their permit. The one time that geographic targeting was employed by the Congress within the Clean Water Act occurred in section 304(l) of the act as amended in 1987 (activity 3). The third category, permit development, uses the national criteria and standards (from the first category) along with site-specific information to determine the conditions and limitations needed on individual permits—specifically, total maximum daily load (TMDL) development, NPDES permit issuance, and "local limits" development (activities 4, 5, and 6). The fourth category, compliance assessment (that is, activity 7, compliance problem identification), uses information about patterns of discharges to determine whether facilities have complied with the conditions and limits of their permits. This activity compares actual monitoring and test data against the limits and conditions imposed in permits. If problems are found, the results of this comparison can lead to either an enforcement action against a facility for violating a permit condition or to a revision of its permit.

Information Required Within the Seven Core Activities

We identified critical information needed to support the core activities through interviews with EPA program managers and others. "Critical" information was defined as having primary importance to conducting the activity with respect to meeting EPA's water quality goals for controlling point source discharges of toxics into surface water. Weaknesses in critical information clearly undermine the effectiveness of an activity. Each of the 13 information types we identified as required by the 7 activities is briefly described in table 2.3.

Table 2.3: The Thirteen Types of Information Required Across the Seven Activities

No.	Information type	Description
1	Hydrology	Characteristics of the properties of lakes and rivers such as stream flow
2	In-stream water quality	The chemical properties of the receiving body of water (typically the concentration of the chemical constituents)
3	Concentration in sediments	Concentrations of chemical constituents found within the sediments of receiving water bodies
4	Concentration in biota	Concentrations of toxics within the aquatic creatures inhabiting the water body
5	Aquatic life exposure	The extent to which aquatic life is exposed to pollutants
6	Discharges from individual sources	Substances and amounts being discharged from specific plants and facilities
7	Removal technologies	Characterizations of the technologies that are effective within the industry for removing pollutants from wastewater
8	Water use reduction technologies	Characterizations of the techniques that can be used to reduce discharges of pollutants through water reuse in the industrial production process
9	Aquatic life effects	The nature and extent of effects upon aquatic organisms that come into contact with substances in the environment[a]
10	Human health effects	The nature and extent of human effects associated with exposure to the substance in the environment
11	Fate and transport	The mechanisms and rate at which a substance undergoes change and moves through the environment (or within a publicly owned treatment works)
12	Human health exposure	The extent and way in which humans are exposed to water pollutants through drinking water and eating fish
13	Economic data	The effect on an industry's profitability of changes in categorical technologically based effluent standards

[a]In connection with the section 304(l) exercise, this took on the meaning of assigning "biocriteria," or using indicator species, to measure environmental impairments.

The Seven Core Activities and Their Information Needs

We found, as expected, that all 7 activities depend heavily on information. Each requires a different set of specific data for its implementation. As already noted, 13 different types of information in all are required across the 7 activities. The types of information listed as 1-13 in table 2.3 are labeled A-M in figure 1 and elsewhere in the report. The types of information used to support the 7 activities vary significantly.

The Roles and Functions of the Information

In the series of summary tables 2.4 through 2.10, we present the reasons why the 13 types of information we identified in the preceding section (types A-M) are required across the 7 activities. Each table characterizes the determinations, within each activity, that the information is required to support (its purposes) and states the source of the information and how it is developed. In appendix II, we present a more detailed description of each activity, highlighting its statutory and regulatory basis in addition to the role and principal information sources of each information type.

Table 2.4: The Purposes and Sources of Critical Information Within Activity 1: Effluent Guidelines Development

Information type	Purpose	Typical principal source
Discharges from individual sources (F)	To identify the pollutants that are typical of facilities within an industry	Questionnaire to a sample of facilities within industry; site visits
Removal technologies (G)	To identify the most efficient technologies available within an industry to remove pollutants	Questionnaire to a sample of facilities within industry; site visits
Water use reduction technologies (H)	To identify the most efficient technologies available within an industry to reduce discharges through efficient water use	Questionnaire to a sample of facilities within industry; site visits
Economic data (M)	To identify and characterize the economic effect on an industry of various alternatives	Questionnaire to a sample of facilities within industry

Table 2.5: The Purposes and Sources of Critical Information Within Activity 2: Water Quality Criteria Development

Information type	Purpose	Typical principal source
Concentration in biota (D)	To determine how pollutants bioconcentrate in the environment	Peer reviewed scientific literature; EPA's field studies
Aquatic life exposure (E)	To provide a measure allowing the results of the effects studied to be related to "real world" exposures	Criteria from EPA (on magnitude, duration, and frequency of exposure)
Aquatic life effects (I)	To identify the nature and magnitude of the effects of exposure of the pollutant to aquatic species	Aquatic toxicology studies, internally developed or from the scientific literature; EPA testing
Human health effects (J)	To identify the nature and magnitude of the effects of exposure of the pollutant to people	Peer reviewed scientific literature; EPA's field studies
Human health exposure (L)	To provide a measure allowing the results of the effects studied to be extrapolated to the exposures of people	Peer reviewed scientific literature; EPA's field studies

Table 2.6: The Purposes and Sources of Critical Information Within Activity 3: Impaired Water and Point Source Identification

Information type	Purpose	Typical principal source
In-stream water quality (B)	To identify areas that are contaminated by toxics	State monitoring programs; STORET[a]; state-specific data bases
Concentration in sediments (C)	To identify areas that have sediments contaminated by toxics	State monitoring programs; STORET state-specific data bases
Concentration in biota (D)	To determine areas that have aquatic life contaminated by toxics	State monitoring programs and assessments
Discharges from individual sources (F)	To identify areas that may be contaminated by toxics and the contributing sources	Permit applications and discharge monitoring reports
Aquatic life effects (I)	To determine whether aquatic life is being harmed by discharges	State monitoring programs and section 305(b) reports
Fate and transport (K)	To provide precise estimates of in-stream concentrations	State section 305(b) assessments; state surveys; state and EPA compliance monitoring for point sources

[a]STOrage and RETrieval (STORET).

Table 2.7: The Purposes and Sources of Critical Information Within Activity 4: TMDL Development

Information type	Purpose	Typical principal source
Hydrology (A)	To estimate the "critical flow" of the receiving water body	USGS gaging stations and regression equations from gages on neighboring streams
In-stream water quality (B)	To estimate the background concentration of the substance being discharged	State monitoring programs; STORET
Concentration in sediments (C)	To determine whether the sediment is contaminated	State monitoring programs; STORET
Concentration in biota (D)	To determine whether there is a contamination problem	State monitoring programs; STORET
Discharges from individual sources (F)	To estimate the amount discharged by the facility	Permit applications and discharge monitoring reports
Fate and transport (K)	To provide precise estimates of in-stream concentrations	Textbooks, journal articles, EPA and U.S. Fish and Wildlife Service publications; EPA-supported water quality models

Table 2.8: The Purposes and Sources of Critical Information Within Activity 5: Water-Quality-Based Permit Issuance

Information type	Purpose	Typical principal source
Hydrology (A)	To determine the dilution limits for aquatic life and human health effects	USGS gaging stations and regression equations from gages on neighboring streams
In-stream water quality (B)	To determine the background concentrations for the substances being considered	STORET and state water quality data bases
Discharges from individual sources (F)	To determine the amount discharged from the facility	Permit applications and discharge monitoring reports
Fate and transport (K)	To provide precise estimates of in-stream concentrations	Textbooks, journal articles, EPA and U.S. Fish and Wildlife Service publications; EPA-supported water quality models

Table 2.9: The Purposes and Sources of Critical Information Within Activity 6: "Local Limits" Development

Information type	Purpose	Typical principal source
Discharges from individual sources (F)	To determine the substances and amounts being discharged	Monitoring of the source's effluent, by the indirect discharger and the publicly owned treatment works
Removal technologies (G)	To determine the effectiveness of the publicly owned treatment works at removing the substance	Self-monitoring of the publicly owned treatment works' effluent
Fate and transport (K)	To determine the amount of each substance remaining in wastewater, volatilizing into the atmosphere, and precipitating in sludge as a result of treatment at the publicly owned treatment works	Self-monitoring of the publicly owned treatment works' wastestream

Table 2.10: The Purposes and Sources of Critical Information Within Activity 7: Compliance Problem Identification

Information type	Purpose	Typical principal source
In-stream water quality (B)	To compare against permit limits in order to evaluate compliance (in-stream monitoring is rarely included)	Self-monitoring by facility; data for major facilities entered into PCS
Aquatic life exposure (E)	To compare against permit limits in order to evaluate compliance (WET limits)	Self-monitoring by facility; data for major facilities entered into PCS
Discharges from individual sources (F)	To compare against permit limits in order to evaluate compliance	Self-monitoring by facility; data for major facilities entered into PCS

Summary

Seven activities across various EPA water quality programs form the core of the agency's effort to control toxic discharges from point sources into surface waters: effluent guidelines development, water quality criteria development, impaired water and point source identification, total maximum daily load development, water-quality-based permit issuance, "local limits" development, and compliance problem identification.

A wide variety of information is employed within the 7 core activities. All 7 use several different types of information for making decisions. In all, 13 different types of information are used at 31 points across the 7 activities (tables 2.4 through 2.10).

Information plays a critical role across these activities. From setting national standards to ensuring compliance with individual NPDES permits, information forms the basis for these efforts. Each one of the 13 types of information is critical to the activities. For example, without reliable information about efficient and feasible removal technologies, the effluent guidelines activity would not produce technological requirements that meet congressional objectives in the Clean Water Act. Without reliable information about the actual discharges of facilities with permits, the NPDES compliance program would not be able to identify the facilities that are not conforming to their permit requirements.

Having established the core activities and their related information requirements, we now address our second evaluation question. In chapter 3, we evaluate the extent to which EPA ensures that critical quality assurance steps are taken in developing the required information.

The Extent to Which Required Information Meets Quality Assurance Requirements

In chapter 2, we identified the EPA activities that control toxic discharges to water and the types of information that support the activities. In this chapter, we address our second evaluation question: To what extent do these activities meet critical information quality assurance requirements? Here, we compare EPA's official policy for quality assurance in data collection with reported practice.

Introduction

As we discussed in chapter 2, information is a critical component of the nation's approach for controlling discharges of toxics, and the quality of that information is central to the effectiveness of the 7 core activities. In general (that is, within each activity), information quality is promoted through adopting and practicing quality assurance standards. Quality assurance practices and standards control how data are collected, managed, and analyzed so as to ensure their reliability, validity, and completeness. These standards also regulate whether the information base is sufficient for drawing inferences and making decisions. We evaluated information quality according to two types of criteria. The first type concerns the methodological steps taken to ensure information quality.[1] The second type concerns the completeness of the data gathered vis-a-vis the envisaged purpose—that is, whether all the information required to support the activity was in fact acquired.

EPA's policy is to protect information quality by incorporating quality assurance practices into individual studies. EPA order 5360.1 requires a quality assurance program for all environmentally related measurements performed by or for the agency. The primary goal of the program is to ensure that all such measurements yield data of known quality that can be verified as being reliable and appropriate to the program's objectives. The quality assurance management staff serves as the central management authority for this program within EPA.

The staff is charged with developing quality assurance policy and training program managers in quality assurance practices. Program managers are responsible for specifying the quality of the data they require and for

[1]Concerning methodological adequacy, EPA and USGS have recently determined that the analytical methods used to collect and analyze the in-stream data for metals may be flawed. As a result, concerns have been raised about the soundness of the information on which the states have been basing their water quality programs. At a workshop that EPA convened to study the issue, an agency official raised the possibility that the numbers are problematic. A professional hydrologist suggested that much of the data collected in the past to determine whether water bodies are exceeding standards is "almost certainly useless" (Water Policy Report, February 3, 1993, p. 3). EPA and USGS, the two principal agencies involved in developing protocols for sample collection, are currently studying how to deal with these questions.

providing sufficient resources to ensure that an adequate level of quality assurance is performed. All routine or planned projects involving environmental measurement must begin with a "quality assurance project plan" that specifies acceptable quality goals.

