United States Environmental Protection Agency | Solid Waste and Emergency Response (OS-305) | EPA530-R-92-012 January 1992

EPA

RCRA Environmental Indicators

FY 1991 Progress Report and Implementation Plan for the Future

RCRA Environmental Indicators

FY 1991 Progress Report and Implementation Plan for the Future

Office of Solid Waste
Communications, Analysis, and Budget Division
U.S. Environmental Protection Agency
401 M Street SW
Washington, D.C. 20460

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

EXECUTIVE SUMMARY

A STRONG OSW ENVIRONMENTAL INDICATORS PROJECT IS NOW IN PLACE

From the time of EPA's creation in 1972 until 1989, information on environmental conditions was either not available, or not well enough organized, to measure the progress of most EPA programs. In response to a challenge from the EPA Administrator in March of 1989, the Agency embarked on a new approach of risk-based strategic planning. This new approach requires that strategic choices be made to give priority attention to problems posing the greatest risks, and that efforts are made to set goals in terms of the environmental accomplishments EPA hopes to achieve, with progress being evaluated in terms of environmental indicators that correspond to those goals. Establishing measurable environmental goals and adequate and reliable environmental indicators is vital to this new approach.

To meet this challenge, the Office of Solid Waste (OSW) initiated an effort to identify environmental indicators that measured progress in the RCRA program in 1989. OSW recognized that for such a complex undertaking, the program needed to create a better institutional framework for identifying a full set of environmental indicators and developing a long-term strategy for reporting on them. Toward this end, OSW has:

- Established a workgroup composed of EPA Regional, Headquarters, and state personnel to identify and assess potential RCRA indicators;
- Established national databases which will be used to report on indicators;
- Identified and evaluated a complete list of candidate RCRA indicator categories;
- Assessed data availability for the candidate indicator categories;
- Selected short-term indicator categories for which reporting will begin in FY 1992; and
- Selected longer-term indicators for more detailed examination in FY 1992 and beyond.

Throughout this project, valuable input has been provided by representatives of program offices including the Office of Emergency and Remedial Response (OERR); the Office of Waste Programs Enforcement (OWPE); the Office of Policy, Planning and Evaluation (OPPE); the Office of Ground Water Protection (OGWP); the Regions; and several states. OSW has actively involved these parties through several mechanisms, including working sessions held at OPPE's Agency-wide workshop on environmental indicators (July 1991); the two-day "RCRA Environmental Indicators Workshop" held in September 1991 for Headquarters, Regional, and

state managers; and the RCRA Environmental Indicators Workgroup (on-going), which involves Headquarters, Regional, and state representatives. The recommendations presented in this report reflect the input of all of these parties.

ENVIRONMENTAL INDICATORS WILL BE USED TO REPORT TO THE PUBLIC ABOUT THE RCRA PROGRAM

RCRA environmental indicators have two different audiences: EPA managers and the public. EPA and state managers need environmental indicator data to assess the results of their regulatory or non-regulatory activities and to assist them in setting program priorities. Technical indicators that are meaningful to EPA personnel are not always easily understood by people outside the Agency. Therefore, OSW developed the concept of *environmental messages*, which are broad, non-technical statements of environmental progress or trends. They are based on the environmental indicators, but present a plain English summary of conclusions that the technical environmental indicators support. OSW believes that the public's clear comprehension of environmental indicators, and the environmental messages they support, is a crucial component in developing a successful indicators program. The RCRA Environmental Indicators Workgroup activities will include an emphasis on translating environmental indicators into non-technical environmental messages to "tell the story" about progress in the RCRA program.

INDICATORS ARE LINKED TO RCRA GOALS AND OBJECTIVES

After extensive analysis, the RCRA Environmental Indicators Workgroup chose to develop indicators that try to measure progress toward achieving the three major RCRA program goals: waste minimization, safe management of wastes, and corrective action.

Waste minimization goals are aimed at reducing the quantity, toxicity, and hazardous properties of wastes; conserving natural resources by reducing the use of raw materials; and reducing the use of toxic materials in production. Because the waste minimization program is young and reporting is not fully developed, OSW has limited capabilities to report environmental indicators for waste minimization programs for all wastes at this time. However, waste minimization will be an important aspect of the RCRA program, and OSW will improve its reporting capabilities over time.

Safe management goals are aimed at preventing risks to human health and the environment from the management of wastes after they are generated. This category of indicators encompasses the safe management of wastes from "cradle to grave," i.e., from the point of a waste's generation through its transportation, storage, treatment, and final disposal. A wide variety of program activities are covered in this category, including waste manifesting; treatment of wastes prior to land disposal (e.g., Best Demonstrated Available Technology [BDAT]); standards for the design, operation, and closure of waste management units; and monitoring to detect potential releases from waste management units to ensure that the waste management measures are effective. OSW is just beginning to define indicators for safe management goals and has identified some safe management indicators that can be reported with existing data sources.

Corrective action relates to the cleanup of past, present, and future contamination from waste management at RCRA facilities. Activities covered include assessing sites to

determine the need for corrective action, stabilizing and cleaning up releases, and setting priorities for site assessment and cleanup based on human health and environmental risks. There are several parallels between the Superfund and RCRA corrective action programs, and OSW has considered the Superfund indicators strongly in the development of indicators for RCRA corrective action.

Although most of the RCRA program's progress to date has been in the Subtitle C (hazardous waste) area, the indicators that OSW is developing will be assessed for their applicability to the Subtitle D (municipal and industrial solid waste) universe as well. Some municipal solid waste data are available for immediate reporting.

THE RCRA ENVIRONMENTAL INDICATORS WORKGROUP DEVELOPED CRITERIA TO SELECT SPECIFIC INDICATORS

To develop environmental indicators for the RCRA program, OSW prepared a list of indicator categories for each of the three RCRA program goals. The specific indicators that fall within a category express similar themes, have similar advantages and disadvantages, or require similar types of data. Below is an example of an indicator category, and specific indicators that fall within that category:

Category of indicators: *Quantity and percent of waste managed by method.*

Examples of specific indicators included in that category:

Changes in the quantities of waste recycled, incinerated, landfilled, etc., over time;

Changes in the quantities of waste treated prior to land disposal; and

Changes in the quantities of land-disposed wastes managed in minimum technology units.

The list of categories for each program goal include activity measures as well as direct measures of environmental quality.

With the help of Headquarters, Regional, and state representatives, OSW evaluated each category of indicators in terms of eight criteria agreed upon by the RCRA Environmental Indicators Workgroup. The most important criteria were: (1) data availability, (2) the extent to which trends in the indicator can be related to program activities in a cause-and-effect manner, (3) whether the indicator is useful for demonstrating incremental change and/or interim progress, and (4) whether the indicator could be translated into an environmental message that would be useful to the public. The last three criteria were used as a basis for selecting indicators to study further, while the first criterion (data availability) was used to determine the timeframe for reporting. In conducting feasibility studies and further analysis of indicators for the medium- and long-term, the workgroup will consider an additional criterion -- namely, the ability of an indicator to portray an environmental impact.

OSW WILL BEGIN REPORTING ON INDICATORS IN 1992

OSW has assigned each category of indicators to one of three groups: short-term, medium-term, and long-term, reflecting primarily the data availability for reporting.

Short-term indicators are those that OSW will begin reporting in FY 1992 and will continue to report thereafter. They are called "short-term" because reporting can begin soon, as data are currently available in an accessible form at the national level.