Evaluating Quality Assurance Practices

Each of the 7 activities we identified in our evaluation has resulted in a large number of program decisions and products. For example, dozens of effluent guidelines have been issued over the course of the clean water program and thousands of NPDES permits are issued and reissued each year. Because of the large number of decisions and products, which went far beyond the scope of our evaluation, we focused our evaluation at the level of the 7 activities.

Developing Criteria Statements

Through a review of the scientific literature on quality assurance, EPA's quality assurance guidelines, and interviews with experts in the field, we identified a set of 40 criteria that define a basis for ensuring both information quality and completeness for the toxic pollutant control activities we are addressing. Thirty-one of the 40 reflect consensus criteria developed by EPA itself or industrial groups such as the American Society of Testing and Materials (ASTM) relating to methodological adequacy. That is, they deal with how information collection activities should be planned and implemented and how the information should be reviewed. Most of them apply to whether safeguards were taken to ensure the validity and reliability of the information collected in the field and analyzed in the laboratory. The remaining 9 criteria relate to completeness—that is, whether the information base of all studies is sufficient (aside from data quality concerns of individual studies) to reach conclusions about the subject of interest, such as the in-stream concentration of dioxin (for setting a limit on an individual permit).

We converted the 40 quality assurance criteria into a set of questions, using a response scale of frequency. The questions, presented in table 3.1, are divided into those dealing with methodological adequacy and those that ensure a complete information base.

Table 3.1: Quality Assurance Criteria for Evaluating the Seven Core Toxic Pollutant Control Activities

Type	Criterion	Question
Methodological adequacy	1	How often are data quality objectives instituted at the initiation of a project?
	2	How often is the design for data collection and analysis reviewed by an individual not directly associated with the program who is familiar with the methodological issues involved in data collection and analysis?
	3	How often is a quality assurance project plan employed within the data collection process?
	4	How often are standard operating procedures for field and laboratory sampling and reporting followed?
	5	How often are QA/QC procedures for data storage and maintenance employed?
	6	How often are questionnaires pretested?
	7	How often are chemical analyses and bioassays conducted according to EPA-approved methods or other methods specified in the project plan?
	8	How often are chemical analyses and bioassays performed by laboratories that follow good laboratory practices?
	9	How often is an independent analysis conducted to assess the quality of the data that went into water quality criteria?
	10	How often do assessments of environmental quality that are based on best professional judgment undergo quality control checks and independent verification?
	11	How often were subject area experts consulted and drafts distributed for public review before the data were accepted?
	12	How often are multiple, independent sets of data used to identify the toxic substances that were included within the data collection effort?
	13	How often are multiple, independent sets of data used to identify the facilities to gather data from within the data collection effort?
	14	Where sampling data were unavailable, how often were assessments, based on observations of water, biota, and sediment by an experienced professional?
	15	How often do individual studies present missing data exceeding 10 percent of planned sample size?
	16	How often is a probabilistic sampling scheme (a random sample) employed and documented?

(continued)

Type	Criterion	Question
	17	How often are all requirements of the model, such as times and locations for in-stream or discharge monitoring, adhered to?
	18	How often are the data checked for age and only those that are appropriately current retained and used in the analysis?
	19	How often are data from different time periods gathered in such a way as to ensure that they are comparable?
	20	How often are independent studies conducted to assess the degree to which self-reported samples represent discharges at different production and discharge levels?
	21	How often is the critical flow based on data from gaging stations (whether on the reach itself or estimated from gaging stations on neighboring reaches)?
	22	When substituting one variable for another within a model, how often were steps taken to ensure that the surrogate variable is correlated with the original with respect to the function it performs in the model?
	23	For critical model parameters, how often were laboratory findings replicated with field studies?
	24	How often are estimates of in-stream concentrations of discharges based on water quality models of proven validity with respect to local stream conditions?
	25	How often do major externally published reports of findings discuss significant components of bias and measurement error?
	26	How often was the laboratory "in control" during the period in which it performed the tests?
	27	How often are field-derived data obtained under conditions that adequately represent the range and variability of biotic and abiotic conditions?
	28	How often is the design for data collection and analysis reviewed by an individual within the organization who is familiar with the methodological issues involved in data collection and analysis?
	29	How often is the survey design reviewed by an individual familiar with methodological issues involved in survey methods?
	30	How often are manufacturers' specifications adhered to in calibrating gages?
	31	How often was the laboratory instructed about detection and quantitation levels and how to report data below these levels?

(continued)

Type	Criterion	Question
Completeness	32	How often is a judgment made that sampling and analysis included all pollutants that were likely to be present at measurable levels?
	33	How often are data gathered on all relevant effects when developing criteria?
	34	How often are there enough data of proven quality concerning the most likely effects to support the contention that criteria are based on the most sensitive effect?
	35	How often are enough data of proven quality collected on a variety of representative species or cell lines to support the contention that criteria are based on impacts to the most sensitive species that will encounter the toxic substance in the environment?
	36	How often is an assessment made downstream of each "major" discharger?
	37	How often are sampling data available for waters on which "major" dischargers of toxics are situated?
	38	How often are minimum data set size requirements stipulated?
	39	How often are sampling frequency and size based on an assessment of the variability of discharge loads?
	40	How often is the data set of adequate size to reflect variations and differences for this regulatory purpose?

Determining the Relevance of the Quality Assurance Criteria

The list of criteria for ensuring the methodological adequacy and completeness of information is broad. Whether a criterion is relevant to an information requirement depends on the activity that the information requirement supports. Consequently, our first task was to determine which criteria were relevant to and critical for each information requirement as it supports each specific activity. We did this with the assistance of a panel of five experts familiar with the information requirements of these activities. That is, for each of the 13 types of information used by the activities (figure 2.1), we identified the criteria that are both relevant and critical for ensuring information completeness and quality. We defined a critical criterion as one that, if not routinely met, would jeopardize the quality of the information and threaten EPA's ability to draw conclusions from it. The critical criteria are presented in table 3.2. Thirty-eight of the 40 criteria were applied to at least one information type.

Table 3.2: Quality Assurance Criteria Applicable to Information Types

Activity	Information type	Criteria
Effluent guidelines development	Discharges from individual sources	1-5, 7, 8, 12, 13, 19, 20, 28, 39, 40
	Removal technologies	1-5, 7, 8, 10, 13, 19, 25, 28, 39
	Water use reduction technologies	1-5, 7, 8, 10, 13, 19, 25, 28, 39
	Economic data	1, 3, 5, 6, 18, 28, 29
Water quality criteria development	Concentration in biota	1-5, 9-11, 26-28, 34
	Aquatic life exposure	1-5, 9, 11, 26, 28
	Aquatic life effects	1-5, 7-9, 11, 26, 28, 33-35, 38
	Human health effects	1-3, 5, 9-11, 18, 28, 33, 34, 38
	Human health exposure	1-3, 5, 9, 11, 28
Impaired water and point source identification	In-stream water quality	1, 3-5, 7, 8, 18, 26, 28, 32, 40
	Concentration in sediments	1, 3-5, 7, 8, 18, 25, 26, 28, 40
	Concentration in biota	1, 3-5, 7, 8, 18, 26, 28, 40
	Discharges from individual sources	1, 3-5, 7, 8, 18, 26, 28, 32, 40
	Aquatic life effects	1, 3-5, 7, 8, 28, 33, 40
	Fate and transport	1-3, 5, 18, 21, 22, 24, 28, 37, 39, 40
Total maximum daily load development	Hydrology	21, 22, 24, 28, 38
	In-stream water quality	1-5, 7, 8, 18, 28, 37, 39
	Concentration in sediments	1-5, 7, 8, 18, 28, 32, 37, 39
	Concentration in biota	1-5, 7, 8, 28, 37
	Discharges from individual sources	1-5, 7, 8, 18, 28, 39, 40
	Fate and transport	1-5, 7, 8, 18, 21, 22, 24, 26, 28, 32, 37, 39, 40
Water-quality-based permit issuance	Hydrology	1-5, 19, 24, 25, 27, 28, 30, 36, 40
	In-stream water quality	1-5, 7-12, 17-19, 25-28, 31, 32, 36, 37, 40
	Discharges from individual sources	1-5, 7-12, 15, 16, 18, 19, 25, 26, 28, 31, 32, 39, 40
	Fate and transport	1-5, 7-9, 17-19, 24-28, 31, 32, 36, 39, 40
"Local limits" development	Discharges from individual sources	1-5, 7, 8, 12, 15, 16, 18, 25, 26, 28, 31, 32, 39, 40
	Removal technologies	1-5, 7, 8, 10, 19, 25, 26, 28, 39
	Fate and transport	1-5, 7, 8, 10, 18, 19, 25, 26, 28, 39
Compliance problem identification	In-stream water quality	1, 3-5, 7, 8, 18, 26, 32, 40
	Aquatic life exposure	1, 3-5, 7, 8, 18, 19, 26, 40
	Discharges from individual sources	1, 3-5, 7, 8, 18, 26, 32, 38, 40

Quality Assurance Practices

To determine the extent to which the completeness and quality assurance criteria were employed within the 7 activities, we interviewed the relevant EPA managers, using our 40 criteria as a questionnaire with a five-point response scale rating the extent to which the activity is conducted "always," "usually," "sometimes," "seldom," and "never." A criterion should be met at least "usually" if quality assurance criteria are to be met. Therefore, we classified the responses by grouping them into two categories: met ("always" and "usually") and not met ("sometimes," "seldom," and "never"). We also asked for any supporting data and requested that each response be explained as we conducted our interviews.

We examined the extent to which the quality assurance criteria were met from two different perspectives: first, from the overall perspective of the 7 activities, and, second, from the perspective of the information types (that is, to what extent were they supported by necessary quality assurance efforts?).

A preliminary finding was that the officials we interviewed were aware of EPA's position concerning quality assurance policies and practices. From our review, it is clear that these managers recognize and have accepted the principle of quality assurance within their activities.

Table 3.3 presents the results of our interviews with EPA officials concerning the degree of implementation of the quality assurance criteria. Table 3.4 summarizes our results for the activities and information types. As presented in table 3.4, 2 activities (those that establish effluent guidelines and water quality criteria) were exceptional in meeting quality assurance criteria that are critical to the effort. They met 93 percent of their quality assurance requirements. However, the 5 other activities fall short in taking the necessary steps to ensure information quality. That is, impaired water and point source identification, TMDL development, water-quality-based permit issuance, "local limits" development, and compliance problem identification are less than optimal in ensuring that the required quality assurance steps are taken in developing, collecting, or maintaining their needed information. Collectively, about 58 percent of their quality assurance criteria were met.