For medium-term indicators, data are generally available, but the quality of the data needs to be reviewed. OSW will conduct further analysis and evaluation of the data for medium-term indicators in FY 1992. Depending on the results of these evaluations, reporting could begin in FY 1993 or later.

Finally, long-term indicators are those for which data are either not collected or not readily accessible. Data systems will need to be modified to incorporate the data, and Regions and states will have to obtain, quality control, and/or maintain the data. Long-term indicators could also require regulatory action. For the long-term indicators, in FYs 1992 and 1993, OSW will examine the feasibility and utility of collecting the data and modifying existing data systems. Assessment and feasibility studies will be performed for the highest-priority indicators beginning in FY 1993, and data collection and reporting will begin in FY 1994 or later and will continue into the outyears as additional assessments are made on other long-term indicators.

OSW's proposed short-term, medium-term, and long-term indicator categories encompass the breadth of the RCRA program. The categories are listed in Exhibits ES-1, ES-2, and ES-3 which appear at the end of this Executive Summary. Some examples of specific indicators that fall into each category are also provided, but only to help illustrate what the categories mean. OSW will not necessarily report the specific examples provided in these exhibits.

OSW WILL RELY ON A VARIETY OF DATA SOURCES

To obtain the data needed to report on these indicators, OSW will rely mostly on the program's two main reporting systems -- the RCRA Information System (RCRIS) and the Biennial Reporting System (BRS). These ongoing reporting systems will allow OSW to track trends in RCRA indicators over time. Other data sources (such as one-time surveys) will be used where appropriate and feasible.[1] In addition, OSW will review municipal solid waste data used to develop the Characterization of Municipal Solid Waste in the United States, 1960 to 2010, 1990 Update.

Groundwater data collected under RCRA can be used to characterize releases from permitted land-based waste management units. In the short term, OSW plans to use the groundwater data in the form in which they are presently reported: numbers of facilities in each stage of monitoring. In the longer term, OSW will refine the data to include such possible

---

[1]Two of these studies include the 1987 National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (the TSDR Survey) and the 1987 Survey of Hazardous Waste Generators (the Generator Survey).

measures as the numbers of facilities with off-site contamination. However, routine reporting of groundwater constituent data at the national level is not planned.

OSW HAS AN AGGRESSIVE IMPLEMENTATION PLAN IN PLACE

OSW is committed to using environmental indicators as a basis for reporting on the RCRA program and communicating the program's achievements to the public. To this end, OSW has identified the following specific milestones for the next year:

January 1992	Deliver draft report on short-term indicators to OPPE. This report, already completed, is to be included in an Agency-wide report to the Deputy Administrator on EPA's environmental indicators.
Summer/Fall 1992	Complete final report on short-term indicators.
January/ December 1992	Develop and implement a plan for collecting the data needed to report on the most promising medium-term indicators.
December 1992	Complete the FY 1992 Annual Progress Report on RCRA Environmental Indicators. The Progress Report will include implementation plans for collecting medium- and possibly some long-term indicators.

OSW will continue to aggressively pursue the development and reporting of indicators in FY 1992 and beyond, and will continue to rely heavily on input from Headquarters, the Regions, and the states throughout this important long-term effort.

EXHIBIT ES-1.

SHORT-TERM RCRA INDICATORS

Report in FY 1992 and beyond

RCRA Program Goal	Category of Indicators
Waste Minimization	**Trends in Waste Quantity Generated** *Examples of indicators:* - *Quantity of waste generated (normalized per capita, or by economic activity).* - *Changes in waste recycling, source reduction, and management.*
Safe Management	**Quantity and Percent of Waste Managed by Method, by Type of Waste** *Examples of indicators:* - *Reductions in quantities of waste managed in land-based units without prior treatment, by type of waste.* - *Consolidation and improvement of land-based waste management, pre-1980 to 1990.* - *Quantities of waste incinerated or land disposed.* **Number, Percent, and Status of Facilities Monitored and Evaluated** *Example of indicator:* - *Number and percent of RCRA facilities conducting groundwater monitoring (in compliance with RCRA regulations).*
Corrective Action	**Number and Status of Assessments, Investigations and Actions to Reduce Risk and Control or Contain Releases Imposed or Underway** *Examples of indicators:* - *Number of RFAs and RFIs initiated and/or completed.* - *Number of facilities priority ranked as high, medium, or low.*

EXHIBIT ES-2.

MEDIUM-TERM RCRA INDICATORS

Develop list of most promising indicators by December 1992
Develop potential implementation plan by December 1992
Possibly report in 1993 or later

RCRA Program Goal	Category of Indicators
Waste Minimization	**Number of Waste Streams and Quantities of Some Specific Wastes Addressed by Waste Minimization Program** *Examples of indicators:* - *Type and number of waste streams subject to source reduction and recycling, by industry.* - *Quantity and type of municipal waste being recycled.* **Number of Entities Implementing Waste Minimization Programs** *Example of indicator:* - *Number of facility-specific waste minimization programs reviewed by EPA or the States.* **Quantity of Waste Prevented Due to Waste Minimization Activities** *Example of indicator:* - *Quantity of waste reduced or eliminated through source reduction or recycling.*
Safe Management	**Number and Percent of Facilities Using Designs, Operating Methods, and Closure Practices that Minimize Releases** *Example of indicator:* - *Number of incinerators with adequate air pollution controls in place.*
Corrective Action	**Number of Facilities (Undergoing Corrective Action) with On-site and/or Off-site Releases** *Example of indicator:* - *Number and percentage of facilities with releases to groundwater.* **Quantities of Waste or Contaminated Media Treated, Removed, or Prevented from Spreading** *Examples of indicators:* - *Quantity of cleanup waste managed (treated, contained, removed)* - *Gallons of groundwater pumped and treated.*

EXHIBIT ES-3.

LONG-TERM RCRA INDICATORS

Refine indicator categories and identify most promising indicators by December 1992
Begin pilot studies to assess data availability January - June 1993
Begin reporting on results of pilot studies and present proposal for national reporting of select indicators by December 1993 and beyond
Collect data and begin reporting in 1994 and beyond

RCRA Program Goal	Category of Indicators
Waste Minimization	**Trends in Waste Toxicity** *Example of indicator:* - *Tons of hazardous waste generated with "acutely toxic" waste codes.*
Safe Management	**Number and Percent of Facilities Located in Areas that Minimize Releases, Exposure, and Environmental Damage** *Examples of indicators:* - *Number and percent of land disposal units located outside wellhead protection areas.* - *Number and percent of hazardous waste incinerators located in areas where a certain number of people live close to the facility.* **Occurrence and Toxicity of Releases and Extent of Contamination from Waste Management** *Examples of indicators:* - *Number and percent of facilities reporting groundwater releases and percent requiring remediation of releases.* - *Number of spills, explosions, or transportation accidents resulting in toxic releases from wastes.* **Waste Management Capacity** *Example of indicator:* - *Total waste management capacity provided by facilities in the permitting pipeline, by state and type of waste.* (long-term indicators continue on the next page.)

EXHIBIT ES-3 (cont.) LONG-TERM RCRA INDICATORS	
RCRA Program Goal	**Category of Indicators**
Corrective Action	**Changes in the Level of Environmental Contamination due to Remedial Activities** *Examples of indicators:* - *Median concentrations of contaminants in groundwater, surface water, soil, and air.* - *Surface area or volume of groundwater contaminated above concern levels.* - *Number of sites with groundwater contamination.* - *Number and percent of units with ground-water concentration reductions of a specified level (e.g., 25%, 50%, 75%, and 90%).* - *Number of units with soil contamination eliminated.* **Exposure to Releases from Waste Management Facilities** *Examples:* - *Number of people protected as a result of actions taken to control actual or imminent exposures to contaminated media (e.g., drinking water well closures, provision of alternative water supplies).* - *Number of people exposed or potentially exposed to contaminated groundwater, surface water, soils, or air.* - *Percent reduction in actual and potential human health and/or ecological exposures to releases from TSDFs.*

INTRODUCTION AND GENERAL CONCEPTS ON ENVIRONMENTAL INDICATORS

CHAPTER 1

EPA's Office of Solid Waste (OSW) is developing environmental indicators to measure progress in the RCRA program. The purpose of this report is to present OSW's findings and recommendations to date concerning indicators that will be reported in the short term, and those that OSW will examine further during FY 1992 and beyond.

This chapter provides an introduction to environmental indicators, including definitions of the terms "activity measure," "environmental indicator," and "environmental message." Some practical uses of environmental indicators are then examined.[2] Chapter 2 presents OSW's basic framework for developing RCRA indicators, addressing such topics as the goals of the RCRA statute and the aspects of the RCRA program that affect the design of indicators.

Chapters 3 through 5 discuss indicators for the three major goals of the RCRA program discussed in this report -- waste minimization, safe management, and corrective action -- respectively. Included in each chapter are a discussion of program goals, a list of the indicator categories examined to date, a summary of the advantages and disadvantages associated with each indicator category, and an overall evaluation of whether the category should be pursued, and over what timeframe. Chapter 6 presents OSW's implementation strategy for assessing and reporting on short-, medium-, and long-term categories of indicators.

BACKGROUND

EPA is moving from reliance purely on measures of activities accomplished toward more direct measures of trends in environmental quality. This change in approach can be traced to the late 1980s, when Administrator Lee Thomas challenged EPA's programs to find better ways to evaluate program accomplishments in terms of environmental results, and promoted workshops and other technical studies to that end. When Administrator Reilly came to EPA, the need for a better scientific understanding of the effect of EPA program activities on the environment was becoming even more widely recognized. Bolstered by Science Advisory Board reports recommending more emphasis on good science to support EPA's decisions, and maximized risk reduction as the principal focus for organizing EPA's work, Administrator Reilly began his Strategic Planning Initiative in 1989. This established the policy that all programs must, in the context of developing four-year strategic plans, set forth measurable environmental goals and name the environmental indicators to be used to evaluate progress relative to those goals. Program offices that had data readily available began reporting environmental indicators in 1990, and other programs are expected to do so as soon as is practical.

[2]Much of the material presented in this chapter was derived from papers written by EPA's Office of Policy, Planning, and Evaluation (OPPE) (see list of references in Chapter 7).

ACTIVITY MEASURES VS. ENVIRONMENTAL INDICATORS

EPA has identified a continuum of measures of environmental program effectiveness, shown in Exhibit 1-1. At the left-hand side of the exhibit are activity measures, which measure actions taken by EPA or the states, or by the entities regulated by EPA or state programs. Examples of activity measures include the number of permits issued to hazardous waste management facilities; the number of inspections conducted or enforcement actions taken; and the number of sites at which groundwater monitoring systems have been installed.

To the right are environmental indicators, which are more direct measures of environmental quality. Those furthest to the right are direct measures of human health or environmental endpoints, such as the incidence of disease or the abundance of a species of wildlife in an area. In the middle are measures of factors that contribute to human health or environmental endpoints which are also considered "environmental indicators," but are not themselves measures of those endpoints. Listed in decreasing order of their "directness" to actual endpoints, are measures which include: uptake or body burden (such as lead levels in human blood), ambient conditions (such as concentrations of pollutants in groundwater near sites), and loadings or emissions (such as pounds of pollutants released to surface water).

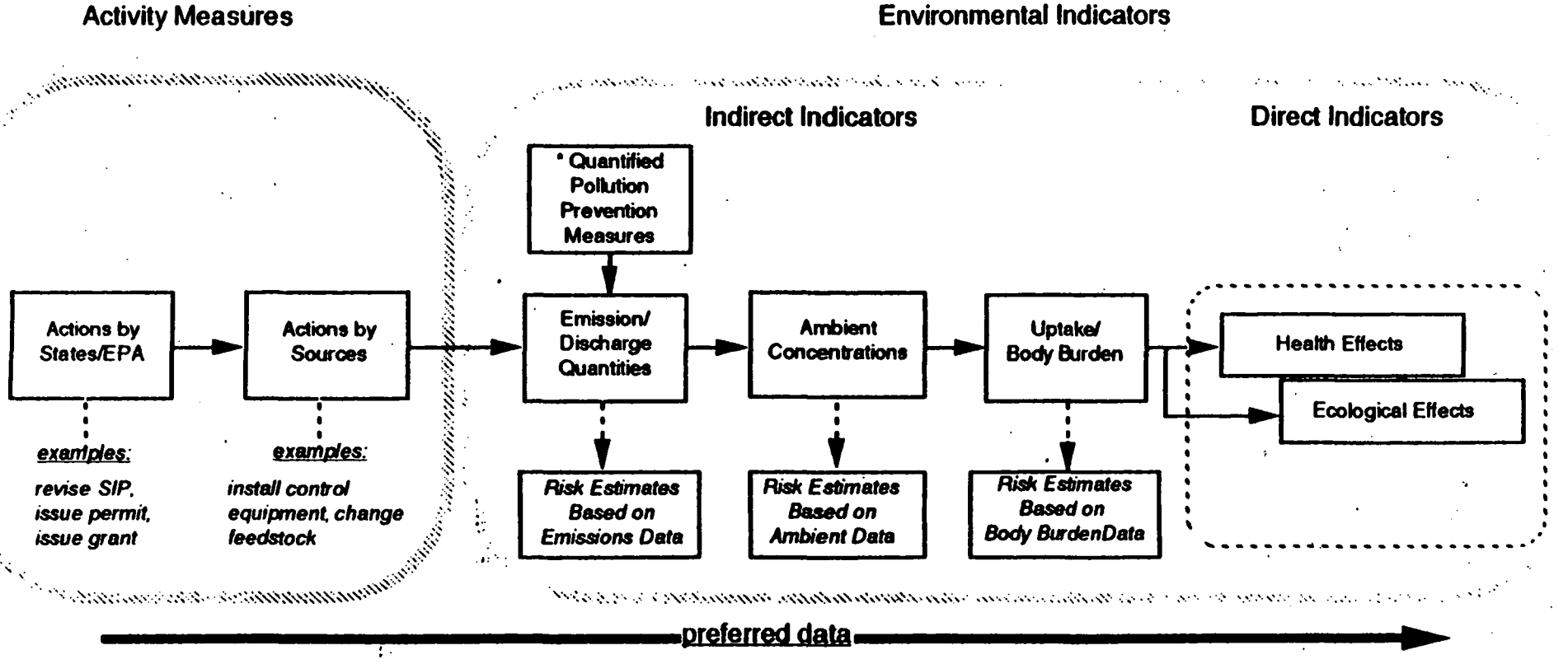
Activity measures and environmental indicators both play an important role in program management and evaluation, and both are necessary. Activity measures provide a means for documenting Agency responses to legislative mandates and public pressure, both for internal purposes and for communications with Congress and the public. They are used to support short-term program management activities such as determining the amount of work completed and additional work needed to be done. Because environmental results are sometimes not manifested for years or decades, activity measures also provide a valuable record of actions taken to address environmental problems. The major shortcoming of activity measures is that they do not tell us whether the actions taken have had, or will have, the desired effect on environmental quality.