Table 3.3: Responses to Individual Quality Assurance Criteria

	Effluent guidelines development				Water quality criteria development				
No.[b]	F	G	H	M	D	E	I	J	L
1	5	5	5	5	5	5	5	5	5
2	4	4	4		5	5	5	2	2
3	5	5	5	4	5	5	5	4	4
4	5	5	5		5	5	5		
5	5	5	5	5	5	5	5	4	4
6				5					
7	5	5	5				5		
8	5	5	5				5		
9					5	5	5	5	5
10		5	5		5			5	
11					5	5	5	5	5
12	5								
13	4	4	4						
14									
15									
16									
17									
18				5				5	
19	5	5	5						
20	5								
21									
22									
23									
24									
25		2	5						
26					4	4	4		
27					5				
28	5	5	5	5	5	5	5	4,5	4,5
29				5					
30									
31									
32									
33							5	5	
34					3		3	3	
35							3		

Activity and information type[a]																					
Impaired water and point source identification						TMDL development						Water-quality-based permit issuance				"Local limits" development			Compliance problem identification		
B	C	D	F	I	K	A	B	C	D	F	K	A	B	F	K	F	G	K	B	E	F
4	4	4	2	3	2		4	4	4	4	4	5	4	5	4	4	4	4	3	4	4
					2		3	2	2	2	3	5	3	4	4	4	3	3			
4	4	4	2	3	2		4	4	4	4	4	5	4	3	4	4	4	4	3	4	5
5	4	4	3	4			4	4	4	4	4	5	4	4	3	4	4,5	4,5	4	4	3
4	4	4	3	4	4		4	4	4	4	4	5	4	4	3	2	2	2	1	3	3
4	3	4	5	4			4	4	3	4	4		4	4	4	4	4	4	2	4	4
4	4	4	3	4			4	4	4	4	4		4	4	4	4	4	4	3	4	4
													3	3	3						
													3	2			3	3			
													4	4							
													3	2		3					
														2		2					
														2		1,2					
													4		4						
3	4	4	4		4		4	4		4	4		4	4	4	5		3	2	5	4
												4	3	4	4		4	4		3	
					3	3					3										
					3	4					4										
					4	3					3	2			4						
	3											2	3	4	4	2	2	2			
4	4	4	3								4		4	3	4	4	4	4	4	4	4
												4	4		3						
3	2	3	2	3	3	3	3	2	2	3	3	4	4	4	4	3	4	4			
												5									
													3	3	3	4					
2			2					3			3		4	2	3	4			3		4,5
				3																	

(continued)

	Effluent guidelines development				Water quality criteria development				
No.[b]	F	G	H	M	D	E	I	J	L
36									
37									
38							5	5	
39	5	5	5						
40	5								

Activity and information type[a]																					
Impaired water and point source identification						TMDL development						Water-quality-based permit issuance				"Local limits" development			Compliance problem identification		
B	C	D	F	I	K	A	B	C	D	F	K	A	B	F	K	F	G	K	B	E	F
												3	4		5						
					4		4	3	2		4		3								
						2															5
					3		3	2		3	3			3	3	3	4	4			
2	2	3	2	2	2					3	2	4	2	3	4	3			2	3	3

[a]Letters in column headings under each activity refer to information types displayed in figure 1. Numbers in cells are 1, never; 2, seldom; 3, sometimes; 4, usually; 5, always.

[b]Criteria follow numbers in table 3.1.

Table 3.4: The Number of Criteria Met Within Each Information Type

		Number of criteria[a]		
Activity	Information type	Assigned	Met	Not met
Effluent guidelines development	Discharges from individual sources	14	14	0
	Removal technologies	13	12	1
	Water use reduction technologies	13	13	0
	Economic data	7	7	0
Water quality criteria development	Concentration in biota	12	11	1
	Aquatic life exposure	9	9	0
	Aquatic life effects	15	13	2
	Human health effects	12	10	2
	Human health exposure	7	6	1
Impaired water and point source identification	In-stream water quality	11	7	4
	Concentration in sediments	11	7	4
	Concentration in biota	10	8	2
	Discharges from individual sources	11	2	9
	Aquatic life effects	9	4	5
	Fate and transport	12	4	8
TMDL development	Hydrology	5	1	4
	In-stream water quality	11	8	3
	Concentration in sediments	12	7	5
	Concentration in biota	9	5	4

(continued)

		Number of criteria[a]		
Activity	**Information type**	**Assigned**	**Met**	**Not met**
	Discharges from individual sources	11	7	4
	Fate and transport	17	9	8
Water-quality-based permit issuance	Hydrology	13	10	3
	In-stream water quality	23	14	9
	Discharges from individual sources	22	12	10
	Fate and transport	21	14	7
"Local limits" development	Discharges from individual sources	18	11	7
	Removal technologies	13	9	4
	Fate and transport	14	9	5
Compliance problem identification	In-stream water quality	10	2	8
	Aquatic life exposure	10	7	3
	Discharges from individual sources	11	8	3
Total		**386**	**260**	**126**
Percent			**66%**	**34%**

[a]Criteria numbers are in table 3.1.

Meaningfulness of the Results

The work presented above shows that practice within 5 of the 7 core activities does not measure up to EPA's enunciated information quality assurance policies and principles. This raises questions about the quality of information generated and used within these 5 activities.

We initiated a separate qualitative review of agency documents and information bases and were able to confirm at least some of these findings. For example, many of our EPA interviewees had noted that data on in-stream water quality for toxic pollutants are generally lacking (criterion 37). We were able to confirm the accuracy of these responses through a review of the data in STORET, EPA's principal repository of water quality data. For a group of streams around the nation on which large manufacturing facilities are situated, we found very few with any data for toxic pollutants.[2] In fact, we found that only 9 percent of these streams had had any in-stream data for organic toxic pollutants or pesticides entered in STORET since 1988, despite the presence of major industrial facilities discharging a variety of toxic pollutants into all these waterways.

A lack of in-stream data can result in pollutants failing to be identified or limited on NPDES permits. For example, when there is no information about in-stream concentrations of pollutants being considered for a water-quality-based limit (activity 5), the in-stream concentration parameter is set to zero within the modeling routine used to derive permit limits. For streams in which the pollutant is present but is not reported, the absence of data signifies that a greater amount of pollutant discharge from facilities will be allowable than if valid in-stream data had been available.[3] It may also lead to facilities not receiving limits (restrictions) covering toxic pollutants although there is a water quality concern in the receiving body of water. EPA acknowledges some of these problems and has embarked on a program to modernize STORET to address them.

Summary

Our findings raise concerns about the quality of the information supporting EPA's core activities controlling toxic discharges into surface waters. Although 2 of the activities had strong quality assurance practices associated with them, the 5 others were much weaker, meeting about 58 percent of their critical quality assurance criteria.

[2]These streams (river reaches) were selected because dischargers within three significant industrial categories (pesticide manufacturing, pharmaceutical manufacturing, and pulp and paper manufacturing) are situated on them.

[3]Environmental Protection Agency, Technical Support Document for Water Quality Based Toxics (Washington, D.C.: March 1991), p. 130.

The Extent to Which Limits for Toxic Substances Are Included on NPDES Permits

In this chapter, we address our third evaluation question: To what extent are limits for toxic substance discharges included on NPDES permits? We answered this question by comparing information on actual toxic pollutant discharges from three data sources with a list of toxic pollutants controlled through NPDES permits for a sample of facilities.

Identifying Toxics to Be Limited on NPDES Permits

We based the development of our sample of facilities to examine on three industrial categories: pesticide manufacturing, pharmaceutical manufacturing, and pulp and paper manufacturing.[1] We reviewed the information on actual toxic effluent discharges for 236 facilities within these categories and compared them to the facilities' permits. Identifying which pollutants to control through the NPDES permit process is the critical step in issuing permits. As stated earlier, without an explicit permit limit on a pollutant, a facility is free to discharge any amount. Hence, identifying the range of pollutants that should be included on NPDES permits is essential for the toxic control program to succeed.

It has been generally conceded that a discrepancy exists between the number of pollutants that are regulated through permits and the number that should be regulated.[2] However, this gap has not been systematically examined. We do so here and report our findings in this chapter for a sample of dischargers. It should be noted that the existence of such a gap would not in itself suggest problems with the permit process. That would be the case only if the discharge of uncontrolled toxicants resulted in unacceptable risks to human health and aquatic life. We address this issue in chapter 5.

Information Sources About Discharges

Our sources of information about toxic pollutant discharges for our sample of facilities were (1) each facility's permit application (EPA Form 2c); (2) EPA's Toxic Release Inventory (TRI), an annual inventory of discharges from the largest manufacturing facilities in the nation; and (3) discharge data collected under effluent guidelines.[3] We pooled these three sources of information to identify the toxic pollutants being

[1] We selected these three because EPA's effluent guidelines program had recently conducted monitoring studies for facilities within these categories.

[2] U.S. General Accounting Office, Water Pollution: Stronger Efforts Needed by EPA to Control Toxic Water Pollution, GAO/RCED-91-154 (Washington, D.C.: July 1991), p. 4.

[3] We used the TRI responses from 1989, the most recent available when we conducted our analyses.

discharged at the facilities in our sample.[4] Each of these sources employs a different data collection method. Consequently, using all three sources provides us a more comprehensive characterization of the toxic pollutant discharges from our sample of facilities. TRI in particular has a different data collection method than the permit applications. Much of the data it contains were derived from mass balance calculations or published emissions factors. These data collection methods complement the monitoring information contained within the other data sources. Table 4.1 presents the major attributes of the three data sources.

Table 4.1: Major Attributes of Three Sources of Discharge Information

	Information source		
Attribute	**Permit applications**	**Effluent guidelines**	**TRI**
Primary purpose	To identify pollutants being discharged for purposes of permit issuance	To identify pollutants and concentrations discharged by the most efficient facilities within an industry	To identify the amounts of "hazardous chemicals" that are annually and routinely discharged into the environment
Data source	Approximately 7,000 major and 57,000 minor facilities	Small sample within selected industries	Approximately 2,300 facilities discharging into surface waters
Frequency of reporting	Every 5 years	No schedule	Annually
Time period covered by estimate	Daily	Daily and annually	Annually
Number of samples for each estimate	Varies	Typically, a series over 3 days	No requirements
Sampling frame	Not applicable	Individually selected industries	All facilities meeting size requirements discharging toxics
Pollutants covered	Priority pollutants and 80 others "if expected to be present"	More than 450 pollutants	Approximately 300 pollutants and chemical groups
Principal basis of estimate	Monitoring for priority pollutants; identification of 80 others "if expected to be present"[a]	Monitoring	Mass balance, engineering calculations, or monitoring
Who collects sample	Facility	EPA	Facility

[a]Details of monitoring requirements are contained in section 122.21 of title 40 of the Code of Federal Regulations.

Toxics Discharged Without Permit Limits

We found a large number of different pollutants being discharged by one or more of the 236 facilities. One hundred and eighty-five different toxic

[4]We included 234 facilities from TRI. Because of the difficulty of obtaining and reviewing permit applications, we drew a random sample of 72 facilities for data from that source. The third source of data, effluent guidelines studies, contributed data for approximately 32 facilities, which was the number of direct dischargers available within that data set.

pollutants were reported to have been discharged from the 236 facilities. Whereas some pollutants were discharged from a single facility, others were reported from numerous facilities. For example, chloroform, a common byproduct of industrial processes that EPA views as a "probable" carcinogen, was reported to be discharged by 91 of the 236 facilities. Table 4.2 presents the toxic pollutant discharges we identified, indicates whether they are priority pollutants or nonpriority pollutants, and shows the number of facilities they were discharged from and the number that were uncontrolled through the permit process across the 236 facilities in our sample. Because of the proprietary nature of some of the discharge data, we cannot present a facility-by-facility breakdown of our results.