COMMUNICATING ENVIRONMENTAL RESULTS: THE ROLE OF ENVIRONMENTAL MESSAGES AND ENVIRONMENTAL INDICATORS

There are two basic types of audiences for environmental indicators: EPA managers and staff, who use environmental indicators to assist in program planning and management; and policy makers and the general public, who simply want to know what the program has accomplished -- what is the "bottom line." These audiences may differ substantially in terms of their depth of understanding of EPA programs. Since indicators that are useful to EPA personnel frequently have no meaning to people outside the Agency, OSW developed the concept of *environmental messages*. These are broad, non-technical statements of environmental progress or trends designed to be understandable to the public. They are based on environmental indicators, but they also present the plain English conclusion that technical environmental indicators support. The following examples illustrate the difference between an environmental indicator and an environmental message:

> *Environmental indicator*: Changes in the number of acres of groundwater contaminated above MCLs at RCRA facilities.

EXHIBIT 1-1.
CONTINUUM OF MEASURES OF ENVIRONMENTAL PROGRAM EFFECTIVENESS



Theme 1: Managing for Environmental Results. Data to the right are closer to the "adverse ultimate impacts of pollution" that the States and EPA are charged with preventing or mitigating. All else being equal, data further to the right are better indicators of environmental result than data further to the left.

Theme 2: Emphasizing Pollution Prevention. Pollution prevention should result in the same kinds of environmental improvements as all Agency programs, so all these indicator types may be used to reflect pollution prevention successes. However, to prove the results are due to pollution prevention, data would be needed on the box marked with a *.

Environmental message: "The RCRA program is cleaning up contamination from past waste management activities. A portion of groundwater that was once polluted has been restored to meet standards."

Translating environmental indicators into easily understood environmental messages is a crucial step in developing a successful indicators program, as environmental messages are being proposed by OSW as the vehicle by which environmental indicators are communicated to the public.

POTENTIAL USES OF ENVIRONMENTAL INDICATORS

Environmental indicators have two broad uses: (1) determining environmental status and trends for internal planning and public communication purposes, and (2) measuring the effectiveness of EPA programs in addressing environmental problems.

Determining Environmental Status and Trends

The fundamental use of environmental indicators is to measure the status and trends of environmental conditions and identify the factors that affect such conditions (e.g., pollutant loadings). This information is of interest to the public, Congress, and policymakers. Using environmental indicators to track trends in environmental conditions helps EPA programs identify emerging problems, assess their significance, and set priorities.

For some programs, environmental trend data is available because it is legislatively mandated. For example, the Clean Water Act (CWA) instructs EPA and states to report to Congress and the public biennially on ambient surface water quality. In their 305(b) assessments, states report on attainment of the CWA "fishable/swimmable" goals and "designated use support." The Air Program's annual "Trends Report" provides a national summary of air quality and emissions data. For other programs, such as RCRA, states do not have a legislative mandate to report on environmental status and trends. While EPA does collect some information from states on Subtitle C wastes and facilities (RCRIS, BRS), EPA does not have a comprehensive data system for Subtitle D wastes and facilities.

Evaluating Program Performance

One of the most important internal uses of environmental indicators is to assess the success of EPA programs. Once environmental goals are set, data on environmental trends and improvements can be used to determine whether a program's activities are bringing about the intended improvements in environmental quality. If data on environmental quality are to be used for assessing program performance, it is absolutely crucial to establish cause-and-effect relationships between program activities and changes in environmental conditions, and to isolate program impacts from the influence of extraneous factors.

Some programs are attempting to use environmental indicators to evaluate program success. The Air Program has always been driven largely by legislatively mandated ambient air quality goals; therefore, the success of the program has always been evaluated in environmental terms. In the Surface Water Program, states assess their waterbodies according to their ability to support the designated uses established in their water quality standards. States determine whether the designated uses are supported by compiling and interpreting data on a variety of physical, chemical, and biological measures. However, it has been difficult for the program to document that improvements in water quality are attributable to

program activities, and the program relies more on activity measures than environmental indicators for evaluating program effectiveness.

The RCRA program is faced with a more complex challenge in measuring environmental trends, since effects of RCRA-regulated sites tend to be localized and would require identification and assessment of impacts on several media -- air, groundwater, surface water, etc. For the most part, OSW has relied more on activity measures for evaluating program progress.

Information on program progress can be used to support many types of program management functions. In using environmental indicators for program management, however, the following caveats should be kept in mind:

- Indicator results used as short-term performance measures may bias the allocation of resources toward activities with short-term results, at the expense of longer-term investments that may have greater ultimate environmental payoff.

- Use of indicators as performance measures may discourage activities that address difficult-to-measure problems, for which there may presently be no indicator.

- Where indicators are based on performance against goals, relying on such indicators to measure performance may encourage the setting of less ambitious goals.

- Use of indicators as a primary measure of performance might discourage aggressive investigation and accurate reporting of environmental problems. It is important to avoid creating disincentives for Agency staff to take or propose action on emerging problems or problems that cannot be addressed with existing resources.

- If indicators are to be used in managers' performance evaluations, it is important to avoid penalizing managers for circumstances beyond their control. However, if environmental indicators show that particular environmental goals were not attained when projected, managers should be able to explain (1) why the environmental goals were not attained or what activities will be undertaken to understand why the goals were not attained, and (2) what actions could be taken to achieve better results.

CHARACTERISTICS OF "IDEAL" ENVIRONMENTAL INDICATORS

In theory, an "ideal" environmental indicator has all of the characteristics listed below. In practice, few indicators exhibit all of these criteria.

- The indicator is based on environmental data, to the greatest extent possible. Indicators further to the right on Exhibit 1-1 are generally considered "better" than those further to the left because they are more directly related to environmental conditions.

- Changes in the indicator can be related to the program's activities (or human activities regulated under the program) in a cause-and-effect manner. This is essential if the program is to take credit for observed improvements in environmental quality.

- The indicator is useful for demonstrating incremental change and/or interim progress. This is particularly important in RCRA and other programs where it can take several years or decades to achieve ultimate environmental goals.

- The indicator must be understandable to the target audience(s), which may include senior EPA staff, other EPA personnel, Congress, or the public.

- It must be possible to aggregate the indicator to the Regional or national scale.

- The costs associated with data collection and management should be justifiable in terms of the benefits to be gained by having the indicator data available.

- The indicator must be directly related to the goals of the program.

- The indicator must be scientifically credible -- recognized experts would agree that it is a valid measure for the environmental conditions of interest.

Depending on the intended use of the indicator, some of the above criteria are much more important than others. Chapter 2 discusses how OSW has approached identifying environmental indicators for the RCRA program.

RCRA GOALS AND THE DEVELOPMENT OF ENVIRONMENTAL INDICATORS

CHAPTER 2

This chapter discusses a basic framework for developing indicators for the RCRA program. The first section relates the goals of the RCRA statute to the development of indicators for the program, and the second section discusses certain aspects of the program that must be taken into account when developing indicators. The final section reviews the process by which the environmental indicator categories identified in this report were developed.

RCRA GOALS AND THEIR RELATIONSHIP TO INDICATORS

According to Section 1003 of RCRA, the purpose of the RCRA statute is "to promote the protection of health and the environment and to conserve valuable material and energy resources" through 11 specific objectives, summarized in Exhibit 2-1. OSW has defined three major goals for the RCRA program, consistent with the objectives and themes of the statute:

- Waste minimization: Reducing the quantity and toxicity of wastes generated and disposed;
- Safe management: Ensuring that wastes that continue to be generated are managed in an environmentally safe manner; and
- Corrective action: Cleaning up environmental contamination from past, present and future waste management activities.

The RCRA Environmental Indicators Workgroup has used these three goals to identify categories of environmental indicators as follows:

Waste minimization indicators are being developed to measure the effectiveness of RCRA program activities aimed at reducing the quantity, toxicity, and hazardous properties of wastes; conserving natural resources by reducing the use of raw materials; and reducing the use of toxic materials in production.

Safe management indicators are being developed to measure the effectiveness of program activities aimed at preventing human health and environmental harm from the management of wastes after they are generated. This category of indicators encompasses the safe management of wastes from "cradle to grave," i.e., from the point of generation through transportation, storage, treatment, and final disposal. A wide variety of program activities are covered in this category, including waste manifesting; treatment of wastes prior to land disposal (e.g., best demonstrated available technology [BDAT]); location standards for waste management units; standards for the design, operation, and closure of waste management units; and monitoring to identify releases from waste management units to ensure that the waste management measures are effective in preventing releases.

EXHIBIT 2-1. OBJECTIVES OF THE RCRA STATUTE	
1.	Provide technical and financial assistance to State and local governments to develop solid waste management plans that promote improved methods of collection and recovery and environmentally safe disposal.
2.	Provide training grants in occupations involving the design, operation, and maintenance of solid waste disposal systems.
3.	Prohibit open dumping on the land.
4.	Assure that hazardous waste management practices are protective of human health and the environment.
5.	Require that hazardous waste be properly managed, reducing the need for corrective action.
6.	Minimize the generation and land disposal of hazardous waste by encouraging process substitution, materials recovery, recycling, reuse, and treatment.
7.	Establish a Federal-State partnership to carry out the purposes of the Act, giving high priority to authorizing State programs under Subtitle C.
8.	Provide for the promulgation of guidelines for solid waste collection, transport, separation, recovery, and disposal practices and systems.
9.	Promote a national research and development program for improved solid waste management and resource conservation techniques.
10.	Promote the demonstration, construction, and application of solid waste management, resource recovery, and resource conservation systems that preserve and enhance the quality of air, water, and land.
11.	Establish a cooperative effort among Federal, State, and local governments and private enterprise to recover valuable materials and energy from solid waste.
Source: Section 1003 of RCRA	

Finally, corrective action indicators are being developed to measure the success of activities related to the cleanup of past, present, and future contamination from waste mismanagement at RCRA facilities. Activities covered include assessing sites to determine the need for corrective action, stabilizing and cleaning up releases, and prioritizing site assessment and cleanup based on human health and environmental risks.

In principle, these three sets of indicators can be reported for both Subtitle C (hazardous) wastes and Subtitle D (industrial and municipal) wastes. Since states currently report some data to EPA (which is compiled in national databases) for Subtitle C facilities, this report focuses primarily on Subtitle C wastes. However, while states do not currently report similar data to EPA for Subtitle D facilities (industrial, municipal wastes), EPA has compiled municipal solid waste data that are appropriate for indicators in the Characterization of Municipal Solid Waste in the United States, 1960 to 2010, 1990 Update. Thus, a limited set of indicators can be reported for municipal wastes in FY 1992. Indicators for other Subtitle D sites (industrial, special wastes) will be deferred until mechanisms are developed to collect and report data.

CHARACTERISTICS OF THE RCRA PROGRAM THAT AFFECT THE DESIGN OF INDICATORS

Several factors make it difficult to design and report on environmental indicators for the RCRA program.

First and foremost, , two of the major objectives of the program -- waste minimization and safe waste management -- are not linked to active restoration of environmental quality (a more easily measurable effect), but are targeted towards the prevention of future environmental damage.

- We assume that waste minimization activities result in a high degree of environmental protection, since minimizing wastes reduces the quantity and type of hazardous waste generated and therefore reduces potential exposure. However, there is no easy way to monitor environmental quality to measure these benefits directly.

- Likewise, it is very difficult to measure progress related to safe waste management activities because their objective is to prevent contamination from occurring. If these activities are 100 percent effective, there is no contamination to measure. Using environmental indicators to measure progress associated with preventive measures would require a prediction of what the environmental damages would have been without the controls -- a very complex and difficult task.

Second, RCRA is not a media-specific program. Unlike the media-specific air and water programs, RCRA focuses on a set of potential sources contamination -- solid and hazardous wastes. These wastes may affect any of the environmental media, and other sources not regulated by RCRA (including natural sources) may influence the same media. For example, EPA has authority under several statutes to protect groundwater quality (e.g., RCRA, CERCLA, the Safe Drinking Water Act), and does so under a myriad of regulations. It is very difficult, particularly on a national scale, to decipher the impacts of these programs individually on groundwater quality. It is therefore very difficult to measure the effectiveness of the RCRA program by monitoring human health effects, the well-being of other species, or the physical and chemical characteristics of groundwater, surface water, soil, or air.

Third, the RCRA program is not fully in place. Many regulations governing the management of hazardous waste are in effect and appear to have prompted significant improvements in waste management practices. In contrast, the Subtitle D program is still immature. Therefore, indicators that would show substantial progress when applied to the Subtitle C universe might show very little progress when applied to the entire universe of solid wastes (i.e., Subtitles C and D combined). Also, these two universes are "moving targets" -- facilities and wastes frequently switch from one universe to the other due to the promulgation of new hazardous waste listings or characteristics, delistings, and regulatory determinations for special wastes. This makes it very difficult to establish a baseline from which to measure progress.

These factors suggest three major guidelines for the development of environmental indicators for the RCRA program:

- First, OSW will have to rely on indirect environmental indicators to some extent, which are those that lie closer to the left hand side of Exhibit 1-1. They are used when data on environmental quality are not available, or when indirect indicators are the most appropriate indicators of progress. For example, if OSW wants to measure progress toward a hypothetical goal of "reducing by 25 percent the amount of municipal solid waste generated," the indirect indicator "tons of municipal solid waste generated" is clearly a better measure of progress than any indicator relating directly to environmental quality.

- Second, OSW will develop environmental indicators in stages, focusing first on indicators that can be reported using existing data. OSW will then shift to identifying "better" environmental indicators and developing strategies for obtaining and managing the data necessary to report on them.

- Finally, in developing indicators, OSW will ensure that indicators can be applied to all facilities and wastes regulated under RCRA. The distinction between a Subtitle C industrial facility and a Subtitle D industrial facility is not a meaningful one to the public or the environment.

THE DEVELOPMENT OF ENVIRONMENTAL INDICATORS

OSW began the process of developing environmental indicators for the RCRA program with the commitment to report on three indicators in 1990: (1) quantity of hazardous waste generated; (2) ratio of hazardous waste quantity to production activity; and (3) number of generators with waste minimization programs in place. OSW accomplished this task (relying for a large part on one-time data sources, such as surveys) but recognized that it was only the first step in developing and reporting a full set of RCRA indicators. OSW thus formed the RCRA Environmental Indicators Workgroup to continue with the indicators development, evaluation, and reporting process.