Table 4.2: The Extent of Discharge and Control of Individual Toxic Pollutants, Priority and Nonpriority

Pollutant	Priority pollutant	Facilities releasing	Facilities where listed on permit
1,1-dichloroethane	No	1	1
1,1-dichloroethylene (vinylidene chloride)	Yes	3	0
1,1,1-trichloroethane	Yes	7	3
1,1,2-trichloroethane	Yes	1	1
1,1,2,2-tetrachloroethane	Yes	1	1
1,2-dichloroethane	Yes	12	6
1,2-butylene oxide	No	2	0
1,2-dichlorobenzene	Yes	1	1
1,2-dichloroethylene	No	1	0
1,2-dichloropropane	Yes	1	1
1,2,4-trimethylbenzene	No	2	0
1,2,4-trichlorobenzene	No	1	0
1,3-butadiene	No	1	0
1,3-dichlorobenzene	Yes	1	1
1,3-dichloropropylene	Yes	1	0
1,4-dichlorobenzene	Yes	1	1
2-hexanone	No	1	0
2-phenylphenol	No	1	0
2,3,7,8-TCDD (dioxin)	Yes	5	1
2,4-D	No	3	2
2,4-diaminotoluene	No	1	0
2,4-dichlorophenol	Yes	2	1
2,4-dimethylphenol	Yes	1	0
2,4-dinitrophenol	Yes	1	0
2,4,5-TP	No	1	0

(continued)

Pollutant	Priority pollutant	Facilities releasing	Facilities where listed on permit
2,4,6-trichlorophenol	Yes	1	0
3,3-dichlorobenzidine	Yes	1	1
3,4,5-trichloroguaiacol	No	1	0
3,4,5-trichlorocatechol	No	2	0
4,4'-isopropylidene diphenol	No	1	0
4,5-dichlorocatechol	No	2	0
4,5-dichloroguaiacol	No	2	0
4,5,6-trichloroguaiacol	No	1	0
5,6-dichlorovanillin	No	1	0
6-chlorovanillin	No	1	0
Acetaldehyde	No	5	0
Acetone	No	108	1
Acetonitrile	No	4	0
Acrolein	Yes	1	0
Acrylamide	No	2	0
Acrylic acid	No	3	0
Acrylonitrile	Yes	3	2
Alachlor	No	1	1
Aluminum	No	7	1
Ametryn	No	1	0
Ammonia	No	147	56
Ammonium nitrate	No	7	0
Ammonium sulfate	No	9	1[a]
Aniline	No	4	0
Antimony	Yes	3	1
Arsenic	Yes	9	1
Asbestos	Yes	1	0
Atrazine	Yes	1	0
Barium	No	6	0
Benomyl	No	1	0
Benzene	Yes	5	2
Biphenyl	No	6	0
Bis(2-chloroethyl) ether	Yes	1	1
Bis(2 ethylhexyl) phthalate	Yes	9	1
Boron	No	3	0
Bromacil	No	1	1
Bromoform	Yes	2	1

(continued)

Pollutant	Priority pollutant	Facilities releasing	Facilities where listed on permit
Bromomethane	Yes	1	1
Butachlor	No	1	1
Butylamine	No	1	0
Cadmium	Yes	1	0
Calcium	No	3	0
Captan	No	2	0
Carbaryl	No	3	1
Carbon disulfide	No	2	1
Carbon tetrachloride	Yes	6	4
Catechol	No	72	0
Chlorinated phenols	No	3	1[b]
Chlorine	No	44	19
Chlorine dioxide	No	2	2[c]
Chloroacetic acid	No	2	0
Chlorobenzene	Yes[d]	4	3
Chloroethane	No	2	0
Chlorofluoromethane	No	1	0
Chloroform	Yes	91	28
Chloromethane	Yes	5	0
Chlorothalonil	No	1	0
Chromium	Yes	22	4
Cobalt	No	1	0
Copper	Yes	17	4
Cresol	No	1	0
Cyanide	Yes	12	8
Cyclohexane	Yes	2	0
Dacthal	No	1	0
DDT	Yes	1	1
DEET	No	1	1
Di-n-butyl phthalate	Yes	1	0
Dicamba	No	2	1
dichlorobromomethane	No	1	0
Dichloromethane	Yes	24	11
Dicofol	No	1	0
Diethanolamine	No	3	0
Dimethyl sulfone	No	2	0
dimethylamine	No	1	1

(continued)

Pollutant	Priority pollutant	Facilities releasing	Facilities where listed on permit
Diuron	No	1	0
Epichlorohydrin	No	2	0
Ethylbenzene	Yes	11	2
Ethylene glycol	No	27	0
Ethylene oxide	No	1	0
Formaldehyde	No	33	0
Gamma chlordane	No	1	0
Glycol ethers	No	6	0
Glyphosate	No	2	2
Heptachlor epoxide	Yes	1	0
Hexachlorobenzene	Yes	1	0
Hexazinone	No	1	1
Hydrochloric acid	No	13	10
Hydrogen cyanide	No	5	0
Iron	No	3	1
Isopropyl alcohol	No	1	0
Lead	Yes	1	0
Magnesium	No	16	0
Maleic anhydride	No	1	0
Manganese	No	18	2
Mercury	Yes	6	2
Methanol	No	39	0
Methomyl	No	1	1
Methoxychlor	No	1	0
Methyl methacrylate	No	1	0
Methyl acrylate	No	1	0
Methyl ethyl ketone (2-butanone)	No	9	0
Methyl isobutyl ketone	No	5	0
Methyl mercaptan	No	2	0
Molybdenum	No	1	0
N-butyl alcohol	No	11	0
Naphthalene	Yes	2	1
Nickel	Yes	10	1
Nitric acid	No	3	3
Nitrilotriacetic acid	No	1	0
Nitrobenzene	Yes	2	1

(continued)

Pollutant	Priority pollutant	Facilities releasing	Facilities where listed on permit
Nitroglycerin	No	1	0
N,n-dimethylaniline	No	2	0
o-anisidine	No	1	0
o-cresol	No	2	0
o-toluidine	No	1	0
o-xylene	No	2	0
P-cresol	No	1	0
P-xylene	No	1	0
Pentachlorophenol	Yes	1	0
Phenol	Yes	24	11
Phenols	No	14	6
Phosphoric acid	No	3	3
Picric acid	No	1	1
Prometon	No	1	0
Prometryn	No	1	0
Propachlor	No	1	1
Propazine	No	1	0
Propylene oxide	No	2	0
Pyridine	No	2	0
Sec-butyl alcohol	No	1	0
Selenium	Yes	1	0
Simazine	No	1	0
Sodium	No	3	0
Styrene	No	5	0
Sulfuric acid	No	19	19
Terbacil	No	1	1
Terbuthylazine	No	1	0
Terbutryn	No	1	0
Terephthalic acid	No	1	0
Tetrachlorocatechol	No	2	0
Tetrachloroethylene	Yes	1	1
Tetrahydrofuran	No	2	0
Thallium	Yes	1	0
Thiourea	No	1	0
Tin	No	1	1
Titanium	No	4	0
Toluene	Yes	22	9

(continued)

Pollutant	Priority pollutant	Facilities releasing	Facilities where listed on permit
Total organic halides	No	3	0[e]
Toxaphene	Yes	1	0
Tributyltin	No	1	1
Trichloroethylene	Yes	1	0
Trichlorosyringol	No	1	0
Triethylamine	No	2	0
Trifluralin	No	2	1
Trimethylamine	No	1	0
Vanadium	No	6	0
Vinyl acetate	No	1	0
Vinyl chloride	Yes	2	0
Xylene (mixed isomers)	No	19	2
Zinc	Yes	46	18
Total		**1,217**	**285**

[a]Ammonia and sulfate are controlled separately.

[b]Phenol is listed on the permit.

[c]Chlorine is listed on the permit for both facilities.

[d]Chlorinated benzenes is a priority pollutant.

[e]None of these facilities had permit limits for any organic halide.

We found that a large number of the toxic pollutants being discharged were not listed on the NPDES permits of the facilities we studied. Our unit of analysis for this assessment was a "pollution case." We define pollution case as an individual pollutant released from a single facility. When we looked at the 1,217 cases represented by our sample, we found that 932 (77 percent) were not included on the NPDES permit.

We also examined the discharge of uncontrolled toxic pollutants from the perspective of individual facilities. We found that for 200 of our 236 facilities (approximately 85 percent) the majority of the toxic pollutants they discharged were not controlled through the permit process.

Permit Control by Category of Pollutants

One of the concerns raised about the EPA permit process is whether there is too much emphasis on "priority" pollutants (discussed in chapter 1).

When we examined the information from the 236 facilities to determine whether they indicated an emphasis on establishing permit limits for priority pollutants, we found that the majority of the discharge cases for our sample were nonpriority pollutants (67 percent): Of the 932 cases in which pollutant discharges were uncontrolled, a high proportion (72 percent) were nonpriority pollutants (see table 4.2). This means that the pollutant category—nonpriority pollutants—that had the greatest number of toxic discharges was also the least controlled.

Finding a bias toward limiting priority pollutants is to be expected given the focus on priority pollutants in the permit application itself (Form 2c), which asks the applicant to provide sampling results for only priority pollutants. Other pollutants "that are suspected to be present in the wastewater" are to be listed on a separate page without monitoring results or even an estimate of loading. This makes it difficult for the permit writer to assess the pollutant for a limit. In a case such as this, the permit writer may require the facility to monitor for the presence of the substance over the course of the new permit and then reconsider whether to issue a limit at the next reissuance (5 years later). However, an EPA official told us that on the average a permit writer remains on the job 18 months, less than one third of the 5-year permit cycle. This is not enough time to acquire a perspective on individual facilities. Moreover, permits have standard "reopener clauses" allowing the agency to amend them during the course of the permit, but we were told that these clauses are rarely used.

There is also an inconsistency within EPA's office of water in how nonpriority pollutants are treated. The effluent guidelines activity gathers sampling data on a broad set of pollutants (including, but not restricted to, priority pollutants) in its monitoring initiatives. This difference in treatment between the effluent guidelines activity and the water-quality-based permit activity appears to reflect an inconsistent attitude by EPA toward limiting nonpriority pollutants on permits: a willingness to consider technology-based limits for nonpriority pollutants (through effluent guidelines) but little willingness to consider water-quality-based limits for them.

Categorizing toxic pollutants as nonpriority pollutants should not suggest that they are without human health or aquatic life risk. In fact, the majority of the toxic pollutants reported in TRI are nonpriority pollutants; they are listed there because they are recognized as human health risks. What this means is that, since so many toxic pollutants fall into the nonpriority category, EPA's emphasis on priority pollutants is of limited value in resolving the toxic water quality problems faced by the nation.

Summary

The NPDES permit process is the major component of EPA's approach for controlling toxic pollutant discharges to waterways. In this chapter, we examined the extent to which permits control toxic pollutants. We found that, for our sample of 236 facilities, approximately 77 percent of the pollution cases we identified were not controlled by permit limits. That is, approximately 77 percent of the discharge of all pollutants across our sample was uncontrolled. Through further review of these uncontrolled discharges, we found that the vast majority were nonpriority pollutants (72 percent) as opposed to priority pollutants. This signifies that the pollutant category with the greatest number of toxic discharges (812 of 1,217) was the least controlled.

In short, this finding makes clear that the permit application process emphasizes the control of priority pollutants over others. To determine whether and to what degree that is important, however, one needs to examine whether not controlling these pollutants actually results in human health or aquatic life risk. We address this issue in the next chapter.

The Effect of the Uncontrolled Discharge of Toxic Substances on Water Quality

In this chapter, we address our fourth evaluation question: What are the effects on water quality of unlisted discharges of toxic pollutants? Here, we estimated the in-water concentration of the uncontrolled pollutants discharged from the 236 facilities within our sample, using the data sources discussed in chapter 4, and then compared the results to published water quality criteria for each individual pollutant. In this way, we could determine whether the cases of uncontrolled pollutant discharge violated either human health or aquatic life criteria and thus were an unacceptable risk.

As we pointed out in chapter 4, the absence of a permit limit for a discharged toxic pollutant is not necessarily a problem. EPA's approach for issuing permits is based on the view that if a discharge does not pose a "reasonable potential" to impair water quality, then permit limits are not warranted. Whether a discharge poses a "reasonable potential" depends on three factors: the toxicity of the pollutant, the amount discharged, and characteristics of the water body receiving the discharge. These three factors determine pollutant risk and the consequent need for controlling it through permits. In this chapter, we report that (1) of the pollution cases we could evaluate, there were only a limited number within our sample of facilities for which uncontrolled discharges of toxic substances pose either a human health or aquatic life risk, and (2) EPA's control of discharges of toxic pollutants is incomplete, because of a widespread absence of water quality criteria needed for determining whether a discharge is a human health or aquatic life risk. That is, most of the toxic pollution that is discharged from all major manufacturing facilities across the country is not covered by water quality criteria and is therefore without regulatory oversight.

The Effect of Toxic Discharges on Water Quality

The approach that EPA and the states use to decide whether permit limits are necessary for a particular pollutant is to determine whether a "reasonable potential" for a water quality standard will be exceeded by that discharge's water concentration.[1] This determination is made by estimating the in-stream concentration of the discharge and comparing it against the water quality standard for that pollutant.

The Analytical Approach

In order to evaluate the significance of the unlisted discharges from the 236 facilities we examined, we conducted an analysis similar to that

[1]Environmental Protection Agency, Technical Support Document for Water Quality Based Toxics (Washington, D.C.: March 1991).

routinely performed by permit authorities when they decide whether or not to issue a permit limit for a particular pollutant from a given facility. In conducting this analysis, we closely followed the approach that is commonly used by permit authorities. However, our approach is not identical to EPA's, as discussed below.

Any approach for assessing the effect of toxic discharges can be evaluated only by estimating their concentration when diluted within the receiving water body and comparing that value to a criterion of maximum allowable concentration. Within the Clean Water Act approach for controlling discharges of toxic substances, water quality criteria and state standards define the maximum allowable concentration.[2] Therefore, we could assess the risk of uncontrolled discharges of toxic pollutants only when there was a water quality criterion for a particular pollutant. We had proposed to answer this question by estimating the extent to which water quality criteria are threatened by all 932 cases of uncontrolled discharges of toxic pollutants for the 236 facilities. However, we found that only a relatively small portion of the uncontrolled discharges (357, or 38 percent) were pollutants that have water quality criteria. Furthermore, for this analysis, we did not use the information included on the permit applications because they were based on a very small number of samples, very often one. We were not comfortable estimating dilution concentrations on such small sample sizes. Therefore, we did not assess 78 cases in which a pollutant with a water quality criterion was characterized solely by a permit application. We also excluded 102 cases in which the water quality criterion is a function of time-dependent characteristics of the water body. For example, the criterion for ammonia consists of a table of values for varying temperatures and levels of pH within the receiving water body. Calculating the criterion is a complex exercise employing ambient data of varying availability and uncertain quality. That left us with 177 uncontrolled cases whose risk we could evaluate.

According to EPA publications, we found that, when establishing the need for permit limits for a particular pollutant, EPA and the states employ a water quality model of the following form:[3]

[2]In a review of state standards for pollutants discharged from the facilities we examined, we found a general agreement between them and water quality criteria. Therefore, we employed the national water quality criteria as the decision point within our assessment.

[3]Environmental Protection Agency, Technical Support Document.

$$C = \frac{C_s Q_s + C_e Q_e}{Q_s + Q_e}$$

where

C = downstream concentration
C_s = upstream concentration
Q_s = upstream flow
C_e = effluent concentration
Q_e = effluent flow

This model is used to estimate the diluted concentration of the discharge when fully mixed in the receiving body of water. It provides an estimate of ambient concentration under different streamflow assumptions (Q_s), typically at either the stream's predicted mean flow or its predicted low flow (such as "7Q10," or the stream flow that occurs seven times in any 10-year period). Because of an absence of monitoring data for all cases to characterize the upstream concentration, we dropped this variable from the model. This is equivalent to setting upstream concentration equal to zero, resulting in a conservative (or lower) estimate for downstream concentration. Whether mean flow or low flow was assumed depends on whether the equation is being used to identify threats to human health or aquatic organisms. Low-flow is used when examining whether there might be a violation of aquatic life criteria, and mean flow is used when examining whether human health criteria might be violated.

We used this model and acquired estimates of low and mean flow for rivers (on a "river reach" basis) from EPA. For water quality criteria, we used EPA publications.

It is legitimate to use such models only for bodies of water with a measurable flow—that is, rivers and streams rather than lakes or estuaries. For this reason, we further restricted our assessment to cases in which the facility discharges into a river or stream; this eliminated 12 cases, reducing the total number of cases we could evaluate to 165.

Risk of Uncontrolled Cases

We used the approach outlined above to assess the 165 cases and found that for 14 of them (8 percent) the estimated in-stream concentration exceeded the applicable water quality criterion. That is, in only 8 percent of the cases we could evaluate did we find that the uncontrolled discharges of toxic pollutants posed a human health or aquatic life risk. Table 5.1 presents the data for the 14 cases. Because of the proprietary nature of these data, we are unable to provide additional information about these releases.

Table 5.1: Fourteen Cases in Which Criteria Were Exceeded

		Criteria[a]					
Case	Pollutant	Aquatic life (acute)	Result	Aquatic life (chronic)	Result	Human health	Result
1	Arsenic	None		None		0.14	Exceeded
2	Mercury	2.4	Exceeded	0.012	Exceeded	0.15	Exceeded
3	Chloroform	28,900	Exceeded	1,240	Exceeded	470	
4	Mercury	2.4		0.012	Exceeded	0.15	Exceeded
5	Chlorine	19		11	Exceeded	None	
6	Chlorine	19		11	Exceeded	None	
7	Chlorine	19	Exceeded	11	Exceeded	None	
8	Cloroform	28,900		1,240	Exceeded	470	
9	Hexachlorobenzene	6	Exceeded	3.68	Exceeded	0.00074	Exceeded
10	Hydrogen cyanide	22	Exceeded	5.2	Exceeded	None	
11	Chloroform	28,900		1,240	Exceeded	470	Exceeded
12	Chlorine	19	Exceeded	11	Exceeded	None	
13	Chloroform	28,900		1,240	Exceeded	470	Exceeded
14	Mercury	2.4	Exceeded	0.012	Exceeded	0.15	Exceeded

[a]Criteria are expressed in micrograms per liter.

As indicated above, we could not assess the risk posed by the majority of our cases (62 percent) because of the absence of related criteria. Therefore, we turned our attention to the issue of whether there is a lack of criteria in general for toxic pollutants and whether this constitutes a problem. EPA has not issued an aquatic life criterion since 1980; the last human health criterion it issued was in 1984 (for dioxin). However, toxicology research has not stood still in the intervening years. Additional water quality needs (such as bioaccumulation and sediments) are being identified that define additional pollutants posing a threat to human health and aquatic life. (This point is discussed later in this chapter.) Yet we found that the list of pollutants with water quality criteria has remained essentially unchanged since 1980.

There is no single delineation of toxic pollutants. The Clean Water Act contains the nonspecific definition of any pollutant that is harmful to organisms (at section 502). When the Congress directed that EPA focus on toxic pollutants in 1977 amendments to the Clean Water Act, it referred to a list of 31 chemical groups and 38 individual substances (in section 307(a)). Each of those groups of pollutants is made up of numerous individual compounds of varying toxicity and usage. For example, EPA selected a small number of the numerous chlorinated benzenes in use to be on the priority pollutant list and developed water quality criteria for very few of them. Clearly, the coverage of pollutants within EPA's approach for controlling discharges is incomplete. Because of the absence of a single standard of toxicity, it is impossible to definitively characterize the degree to which the list is incomplete.

In order to assess whether the lack of criteria posed a serious "regulatory gap," we conducted two assessments. First, we defined a population of toxic discharges at the national level and examined the extent to which they were covered by criteria. Second, for the toxic pollutants that were not covered by criteria, we examined the extent to which they were discharged—that is, the contribution these pollutants make to the overall toxic pollutant discharge problem.

We used the list of pollutants listed in TRI as the basis for a broader definition of "toxic pollutant" than that presented by the 126 priority pollutants. TRI was established through the Emergency Planning and Community Right to Know Act of 1986 and contains a more complete list of individual toxic pollutants than those specified by the Congress in 1977. The inventory lists more than 300 individual pollutants and 20 chemical categories (such as PCBs and lead compounds). It is used within EPA and elsewhere to indicate the incidence of toxic discharges. Again, these are toxic pollutants that are tracked within TRI because they pose a human health risk. TRI listed or tracked 195 toxic pollutants discharged to water. The 195 pollutants are listed in table 5.2.

Table 5.2: Water Quality Criteria for Pollutants Discharged Into Surface Water in 1989

Pollutant	Priority	Pounds discharged	Freshwater acute	Freshwater chronic	Human health
Acetaldehyde		66,722			
Acetamide		250			
Acetone		1,023,408			
Acetonitrile		91,876			
Acrylamide		7,372			
Acrylic acid		10,451			
Acrylonitrile	Yes	4,492	X	X	X
Allyl chloride		364			
Aluminum		78,857	X	X	
Ammonia		24,546,136	X	X	
Ammonium nitrate		8,853,607			
Ammonium sulfate		69,031,944			
Aniline		14,844			
o-Anisidine		4,949			
p-Anisidine		250			
Anthracene	Yes	2,316			X
Antimony	Yes	3,783	X	X	X
Arsenic	Yes	1,754			X
Asbestos	Yes	800			
Barium		26,048			
Benzamide		250			
Benzene	Yes	169,947	X		X
Benzoyl peroxide		1,000			
Benzyl chloride		251			
Beryllium	Yes	372	X	X	X
Biphenyl		42,685			
Bis(2-chloroethyl) ether	Yes	1,552			X
Bis(2-chloro-1-methyl-ether) ether	Yes	12,000			
Bis(2-ethylhexyl) adipate		2,453			
1,3-butadiene		143,434			
Butyl acrylate		6,400			
n-Butyl alcohol		943,547			
sec-Butyl alcohol		6,411			
tert-Butyl alcohol		221,906			
Butyl benzyl phthalate	Yes	1,028			X
1,2-Butylene oxide		4,139			

(continued)

Pollutant	Priority	Pounds discharged	Freshwater acute	Freshwater chronic	Human health
Butyraldehyde		4,297			
C.I. Basic Green 4		250			
C.I. Disperse Yellow 3		24			
Cadmium	Yes	2,746	X	X	X
Captan		500			
Carbaryl		750			
Carbon disulfide		33,091			
Carbon tetrachloride	Yes	16,396	X		X
Carbonyl sulfide		772			
Catechol		313,163			
Chlordane	Yes	4	X	X	X
Chlorine		2,403,657	X	X	
Chlorine dioxide		1,250			
Chloroacetic acid		1,524			
Chlorobenzene	Yes	62,551			X
Chloroethane		71,749			
Chloroform	Yes	1,208,450	X	X	X
Chloromethane	Yes	108,399			X
Chloroprene		9			
Chlorothalonil		252			
Chromium	Yes	67,798	X	X	X
Cobalt		14,415			
Copper	Yes	101,105	X	X	X
p-Cresidine		250			
Cresol (mixed isomers)		7,627			
m-Cresol		45			
o-Cresol		311			
p-Cresol		3,421			
Cumene		10,088			
Cumene hydroperoxide		3,411			
Cupferon		34			
Cyclohexane		20,222			
2,4-D		1,422			
Decabromodiphenyl oxide		3,450			
4,4'-Diaminodiphenyl ether		595			
Diaminotoluene (mixed isomers)		2,068			
2,4-Diaminotoluene		250			
Dibenzofuran		447			

(continued)

Pollutant	Priority	Pounds discharged	Freshwater acute	Freshwater chronic	Human health
1,2-Dibromomethane		250			
Dibutyl phthalate	Yes	2,400			
Dichlorobenzene (mixed isomers)	Yes	185	X	X	X
1,2-Dichlorobenzene	Yes	16,146			X
1,3-Dichlorobenzene	Yes	22			X
1,4-Dichlorobenzene	Yes	6,621			X
3,3-Dichlorobenzidine	Yes	241			X
1,2-Dichloroethane	Yes	227,614	X	X	X
1,2-Dichloroethylene		728			
Dichloromethane	Yes	229,620			X
2,4-Dichlorophenol	Yes	78	X	X	
1,2-Dichloropropane	Yes	14,977			
1,3-Dichloropropylene	Yes	340			X
Diethanolamine		591,555			
Dicofol		250			
Di(2-ethylhexyl) phthalate	Yes	2,983	X	X	X
Diethyl phthalate	Yes	9,163			X
3,3'-Dimethyoxybenzidine		3			
1,1-Dimethyl hydrazine		250			
2,4-Dimethylphenol	Yes	218	X		
Dimethyl phthalate	Yes	1,260			X
Dimethyl sulfate		500			
4,6-Dinitro-o-cresol		25			
2,4-Dinitrophenol	Yes	160,672			X
2,4-Dinitrotoluene	Yes	12,657	X	X	X
2,6-Dinitrotoluene		1,083			
n-Dioctyl phthalate		1,185			
1,4-Dioxane		273,522			
Epichlorohydrin		4,245			
2-Ethoxyethanol		96,042			
Ethyl acrylate		1,188			
Ethylbenzene	Yes	16,923	X		X
Ethylene		14,902			
Ethylene glycol		3,773,670			
Ethylene oxide		5,327			
Formaldehyde		838,705			
Freon 113		14,588			
Heptachlor	Yes	2	X	X	X