To develop environmental indicators for the RCRA program, OSW prepared a list of indicator "categories" for each of the three RCRA program goals. Indicator "categories" reflect general approaches to looking at program areas and activities. A short-term indicator category for the goal of waste minimization, for example, is "trends in waste quantity generated." Specific indicators that fall within a category express similar themes, have similar strengths and weaknesses, and require similar types of data. The list of categories for each program goal included direct measures of environmental quality as well as activity measures.

Through the RCRA Environmental Indicators Workgroup, OSW has accomplished the following:

- Determined which on-going national databases (i.e., RCRIS, BRS) will be used to institutionalize data sources for reporting indicators on a regular basis;

- Developed a candidate list of environmental indicator categories for each of the three major goals of the RCRA program: waste minimization, safe management, and corrective action;

- Evaluated each candidate indicator category in terms of selected criteria, and identified indicators that are meaningful and useful;

- Assessed the availability of data needed to report on each candidate indicator category;

- Selected indicator categories to report in the short term and identified medium- and long-term indicator categories for more detailed analysis for possible reporting in the future; and

- Provided data summaries, analysis, and graphics on RCRA environmental indicators to OPPE for an Agency-wide report on EPA environmental indicators.

Recognizing that the success of this project hinges on close coordination with the Regions, states, and other Headquarters offices, OSW sponsored or participated in several meetings and events to involve these parties early in the process. These efforts are summarized below:

- The RCRA Corrective Action Environmental Indicators Workgroup was formed in late 1990. This small workgroup is made up of staff from OSW, OSWER's Office of Waste Programs and Enforcement (OWPE), and the Office of Policy, Planning, and Evaluation (OPPE). The workgroup has completed several tasks, such as reviewing indicators developed by the Superfund office and EPA's Office of Ground Water Protection (OGWP). It is now incorporated into the larger workgroup.

- In July 1991, OPPE sponsored the Environmental Indicators Workshop in Baltimore, Maryland. At this workshop, OSW held two working sessions on RCRA indicators. Representatives of OSW, other EPA offices, and several Regions identified and discussed a wide range of possible indicators related to groundwater quality at RCRA sites.

- In August 1991, OSW created the RCRA Environmental Indicators Workgroup. This workgroup is chaired by the Regulatory Analysis Branch (RAB) of the Communications, Analysis, and Budget Division (CABD), and its members include representatives of OSW, other offices such as Superfund, OGWP, OPPE, and most of the Regions. In its first five meetings, the workgroup identified indicator categories that can be reported on in the short term, as well as those that appear promising but require additional data collection or data management activities. The RCRA Environmental Indicators Workgroup has been expanded to include state representatives.

- In September 1991, OSW sponsored the RCRA Environmental Indicators Workshop. Managers from Headquarters, the Regions, and the states discussed how to best

communicate environmental progress to the public, and identified specific indicators that could be used to support these messages.

OSW will continue to rely on input from the RCRA Environmental Indicators Workgroup, and on other activities such as those described above, throughout the process of developing and reporting indicators for the RCRA program.

DATA SOURCES FOR INDICATOR REPORTING

To obtain the data needed to report on these indicators, OSW will rely mostly on the program's two main reporting systems -- the RCRA Information System (RCRIS) and the Biennial Reporting System (BRS). These ongoing reporting systems will allow OSW to track trends in RCRA indicators over time. Other data sources (such as one-time surveys) will be used where appropriate and feasible.[3] In addition, OSW will review municipal solid waste data used to develop the Characterization of Municipal Solid Waste in the United States, 1960 to 2010, 1990 Update.

Groundwater data collected under RCRA can be used to characterize releases from permitted land-based waste management units. In the short term, OSW plans to use the groundwater data in the form in which they are presently reported: numbers of facilities in each stage of monitoring. In the longer term, OSW will refine the data to include such possible measures as the numbers of facilities with off-site contamination. However, routine reporting of groundwater constituent data at the national level is not planned.

---

[3]Two of these studies include the 1987 National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (the TSDR Survey) and the 1987 Survey of Hazardous Waste Generators (the Generator Survey).

PROGRAM GOALS AND STATUS

EPA has established waste minimization as the primary strategy for preventing contamination from waste management. RCRA's waste minimization goals focus on risk reduction and resource conservation, and apply to all types of waste -- hazardous, non-hazardous industrial, municipal, and special wastes. The goals can be represented as follows:

- Reducing risk to human health and the environment associated with waste management by reducing the quantity, toxicity, and hazardous properties of wastes;
- Conserving natural resources by reducing the use of raw materials; and
- Reducing the use of toxic materials in production.

OSW is currently developing a comprehensive "Source Reduction and Recycling Action Plan," which will provide an implementation strategy for the RCRA waste minimization program. The "Action Plan" will define a more comprehensive and integrated waste minimization role for OSW, including incorporating source reduction and recycling into the rule-making process, permits and enforcement settlements, and supporting state programs.

In addition to requiring generators to certify that they have hazardous waste reduction programs in place, OSW has undertaken a variety of non-regulatory actions to promote waste minimization. These include developing guidelines for Federal procurement of recycled materials, providing grants to states, and making guidance materials and technical assistance available to states and industry. Another powerful non-regulatory incentive for generators to minimize wastes is the escalating costs of waste disposal and compliance with regulations.

MESSAGES RELATED TO WASTE MINIMIZATION

OSW managers have identified two waste minimization messages that they want to communicate to the public:

1. *Waste minimization is an effective and economical tool to improve environmental quality, preserve natural resources, and protect human health.*
2. *Waste minimization is reducing the generation of waste over time without creating other environmental problems.*

STATUS OF INDICATORS DEVELOPMENT

In 1989, OSW conducted a review of the Biennial Reporting System (BRS) and other existing data sources to identify potential indicators that might be supported by existing data.[4] A number of potential indicators were suggested for waste minimization as well as waste management. In November 1990, OSW reported on three indicators for the RCRA program which relate to waste minimization: (1) the quantity of hazardous waste generated; (2) the ratio of hazardous waste generated to production activity; and (3) the number of generators with waste minimization programs.[5]

While there has been substantial discussion of potential waste minimization indicators, and some progress on acquiring the data to report on such indicators, indicator categories and specific indicators for waste minimization are the least defined of the three RCRA goals.[6] This is in part because definition and measurement of true waste minimization is complex, involving factors relating to process and plant measurement, in addition to influences related to the state of the economy, energy costs, and the effects of other environmental programs. Establishing the link between waste minimization outcomes and RCRA program efforts will be difficult at best. However, in the interim, much can be learned on hazardous waste minimization from BRS, and on municipal waste minimization from data represented in Characterization of Municipal Solid Waste in the United States, 1990 Update.[7]

OVERVIEW OF CANDIDATE INDICATOR CATEGORIES

Exhibit 3-1 lists categories of indicators related to waste minimization goals that have been considered by OSW. The table notes which of the two waste minimization messages described above is supported by each category.

The categories include measures of trends in waste quantity and toxicity, trends in the use of waste minimization programs, trends in waste quantities that can be attributed specifically to waste minimization programs, cross-media shifts that may accompany waste minimization, and the resource conservation benefits associated with waste minimization and recycling.

---

[4]See Versar, Development and Use of Indicator Statistics to Track the Progress of the RCRA Program, Prepared for EPA Office of Solid Waste, Office of Policy Planning and Information, March 16, 1989.

[5]Memorandum from Don Clay to Terry Davies, "Transmittal of OSW's Environmental Indicators to OPPE and OSWER," December 4, 1990.