(continued)

Pollutant	Priority	Pounds discharged	Freshwater acute	Freshwater chronic	Human health
Hexachlorobenzene	Yes	338	X	X	X
Hexachloro-1,3-butadiene	Yes	622	X	X	X
Hexachlorocyclopentadiene	Yes	6	X	X	X
Hexachloroethane		421	X	X	X
Hydrazine		2,291			
Hydrochloric acid[a]		3,052,332		X	
Hydrogen cyanide		5,610			
Hydrogen fluoride		35,918			
Hydroquinone		4,884			
Isobutyraldehyde		751			
Isopropyl alcohol		11,008			
4,4'-Isopropylidene-diphenol		2,629			
Lead	Yes	33,314	X	X	
Maleic anhydride		2,824			
Manganese		148,561			X
Mercury	Yes	1,555	X	X	X
Methanol		21,276,746			
Methoxychlor		250		X	
2-Methyoxyethanol		46,428			
Methyl acrylate		1,172			
Methyl tert-butyl ether		37,439			
Methylenebis		506			
4,4'-Methylenedianiline		1,305			
Methyl ethyl ketone		67,797			
Methyl iodide		1			
Methyl isobutyl ketone		449,410			
Methyl methacrylate		28,802			
Molybdenum trioxide		124,535			
Naphthalene	Yes	146,615	X	X	
Nickel	Yes	86,211	X	X	X
Nitric acid[a]		735,542	X	X	
Nitrilotriacetic acid		5,100			
Nitrobenzene	Yes	1,287	X		X
Nitroglycerin		9,198			
2-Nitrophenol		6			
2-Nitropropane		2,700			
N,N-Dimethylaniline		14,437			
N-Nitrosodiphenylamine	Yes	9			

(continued)

Pollutant	Priority	Pounds discharged	Freshwater acute	Freshwater chronic	Human health
Parathion		250	X	X	
Pentachlorophenol	Yes	2,559	X	X	X
Peracetic acid		40			
Phenol	Yes	267,978	X	X	X
2-Phenylphenol		134			
Phosgene		250			
Phosphoric acid[a]		26,961,174		X	
Phosphorus		3,033			
Phthalic anhydride		2,120			
Picric acid		250			
PCBs	Yes	264	X	X	X
Propionaldehyde		411			
Propylene		953			
Propylene oxide		83,521			
Pyridine		2,356			
Quinoline		5			
Quinone		12			
Selenium	Yes	750	X	X	X
Silver	Yes	1,419	X	X	
Styrene		51,082			
Sulfuric acid[a]		19,800,811		X	
1,1,2,2-tetrachloroethane	Yes	5,429		X	X
Tetrachloroethylene	Yes	54,940		X	X
Thiourea		971			
Toluene	Yes	179,797	X		X
o-Toluidine		1,252			
Trichlorfon		1			
1,2,4-Trichlorobenzene		4,729			
1,1,1-Trichloroethane	Yes	27,549		X	X
1,1,2-Trichloroethane	Yes	8,985		X	X
Trichloroethylene	Yes	16,065	X	X	X
2,4,6-Trichlorophenol	Yes	3,515		X	X
Trifluralin		322			
1,2,4-Trimethylbenzene		10,608			
Vanadium		1,004			
Vinyl acetate		5,449			
Vinyl bromide		270			
Vinyl chloride	Yes	2,969			X

(continued)

Pollutant	Priority	Pounds discharged	Freshwater acute	Freshwater chronic	Human health
Vinylidene chloride	Yes	2,691			X
Xylene (mixed isomers)		185,752			
m-Xylene		2,933			
o-Xylene		3,295			
p-Xylene		2,225			
2,6-Xylidene		1,906			
Zinc	Yes	134,700	X	X	

SOURCE: Environmental Protection Agency, Toxic Release Inventory, 1989 (Washington, D.C.: 1991), and Water Quality Criteria Summary (Washington, D.C.: 1991).

[a]Criteria are for pH, not the acid itself.

Because of the pattern of permit coverage we identified in chapter 4, we examined the extent to which criteria existed for the two categories of toxic water pollutants (priority versus nonpriority) monitored by TRI. We found that priority pollutants were, for the most part, covered well by criteria. Of the 61 priority pollutants reported, only 5 lacked any human health or aquatic life criteria.[4] (See table 5.2.)

Our analysis of the nonpriority pollutants reported in TRI had a very different result. Here we found that 134 toxic pollutants were reported. Of the 134, only 11 (approximately 8 percent) had any type of criteria coverage. That is to say, 92 percent of the toxic nonpriority pollutants reported in TRI had no criteria established for them. (See table 5.2.)

In order to determine whether this lack of criteria coverage was important, we analyzed the findings discussed above in terms of mass pollutant discharges—that is, the number of pounds of toxic pollutants reported discharged from TRI. Overall, approximately 190 million pounds of toxic pollutants were reported as discharged within TRI. Of that amount, approximately 3.5 million pounds are priority pollutant discharges. Consequently, approximately 98 percent of the discharges by weight were

[4]For the purpose of our assessment, we did not assume that every pollutant required both a human health and an aquatic life criterion. In some cases, a pollutant that could cause a threat to aquatic life may not pose a human health threat. The reciprocal argument could also be made. We determined that a pollutant was not covered by a criterion when it lacked both human health and aquatic life criteria. In addition, some pollutants do not have criteria established but have, rather, a "lowest observable effect level" (LOEL). Strictly speaking, LOELs are not criteria but are, in some cases, used in that manner. We accepted the existence of a LOEL for a pollutant as criteria coverage. Given these assumptions, our analysis is a conservative, best case assessment.

nonpriority pollutants. Of this amount, approximately 109 million pounds, or 56 percent, were not covered by criteria.

We discussed the results of our assessment with EPA officials and they agreed that the toxic control process is definitely slanted toward controlling priority pollutants and that nonpriority pollutants warrant coverage within the process.

In addition, there is reason to believe that the priority pollutant list "that has served as a basis for numerous EPA actions" is too restrictive.[5] Our review of agency documents suggests that several pollutants beyond those EPA selected initially in 1980 and treated on a priority status threaten the aquatic environment. Based on an increasing concern toward the threats posed by pollutants that remain in an ecosystem indefinitely, research has been conducted that suggests that a number of toxic pollutants such as 4-bromophenyl phenyl ether, octachlorostyrene, and photomirex may be of equal concern as the older set of priority pollutants. EPA itself has identified these substances as "bioaccumulative chemicals of concern." And, as a result, the agency has placed them in a higher risk category than most priority pollutants such as carbon tetrachloride and cadmium in its recently proposed regional "Great Lakes Water Quality Initiative." Human toxic effects and aquatic life effects have been associated with several nonpriority pollutants for which there are no water quality criteria. Examples are carbon disulfide, ethylene glycol, formaldehyde, and xylene.[6] Xylene, for example, is related to priority pollutants such as toluene and ethylbenzene.

Summary

In this chapter, we addressed our fourth and last evaluation question, concerning whether the uncontrolled toxic pollutants we identified posed human health or aquatic life risk. We found that we could assess only a minority of the uncontrolled toxics we identified from our sample population of facilities in terms of risk: Most did not have the human health or aquatic life criteria that are necessary to determine whether a discharge is a risk. For the cases we could evaluate, EPA and the states are generally effective at identifying those that warrant permit limits. That is,

[5] Environmental Protection Agency, "Water Quality Guidance for the Great Lakes System and Correction; Proposed Rules," 58 Fed. Reg. 20801, at 20843 (April 16, 1993).

[6] Robert E. Gosselin et al., Clinical Toxicology of Commercial Products, 5th ed. (Baltimore: Williams and Wilkins, 1984); Ernest Hodgson, Richard B. Mailman, and Janice E. Chambers, Dictionary of Toxicology (New York: Van Nostrand Reinhold Company, 1988).

only 8 percent of the cases we could evaluate warranted permit limits when none existed.

However, we found that most of the pollutants discharged to the nation's water, at least as represented by the population reported in TRI, have no criteria established. This is a conclusion based upon both the number of pollutants and the amount of pollution discharged.

Thus, many pollutants are not controlled through the permit process. For the majority of toxic discharges to the nation's water, the assessment necessary to determine whether a permit. limit is required cannot be conducted because of the overwhelming lack of human health and aquatic life criteria. Therefore, our conclusion is that EPA's current approach has not yet proceeded far enough to answer the critical threshold question of whether toxic pollutant discharges pose a human health or aquatic life risk.

Conclusions, a Matter for Consideration, Recommendations, and Agency Comments

Conclusions

The discharge of toxic pollutants to the nation's rivers and streams poses both human health and aquatic life risks. This study has found that the current EPA water toxics control program has major problems in effectively controlling these risks. First, because the necessary steps to ensure that program activities are supported by information of acceptable quality are often not taken, the information produced is questionable and the activities themselves are of uncertain usefulness. Second, a wide range of toxic pollutants posing both human health and aquatic life risk are not addressed by the permit control process. Further, the EPA program has not established human health or aquatic life criteria for many of the pollutants that are discharged to the nation's waters. Consequently, when developing permit limits for facilities, their risks cannot be assessed and they are not regulated.

Given that these problems have been long-standing for the EPA water quality program in general and that the likelihood of effectively addressing them is uncertain, we also conclude that it is time to question and reassess whether the basic strategy EPA uses to control toxic discharges can be expected to produce the results envisaged by the Clean Water Act. Therefore, we believe that the overall approach now used for controlling toxic discharges should be reexamined. This is especially important since controlling discharges of toxics from point sources, although an important water quality concern, competes with other causes of water quality impairment for scarce federal funds. In addition, EPA and the states run their water quality protection programs under stringent budgetary constraints. As a result, we cannot assume that the program will be funded adequately to effectively address the quality assurance and pollutant coverage needs identified in this report.

Consequently, we provide a matter for congressional consideration. In addition we make two recommendations specific to the problems we identified. The matter for congressional consideration suggests changing the general approach used for limiting discharges of toxic pollutants into the nation's water, emphasizing pollution prevention. Integrating pollution prevention principles into the current standards approach may yield an improvement in water quality without a significant increase in regulatory overhead.[1] A pollution prevention approach would encourage a reduction in toxic discharges by changing the system to make it in the interest of dischargers themselves to limit the release of toxics. The two

[1]Pollution prevention is discussed in U.S. General Accounting Office, Pollution Prevention: EPA Should Reexamine the Objectives and Sustainability of State Programs, GAO/PEMD-94-8 (Washington, D.C.: January 25, 1994), and Water Pollution: Stronger Efforts Needed by EPA to Control Toxic Water Pollution, GAO/RCED-91-154 (Washington, D.C.: July 19, 1991).

recommendations address the lack of quality assurance and coverage of nonpriority pollutants on permits.

Matter for Congressional Consideration

The Clean Water Act emphasizes a standards approach for controlling toxic pollutants. In its reauthorization of the act, the Congress should consider augmenting this approach with additional authority to allow EPA to emphasize pollution prevention as a way of managing toxic pollutant discharges.

Recommendations

From our report's conclusions, we recommend that the Administrator of EPA direct the Assistant Administrator for Water Quality to

- initiate immediate efforts to address the information quality assurance problems we identified in the 5 toxic control activities in which these problems occur and
- expand the use of the Toxic Release Inventory data base to identify nonpriority pollutants being discharged to water that should be considered for control through the permit process.

Agency Comments and Our Response

After its review of our draft report, EPA submitted several comments to us, both general and specific. The latter have been incorporated where appropriate. Here, we provide EPA's major comments and our response to them.

EPA commented that to address the quality assurance issue, we needed to extensively interview regional EPA and state officials. For the most part, we did not do this. Consequently, EPA questioned the validity of our conclusions. In conducting our evaluation, we interviewed EPA headquarters' managers concerning the extent to which their programs met critical quality assurance criteria. Each had the opportunity during the interviews to indicate where they could not provide information and whether we needed to discuss criteria conformance with regional or other staff. When they indicated that we did, we followed up with regional surveys and interviews. In addition, the EPA official responsible for agency quality assurance efforts indicated that our conclusions would have been the same had we based our entire work on regional or state information.

EPA officials agreed with our finding that the scope of toxic pollutant control is too narrow. However, they pointed out that the risk to human health and the environment from not directly limiting nonpriority pollutants is not well characterized in the report. EPA suggested that we provide some additional information on risks.

Whether and to what degree nonpriority pollutants being discharged from a facility pose human health and environmental risks must be determined facility by facility. We attempted such an evaluation but could not complete it because of the lack of standards for nonpriority pollutants.

EPA officials further indicated that the report seems to equate the lack of a specific effluent limit for a toxic pollutant to the lack of control of that pollutant. They allege that considerable residual control on nonpriority pollutants is accomplished through specifically limiting priority pollutants. We believe that while some residual control of nonpriority pollutants may occur, if it does, it is a fortuitous result of the EPA program, which is focused on the control of priority pollutants. When we pressed agency officials concerning their evidence that such residual control did in fact limit or eliminate human health or environmental risks associated with nonpriority pollutants, or even references indicating related studies, they could not provide us that information.

EPA officials commented that our report does not reflect the extent to which the agency currently relies on TRI within the water quality program. In 1989, EPA issued guidance that included a recommendation to use TRI data to help identify impaired waters and point sources for water-quality-based limits. However, this guidance focused only on priority pollutants. EPA officials also commented that EPA is currently revising the NPDES permit application forms for municipal and industrial dischargers. These revised requirements may also include reporting of TRI data. We recognize that EPA has, to some extent, used TRI data in the water quality program; however, our recommendation is that EPA use TRI data more extensively to identify nonpriority pollutants that should be considered for control.

In evaluating the coverage of toxic discharges, EPA pointed out that we focused on permits and discharges within three industries: pesticide manufacturing, pharmaceutical manufacturing, and pulp and paper production. EPA indicated that recently revised effluent guidelines for these industries also regulate hundreds of nonpriority pollutants as nonconventional pollutants. It also noted, however, that although permits reflect national guidelines, they are renewed only every 5 years and, as we noted, are rarely reopened. In followup discussions with EPA, we learned that only the pesticides' effluent guideline had been made final, in late 1993 after our analytical work had been completed. EPA's estimate of when the pulp and paper guideline will be final is within a year or two, while the pharmaceutical guideline is estimated for February 1996. Consequently, because permits have not been revised for the pesticide industry and the other guidelines are still under development, we believe our conclusions on the limited nature of pollutant control coverage are valid.

Expert Panel

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Descriptions of Seven Activities

We presented the principal EPA program activities designed to control the discharge of toxic water pollutants in chapter 2. We also identified their related information requirements in that chapter. In this appendix, we characterize (1) what makes each activity an important component of EPA's approach for limiting discharges of toxics from point sources, (2) the role that the required information plays in meeting the activity's objectives, and (3) the principal sources of the required information.

Activity 1: Effluent Guidelines Development

Effluent guidelines are national standards establishing baseline requirements for pollution removal for each individual industry. They form the first line of defense within the Clean Water Act's strategy for controlling discharges of pollutants from point sources in that they take no factors into account for controlling effluent discharge other than the technological capability of controlling pollutant discharge from the facilities of an industrial sector.

The Basis for the Activity

One of the foundations and major innovations of the Clean Water Act strategy is to have facilities adopt a baseline level of control over their pollutant discharges regardless of the quality of the water of the receiving body. The result of this requirement is a system of national technology-based effluent standards establishing baseline treatment to be achieved by all dischargers within an industrial sector. EPA has established effluent standards for 51 industrial categories.

This effluent guideline in fact defines a required minimum level of control for facilities within each industrial sector. Typically, the standard establishes the maximum amount of particular pollutants allowed to be discharged as a function of the production level of the plant. These guidelines are incorporated as limits into permits for dischargers.

The industrial technology division of EPA's office of water develops these limits on the basis of common technological and economic characteristics of individual industrial sectors. To select a control technology for standard development, EPA typically delineates a very well-defined subindustrial category within an industrial sector—for example, the "paperboard from wastepaper" subcategory within the "pulp, paper and paperboard point source category."[1] Thus, they select a sample of facilities within the industrial subcategory, survey these facilities, conduct site visits, and

[1]EPA has issued guidelines for 25 subindustrial categories within the pulp and paper point source category.

define the best available technology (BAT) economically achievable. (For example, a current regulation for the BAT establishes that no more than 0.87 pounds of pentachlorophenol and 0.30 pounds of trichlorophenol can be discharged for each million pounds of paper produced (40 C.F.R. 430.54).) All plants defined within this subindustrial category would at a minimum be bound by these limits on their NPDES permits.

Section 301(b) of the act establishes a mechanism for developing these industry-specific effluent limits. For cases in which EPA has not issued effluent guidelines, permit limits may be based on the best professional judgment of the administering official.

The Clean Water Act directs that effluent limits for toxic substances achieve best available technology economically achievable. Effluent limits based on BAT must represent at a minimum the best control technology performance in the subcategory that is technologically and economically achievable.

Critical Information Used Within the Activity

From interviews with EPA staff and our expert panel, we identified four types of information required for developing effluent guidelines:

- removal (control) technology,
- pollutants discharged,
- water used in production, and
- economic feasibility of regulatory alternatives.

The Role of Each Information Type

As used within the Clean Water Act, BAT determines the type of information that EPA must gather to support this activity. Information about the most efficient removal technologies currently employed within an industry is critical to defining BAT. These technologies need to be identified and evaluated so that their applicability to the rest of the industry can be determined. Technological efficiency is defined in terms of how well the removal process can eliminate pollutants from the waste stream. Therefore, the pollutants appearing in the discharges from these plants must be identified and measured. One important method of reducing discharges of pollutants is by using water more efficiently. In order to identify these practices, EPA attempts to gather information from plants that are efficient users of water, so that it can determine whether BAT should be based on water use restrictions.

BAT must be affordable to most facilities within the industry. A technology that would result in most plants being driven out of business would not be consistent with the definition of BAT within the statute. Therefore, economic information must be collected about the industry as a whole to permit EPA to characterize the economic effect on the industry of various BAT alternatives.

Principal Sources of Information and Development Methods

Just as the definition of BAT within the Clean Water Act governs what types of information should be gathered, it also influences how these data are collected. Information about each of these data types is derived through a three-step process. In the first step, EPA attempts to define the size of the industrial sector that will be covered by the standard. It does this through an examination of extant data bases, such as Dun and Bradstreet's and U.S. census data. This provides a sampling frame for data collection in the second and third steps of the information gathering process. In the second step, a questionnaire is administered to a sample of facilities to characterize the range of the types of control or removal technologies, their pollutant discharges and water use employed, as well as the economic characteristics of the facilities. In the third step of the process, EPA conducts site visits at a small number of facilities. Through these site visits, the agency characterizes more fully the removal technologies employed within these specific plants and what pollutants they are discharging. It identifies and measures all pollutants for which approved agency methods governing wastewater analysis exist (currently over 400). It also develops new methods for identifying pollutants as necessary.

Activity 2: Water Quality Criteria Development

Water quality criteria are standards that define the maximum concentration of individual pollutants in water that will be protective of human health and aquatic life.

The Basis for the Activity

In addition to the technology-based requirements included in section 301 of the Clean Water Act, water-quality-based requirements are established by sections 302 and 304(a)(1). The Congress recognized that technology-based limits would not always meet water quality needs. Indeed, there is no analytical relationship between technology-based controls and the goals of the Clean Water Act to prohibit "the discharge of toxic pollutants in toxic amounts" (section 101(a)(3)). Consequently, the Congress included the requirement that discharges must meet water quality needs.[2] That is, if a pollutant that is discharged according to a technology-based permit limit still results in a receiving body of water being unacceptably polluted, then more stringent "water-quality-based" limits are required (section 302).

Water quality criteria are numerical guidelines indicating the maximum concentration of a substance that the agency advises is protective of aquatic life or human health. Water quality criteria themselves provide a basis for ambient water quality standards, which in turn are used to establish water-quality-based permit limits (see activity 5).

EPA develops water quality criteria for individual pollutants. There are two types of criteria: criteria to protect aquatic life and criteria to protect human health. There are separate aquatic life criteria for freshwater and saltwater environments; both human health and aquatic life criteria have separate values for "acute" (or short-term) exposures and "chronic" (or long-term) exposures. EPA has developed aquatic life criteria for 30 toxic pollutants and human health criteria for 91 toxics. All the human health criteria and most of the aquatic life criteria were developed between 1980 and 1985. The agency is currently reviewing several of them.

Critical Information Used Within the Activity

From interviews with EPA staff and our expert panel, we identified five types of information necessary for the development of water quality criteria:

- aquatic life effects,
- aquatic life exposure,
- concentration of toxics in biota,
- human health effects, and
- human health exposure.

The Role of Each Information Type

Section 304(a)(1) of the Clean Water Act stipulates that criteria be based on "the kind and extent of all identifiable effects on health and welfare . . . from the presence of pollutants in any body of water." Given that effects on aquatic life and human health can be so varied, EPA developed an early protocol for establishing criteria.

Information about aquatic life effects and exposure is critical within this program activity since criteria are based on the concentration of a

[2]Water quality needs are interpreted to be support for the aquatic life residing in, and the health of people who drink or fish from, the body of water.

pollutant that is harmful to species in the amounts at which they come into contact with the substance. Bioconcentration information is necessary for determining in what aquatic species and amounts specific toxic substances accumulate, so that human exposure from consuming fish can be estimated. Information about human health effects and exposure are critical for calculating criteria to protect human health. As for aquatic life criteria, these are based on estimates of toxicity and exposure.

Principal Sources of Information

The aquatic life criteria are developed by EPA laboratories using information on aquatic life effects, aquatic life exposure, and concentration in biota. The human health criteria are developed by EPA's Environmental Criteria and Assessment Office of the Office of Research and Development in Cincinnati, Ohio, using human exposure and human health effects information. The principal source of information for both efforts are peer reviewed journal articles describing laboratory studies. For aquatic life and human health effects, the objective is to develop a minimum data set of studies for a variety of different effects (and in the case of aquatic life effects, different species). The laboratories sometimes conduct research to fill gaps in information.

Activity 3: Impaired Water and Point Source Identification

This program activity identifies waterways threatened by point source discharges of toxic substances and the facilities causing the impairment.

The Basis for the Activity

Among the significant additions to the Clean Water Act in the 1987 amendments was section 304(l). In response to the concern that too little headway was being made to control discharges of toxics from point sources, the Congress directed each state to identify "impaired" waters that are not expected to achieve or maintain water quality standards because of toxic pollution from point sources, even after application of technology-based effluent limits.[3] The lists are to consist of the body of water and the facility causing the impairment. Subsequently, an individual control strategy (ICS) is to be established for the point source to remove the impairment. The ICS is to consist of new limits or other conditions on the facility's NPDES permit. So, section 304(l) (the short list) called for three pieces of information: (1) an identification of bodies of water where water quality standards for toxic pollutants are not expected to be met because

[3]As we stated in chapter 2, section 304(l) called for several lists. In this evaluation, we have identified the preparation of the so-called "short list" because it concerns toxic pollution from point sources rather than the broader delineations of impaired waters contained in the other lists.

of point source discharges after technology-based controls have been applied, (2) an identification of the contributing facility or facilities, and (3) an identification of the new control strategy ("individual control strategy") that would allow standards to be met. Of these, the third is ostensibly the same as setting permit limits, which is the fifth core program activity in our list. Therefore, we discuss it under activity 5.

The section 304(l) exercise took place in 1988 and 1989. A total of approximately 600 rivers and streams were named on the lists across the country.

Critical Information Used Within the Activity

From interviews with EPA staff and our expert panel, we identified six types of information necessary for issuing lists of waters and source under section 304(l):

- in-stream water quality,
- aquatic life effects,
- concentrations of toxics in sediments,
- concentrations of toxics in biota,
- discharges of toxics from individual sources, and
- environmental fate and transport.