[6]Waste minimization indicators were discussed in meetings of the RCRA Environmental Indicators Workgroup in August 1991 and the September 1991 RCRA Environmental Indicators Workshop.

[7]U.S. EPA, Office of Solid Waste, Washington, D.C. Characterization of Municipal Solid Waste in the United States, 1990 Update. EPA/530-SW-90-04. June 1990.

Exhibit 3-1

OVERVIEW OF CANDIDATE WASTE MINIMIZATION INDICATOR CATEGORIES

	Indicator Category	Reporting Timeframe*	Messages Supported**
1.	Trends in Waste Quantity Generated	S	2
2.	Number of Waste Streams and Quantities of Some Specific Wastes Addressed by Waste Minimization Programs	M	2
3.	Number of Entities Implementing Waste Minimization Programs	M	2
4.	Quantity of Waste Prevented Due to Waste Minimization Activities	M	2
5.	Trends in Waste Toxicity	L	1,2
6.	Use of "Best" Production and Recycling Practices	D	2
7.	Effects of Waste Minimization on Demand for Virgin Materials	D	2
8.	Effects of Waste Minimization on Demand for Disposal Capacity	D	1

* *Reporting timeframe is based on data availability. S= Short-term; M= Medium-term; L= Long-term; D= Deferred for Future Consideration*

** *Messages Supported:*

1. *Waste minimization is an effective and economical tool to improve environmental quality, preserve natural resources, and protect human health.*
2. *Waste minimization is reducing over time the generation of waste, without creating other environmental problems.*

EVALUATION OF CANDIDATE INDICATOR CATEGORIES

This section provides specific examples of indicators for each category, discusses the merits of the category, reviews the availability of data to support the category, and presents OSW's decisions about short- and long-term reporting for each category. The indicator categories are discussed in the order listed in Exhibit 3-1.

1. TRENDS IN WASTE QUANTITY GENERATED

This category of indicators tracks the quantity of waste generated over time. Some of the indicators in this category "normalize" the waste generation rates to account for factors other than waste minimization programs (e.g., economic factors) that influence waste generation rates.

Examples

Quantity of hazardous waste per unit of production, by industry.

Quantity of municipal waste generated (normalized per capita, or by economic activity).

Changes in municipal solid waste recycling, source reduction, and management.

Data Availability

Data on hazardous waste stream quantities by EPA waste code are available from the Biennial Reporting System (BRS). BRS provides data on sources of waste, which allows for the distinction among cleanup, production, and pollution control residual wastes. It may be difficult in some cases to determine the effects of changes in the scope of the hazardous waste definition from actual increases in waste quantities generated. The possibilities for characterizing types of waste are limited by how the RCRA waste codes are used, and by the fact that large quantities are reported using mixed waste codes. Often, wastes will be characterized generally (e.g., to indicate ignitability, reactivity) as opposed to being identified by specific chemical constituents. Data used to develop the 1990 update of the Characterization of Municipal Solid Waste in the United States may support reporting trends in municipal waste generation. No data are currently reported on non-hazardous industrial waste quantities.

Evaluation

Advantages

- Provides a measure of overall trends in waste generation.
- Can be reported for individual hazardous waste streams, and possibly for municipal waste streams, in the short term with existing data.
- The relationship between changes in the economy and population trends and waste quantity generated can be inferred by trends in the ratio of waste quantity to production level and population.

Disadvantages

- Current waste classification system will somewhat limit EPA's ability to interpret trends in hazardous waste generation.
- Defining appropriate measures of production for different industries and obtaining data on those measures is difficult.

- Trends in waste quantity may not reflect changes in waste characteristics such as toxicity. Reductions in waste quantity may or may not result in net reductions in risk.

- Trends in waste quantity do not directly show the effects of RCRA waste minimization programs.

Recommendations and Next Steps

- Begin reporting trends in hazardous waste quantities using BRS data. To the extent possible, distinguish type and source of waste and the effects of changes in the definition of hazardous waste.

- Use 1990 update of Characterization of Municipal Solid Waste in the United States to measure trends in quantities of municipal waste and quantities per capita.

- Explore options for relating industrial waste quantities to production levels.

- Work with Agency-wide workgroup to explore methods for measuring waste minimization.

2. NUMBER OF WASTE STREAMS AND QUANTITIES OF SOME SPECIFIC WASTES ADDRESSED BY WASTE MINIMIZATION PROGRAMS

This category of indicators portrays the number of waste streams, or volume of wastes, targeted by waste minimization programs. It does not, however, measure the effect of the waste minimization programs on the quantity of waste generated.

Examples

Type and number of waste streams subject to source reduction, by industry.

Type and number of waste streams subject to recycling, by industry.

Quantity and type of municipal waste being recycled.

Data Availability

Data are available for hazardous waste from BRS.

Evaluation

Advantages

- Provides a measure of the scope of reported waste minimization efforts.

- Can be reported by using existing data.

Disadvantages

- Does not measure the success of waste minimization programs in reducing waste quantity or toxicity.

- Data are questionable because most respondents to BRS will report waste minimization activities. This is because in order to send a shipment of hazardous wastes or receive a permit you must first affirm your commitment to waste minimization.

Recommendation and Next Step

- Further evaluate data sources and data reliability.

3. NUMBER OF ENTITIES IMPLEMENTING WASTE MINIMIZATION PROGRAMS

This category of indicators measures the scope of the nation's waste minimization efforts by measuring the number of generators or states implementing waste minimization programs.

Examples

Number of facility-specific waste minimization programs reviewed by EPA or the States.

Number of generators implementing source reduction programs, by type of program.

Number of generators recycling waste, by type of recycling.

Number of states with recycling programs.

Data Availability

Most data are available for hazardous waste from BRS. Revisions to BRS will provide more information on type of source reduction and recycling. Information on state programs is available and can be updated with moderate effort.

Evaluation

Advantages

- Provides measure of generator and state efforts to minimize waste.

- Reporting by type of program would provide some insight into the seriousness of the effort.

Disadvantages

- Provides no measure of the overall success of waste minimization efforts.

- Data quality on hazardous waste may be questionable because failure to report the existence of a program would imply violation of current certification requirements (for generators).

Recommendations and Next Steps

- Evaluate data availability and data reliability.
- Possibly begin reporting in FY 1993.

4. QUANTITY OF WASTE PREVENTED DUE TO WASTE MINIMIZATION ACTIVITIES

This category of indicators tracks the success of the waste minimization program by measuring the amount of waste prevented due to source reduction, recycling, or other waste minimization activities.

Example

Trends in the recovery of municipal solid waste for recycling.

Quantity of waste reduced or eliminated through source reduction or recycling.

Data Availability

1989 BRS data are available that provide measures of the quantity of waste that is reduced or eliminated due to source reduction activities; the data, however, are incomplete as of this writing, and it is uncertain how comprehensive or accurate they nay ultimately be. There are no BRS data that measure the reduction in the quantity of waste being disposed due to recycling activities. There is a BRS data set that quantifies the amount of waste that is recycled, but this is different from measuring how much waste is reduced. Municipal solid waste data are available from Characterization of Municipal Solid Waste in the United States, 1960 to 2010, 1990 Update.

Evaluation

Advantages

- Has potential to link waste quantity generation trends to waste minimization activities; provides insights into which industries are implementing waste minimization programs.
- Measures which recycling or source reduction activities are being undertaken.

Disadvantages

- These data do not measure quantity of waste avoided.
- Currently very difficult to measure.

Recommendation and Next Step

- Workgroup needs to consider further how to proceed.