The Role of Each Information Type

The first four of these information components (in-stream water quality, aquatic life effects, and concentrations in sediments and in biota) provide different views of the health of an ecosystem and indications of whether water quality standards are threatened. The states use information about discharges from individual sources to identify bodies of water that might be at risk and to identify the sources of impairment. Information about environmental fate and transport is used in a small number of cases to provide more reliable estimates of in-stream concentration of toxics than is possible using standard dilution models.

Principal Sources of Information

The states are expected to use extant sources of information to compile their lists of waters and point sources. The principal sources of monitoring information are water quality data included in STORET and other data bases, as well as previous assessments, notably the biennial reports produced under section 305(b) of the Clean Water Act. STORET (along with the related data bases: Biological Information System and Ocean Data Evaluation System) are the major storehouses of water quality monitoring data.[4] Information about discharges is taken from NPDES permit applications and the PCS, which includes monitoring data collected under NPDES. Under the Clean Water Act, facilities must apply (and reapply every 5 years) for a permit to discharge pollutants. On the application, the applicant is expected to characterize the effluent discharge.[5] Required monitoring reports from the facility are recorded on a monthly discharge monitoring report and entered into PCS. Environmental fate and transport information is obtained primarily from textbooks, journal articles, EPA, U.S. Fish and Wildlife Service publications, and EPA-supported water quality models.

Activity 4: Total Maximum Daily Load Development

A TMDL provides an estimate of the amount of the pollutant that can be safely discharged from all sources (including natural sources) into a body of water. It is the sum of the individual allowable allocations of the pollutant from point and nonpoint sources on a stream as well as the amount transported from upstream sources.[6]

The Basis for the Activity

Typically, several sources of pollution contribute to the water quality problems of a given body of water. There may be several industries and sewage treatment plants, as well as nonpoint sources and the naturally occurring load (relevant for many toxic heavy metals, although not for toxic organics) all discharging the same pollutant into the same river. Taken individually, each of the sources might not impair water quality enough to warrant the imposition of permit limits for a specific pollutant. However, the combined discharge of that pollutant could impair water quality. To respond to the possibility that multiple sources could impair water quality, the Congress included section 303(d) in the Clean Water Act. This section directs the states to identify waters in which water quality standards cannot be met through technological controls and to estimate a "total maximum daily load" for the pollutants in question.

The objective of TMDLs is to allocate allowable discharge loads among different sources of pollution. The TMDL estimates the pollutant loadings from all sources and predicts the resulting pollutant concentrations. It then establishes the permitted loads and sets the base for establishing controls on sources. According to EPA, 70 percent of TMDLs have been

[4] EPA is undertaking a major modernization of STORET, in part because of concerns about data quality.

[5] The permit application process is discussed in more detail in chapter 3.

[6] For point sources, these are termed "wasteload allocations" (WLAs), and for nonpoint sources they are termed "load allocations" (LAs).

developed in the course of establishing permit limits under NPDES (see activity 5).

Critical Information Used Within the Activity

From interviews with EPA staff and our expert panel, we identified six types of information necessary for developing TMDLS:

- in-stream water quality,
- discharges of toxics from individual sources,
- hydrology (flow),
- concentrations of toxics in sediments,
- concentrations of toxics in biota, and
- environmental fate and transport.

The Role of Each Information Type

The background concentrations of toxics in-stream and the discharges are used to estimate the allowable maximum daily loads a receiving water body is capable of assimilating while maintaining water quality. Estimates of flow are employed in the mathematical models used to establish TMDLS. Concentrations of toxics in sediments and in biota are used to establish toxic concentrations in the background and in water-dwelling organisms. Fate and transport information is used in a relatively few instances in which a more precise estimate of water quality effect is required than that provided by straightforward dilution models and data are available to permit such an assessment.

Principal Sources of Information

Most flow data are collected at USGS gaging stations. However, there is not a direct measure of flow for the "reach" to which most facilities discharge. In these cases, the flow for the reach is estimated by using data from gages on neighboring reaches.

Information about concentrations in compartments of the environment (sediments, biota, and in-stream) are primarily acquired from monitoring networks. Discharge data are provided by permit applications and discharge monitoring reports. Fate and transport information is obtained from textbooks, journal articles, EPA and U.S. Fish and Wildlife Service publications, and EPA-supported water quality models.

Activity 5: Water-Quality-Based Permit Issuance

NPDES permits are the legal documents that control point source discharges of pollutants into the nation's waters.

'he Basis for the Activity

As we discussed above, the NPDES activity is the keystone within EPA's program to limit discharges of toxics from point sources. Within NPDES, all dischargers must acquire a permit to discharge. An integral component of each permit is a set of limitations on the amount of individual pollutants discharged.[7] The default basis for setting permit limits is to apply the technology-based limits established through section 301. Section 302 establishes an alternative water-quality-based approach whenever "discharges . . . would interfere with the attainment or maintenance of . . . water quality." It is through this permit process that EPA and the states control toxics.

The objective is to determine whether water quality standards are threatened by the discharge of a particular substance and, if so, what is the maximum amount of pollutant discharge that would maintain them. EPA's recommended approach for writing water-quality-based permit limits is described in the Technical Support Document for Water Quality-Based Toxics Control. In short, it uses information about the nature of the discharge and the receiving body of water to determine whether there is a "reasonable potential" for water quality standards to be exceeded by the discharge and, if so, to calculate the amount that would protect them.

Critical Information Used Within the Activity

We identified four types of information necessary for issuing water-quality-based permits:

- discharges of toxics from individual sources,
- hydrology (flow),
- in-stream water quality, and
- environmental fate and transport.

The Role of Each Information Type

A standard approach is employed to determine whether permit limits are necessary and what those limits should be. Water quality standards are used to justify the need for chemical-specific permit limits and the amount allowed to be discharged through the permit. The effluent has to be characterized (that is, the substances and amounts) in order to identify the pollutants that warrant monitoring requirements or limits on the permit. For this reason, an accurate characterization of discharges is essential to the success of this activity and the overall approach. The flow of the stream is calculated in order to estimate the dilution concentration of the

[7]EPA and the states have begun to supplement individual limits with requirements to test wastewater for "whole effluent toxicity" (WET). WET limits are requirements to conduct standardized tests of the wastewater on fish or other aquatic organisms. They give a measure of the overall toxicity of the discharge, which is difficult to accomplish using a chemical-by-chemical approach.

toxic substance in the receiving water body.[8] An estimate of the in-stream concentration of the substance prior to the discharge is also used (where such data are available) so that the total concentration of the toxic can be estimated. Although permit writers usually use very simple models to estimate in-stream concentrations, occasionally more sophisticated models employing fate and transport information are used. These models offer a more precise estimate of concentration.

Principal Sources of Information

The sources for flow estimates are the same as within the TMDL program. Information about concentrations in compartments of the environment is primarily taken from monitoring networks. Discharge data are taken from permit applications and discharge monitoring reports. Fate and transport information is obtained from textbooks, journal articles, EPA and U.S. Fish and Wildlife Service publications, and EPA-supported water quality models.

Activity 6: "Local Limits" Development

"Local limits" POTWs (publicly owned treatment works) restrict the amount of pollutants that indirect dischargers can release into the sewer system to reflect site-specific concerns.

The Basis for the Activity

POTWs are facilities that receive wastes from domestic and industrial sources and treat them and discharge them into a body of water. The industrial facilities that send their wastes to POTWs are termed "indirect dischargers" to contrast them with dischargers, such as POTWs themselves, that release their effluent directly into a receiving body of water. A large portion of the total load of toxic pollutants comes from indirect dischargers. According to EPA estimates, these dischargers release a much larger volume of toxic pollutants than do direct dischargers. The critical issue for the program activity is how to ensure that the toxics discharged into POTWs are effectively treated before being discharged.

The Clean Water Act instituted a separate system of controls for indirect dischargers. The national pretreatment program was established through section 307(b). The principal purpose of the pretreatment program is to ensure that the wastes sent to POTWs can be effectively treated by them without damaging them or passing through into the receiving body of water.[9]

[8]Typically, permits employ discrete measures of flow, normally a measure of low flow (7Q10) and a measure of average flow (the harmonic mean flow).

[9]Additional goals of the pretreatment program are preventing pollutant interference with the POTW and improving opportunities to recycle and reclaim wastewater and sludge.

To achieve these goals, about 1,500 POTWs have been given the authority to write and enforce permits for their larger indirect dischargers ("significant industrial users"), analogous to the permits written by EPA or a state for direct dischargers under NPDES. The first level of control is through technology-based limits. As is the case for BAT with direct dischargers, EPA establishes categorical limits for pretreatment industry by industry.

However, as is the case for direct dischargers, individual circumstances vary among indirect dischargers and POTWs, preventing categorical limits from always achieving the purposes of pretreatment noted above. When this happens, the POTW has the authority to impose "local limits" on individual indirect dischargers. Local limits are derived by determining how much of each toxic pollutant is being discharged and estimating how efficiently the POTW can remove them from its own effluent.

Required Information Used Within the Activity

We identified three types of information required for developing local limits within the pretreatment program:

- discharges of toxics from individual sources,
- removal technologies, and
- environmental fate and transport.

The Role of Each Information Type

This information is used to develop local limits. Information about discharges from indirect dischargers is gathered to identify the sources of the pollutants. Preventing interference or actual damage to the POTW requires a more detailed understanding of the operations of larger indirect dischargers ("significant industrial users"). Information about removal technologies is used to determine the plant's efficiency at removing the pollutants that are found to be discharged. Fate and transport data are gathered by POTWs to gain an understanding of what happens to pollutants within the treatment plant, how much precipitates, and how much volatilizes into the air.

Principal Sources of Information

Information about discharges is obtained through a combination of self-monitoring by the discharger and monitoring by the POTW (a difference from the NPDES program in which permit authorities rarely conduct their own monitoring at facilities). According to EPA, POTWs conduct detailed inspections of the facilities of their significant industrial users. Information about how the POTW is functioning and what happens to the toxic substance once it enters the plant is developed by the POTW itself.

Activity 7: Compliance Problem Identification

NPDES permits require periodic self-monitoring of discharges. By identifying compliance problems using the self-monitored data, EPA marks the dischargers that violate their permit conditions for future enforcement action.

The Basis for the Activity

Once a permit has been issued, the holder of that permit is responsible for attaining, monitoring, and maintaining compliance with it. Failure to do so is a violation of the Clean Water Act.[10] EPA and authorized states are responsible for tracking compliance with and enforcing permit requirements. Section 308 of the act allows the states to impose requirements for sampling, analysis, and recordkeeping and authorizes access for independent verification of facilities' self-reports.

Critical Information Used Within the Activity

We identified three types of information required for developing water quality criteria:

- discharges of toxics from individual sources,
- aquatic life exposure, and
- in-stream water quality.

The Role of Each Information Type

Decisions about compliance and noncompliance are made on the basis of whether these self-reported data are within permit limits. Most permit limits require monitoring of the amount of pollutant discharged (whether pounds per day or milligrams per liter) per day. Increasingly, permits are also including a requirement to test for aquatic exposure or "whole effluent toxicity" (a biological test of the overall toxicity of the effluent).[11] According to EPA, occasionally permit limits are written that require in-stream monitoring, which is a more direct measure of the effect of the discharge on water quality.

Principal Sources of Information

The data used to determine compliance are gathered by each facility and submitted to the permit authority according to the conditions specified on the permit. The permit authority reviews the data and enters them into EPA's PCS data base.

[10]Recent GAO reports on this subject include Water Pollution Monitoring: EPA's Permit Compliance System Could Be Used More Effectively, GAO/IMTEC-92-58BR (Washington, D.C.: June 22, 1992), and Environmental Enforcement: EPA Cannot Ensure the Accuracy of Self-Reported Compliance Monitoring Data, GAO/RCED-93-21 (Washington, D.C.: March 31, 1993).

[11]The EPA respondent for this program coded these whole effluent toxicity limits as "aquatic life exposure." WET limits are discussed in chapter 3.

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