5. TRENDS IN WASTE TOXICITY

This category measures another important goal of waste minimization programs: reducing not only the quantity, but also the toxicity, of wastes generated.

Examples

Tons of hazardous waste generated with "acutely-toxic" waste codes.

Tons of hazardous waste generated with codes indicating the presence of specific toxic constituents (lead, chlorinated solvents, chromium, etc.)

Data Availability

There are incomplete BRS data available that represent measures of each of the examples; the data, however, are more qualitative than quantitative in that they do not measure actual changes in concentrations of contaminants. Quantitative data that can be aggregated do not exist and would be very expensive to collect. TRI data are available for both RCRA hazardous and other wastes from manufacturing.

Evaluation

Advantages

- Provides a measure of trends in toxicity.
- Avoids misleading reporting of "success" when waste quantity reductions are achieved by increasing the toxicity of wastes.

Disadvantages

- Data on concentrations of toxic constituents in hazardous waste are not available in BRS.

Recommendation and Next Step

- Evaluate the feasibility of new data collection to support toxicity measures in FY 1992.

6. USE OF "BEST" PRODUCTION AND RECYCLING PRACTICES

Waste minimization activities vary significantly in their effectiveness in reducing waste quantity or toxicity. For this category of indicators, EPA would identify waste minimization practices that are considered to be relatively successful or "best," and measure the extent to which these types of practices are being used.

Examples

Quantity of waste generated compared with quantity of waste generated by "best production practices" (by industry, process and waste type).

Quantity and percent of waste recycled using "best recycling practices" (by industry and waste type).

Data Availability

Current data sources would support only limited reporting on number and quantity of hazardous wastes recycled by method. To implement the second indicator, EPA would have to specify what recycling methods are "best." Data are available on actual hazardous waste quantities by industry and waste type, but not by process. No definition of "best" (e.g., waste-minimizing) production process in different industries is currently available.

Evaluation

Advantages

- Provides a measure of waste minimization and recycling success relative to what is possible currently (i.e., current best practices).

Disadvantages

- Defining best practices would be difficult and (in the absence of process-specific reporting) controversial.

Recommendations and Next Steps

- Defer further consideration for the present.
- Continue to monitor the results of similar efforts in the states (e.g., Massachusetts).

7. EFFECTS OF WASTE MINIMIZATION ON DEMAND FOR VIRGIN MATERIALS

This category of indicators measures the success of waste minimization programs in terms of reduced demand for virgin materials.

Examples

Quantity of specific materials recovered from waste (lead, aluminum, etc.)

Trends in virgin raw material production, by type of material.

Data Availability

No data are currently reported on quantities recovered, with the exception of some materials (e.g., secondary lead production). Trends in virgin materials production are reported in various sources, such as industry and association data.

Evaluation

Advantage

- Provides direct evidence on one of the major objectives of waste minimization.

Disadvantages

- Current data sources do not link quantities recovered to RCRA waste minimization program efforts.
- Reductions over time in production of virgin materials could be caused by economic conditions, and other factors not related to waste minimization programs.

Recommendation and Next Step

- Defer further consideration for the present.

8. EFFECTS OF WASTE MINIMIZATION ON DEMAND FOR DISPOSAL CAPACITY

One of the important benefits of waste minimization is that it conserves the nation's waste disposal capacity and reduces the need to construct new waste management units. This category of indicators measures that benefit.

Examples

Percent reductions in waste quantities generated in areas with limited disposal capacity.

Percent reductions in quantities of waste for which there are treatment capacity shortages.

Number of new landfills or incinerators avoided by reduced generation.

Data Availability

If available, measures of waste quantities not generated can be converted into estimates of avoided landfills or incinerators using average facility size estimates. Waste disposal avoided through source reduction and recycling by type and area are generally available for hazardous waste from BRS, but are of unknown quality and require further analysis.

Evaluation

Advantages

- Provides direct evidence on one of the major objectives of waste minimization.
- "Landfills or incinerators avoided" may be a useful way to express the effects of trends to the general public.

Disadvantages

- Not clear that "new landfills or incinerators avoided" estimate can be calculated reliably.
- Data on waste volumes avoided are of dubious quality. By using data on waste volumes, trends in measures could be reported based on volume reductions, without attributing the reductions to waste minimization programs.

Recommendation and Next Step

- Conduct further analysis of data quality.

SUMMARY OF RECOMMENDATIONS AND NEXT STEPS

In January 1992 OSW produced a draft report on select indicators for reporting trends in municipal and hazardous waste quantities. OSW will determine whether trends can be explained or whether additional data are needed for interpreting waste minimization trends. OSW will also:

- Begin evaluation of existing data on activity measures for hazardous waste minimization, such as numbers of generators and states with programs (by type of program), numbers of waste streams and quantities of wastes addressed by programs, and numbers of permits and enforcement settlements incorporating waste minimization, and consider reporting of such measures in FY 1993 and later years;
- Evaluating existing and new data on municipal waste generation trends, recycling program trends and results, and source reduction efforts. Report as data sources become available.
- Evaluate the potential for using Section 313 reporting data (the Toxics Release Inventory data) to support RCRA waste minimization indicators; and
- Evaluate the feasibility of new data collection to support reporting on toxicity indicators.

In addition, the Waste Minimization Branch will continue to evaluate ways to measure waste minimization. The results of those efforts will be incorporated into the design of waste minimization indicators as appropriate.

PROGRAM GOALS AND STATUS

In addition to minimizing waste generation, the RCRA program is committed to promoting the safe management of wastes in ways that protect human health and the environment from toxic releases and other hazardous properties of waste. The goal of EPA's waste management program is to reduce risks to human health and the environment by developing rules, policies, and guidance in order to:

- Locate new waste management facilities to reduce the potential for release and exposure to hazardous materials;
- Ensure cradle-to-grave tracking of wastes to reduce illegal disposal;
- Monitor to ensure that technologies are performing as designed and that releases are detected;
- Increase the use of practices that destroy or detoxify wastes more effectively;
- Improve the design and operation of waste management facilities to reduce releases; and
- Require closure of facilities that do not meet acceptable location and design standards.

EPA and the states have promulgated a number of RCRA rules that have encouraged improved waste management practices that strive to meet these goals. In the early years of the program (prior to 1984), the Subtitle C program accomplished the following:

- Defined hazardous waste;
- Established a "cradle-to-grave" system for tracking hazardous wastes;
- Provided controls on the transportation of hazardous waste, primarily through a tracking system;
- Required "good housekeeping practices", groundwater monitoring, and record keeping;
- Brought major categories of waste under RCRA regulation;
- Provided basic locational requirements and engineering performance standards for the most prevalent waste management technologies;
- Required closure and post-closure care; and

- Developed permit, and state delegation processes, and inspection and enforcement programs.

In response to the 1984 Hazardous and Solid Waste Amendments (HSWA), EPA expanded the Subtitle C program. This second phase lead to the promulgation of rules that:

- Retired land disposal facilities that did not have financial responsibility insurance and proper groundwater monitoring;
- Required the treatment of regulated wastes that had previously gone to land disposal untreated;
- Required that hazardous waste land disposal facilities meet more stringent design requirements (double liners, leachate collection systems, etc.);
- Initiated cleanup activities to correct past problems at active sites;
- Closed regulatory "loopholes" such as those for boilers burning hazardous waste;
- Expanded the definition of "hazardous waste" to include new listings, wastes regulated under an EPA-specified toxicity characteristic, and lowering of the small volume generator exemption; and
- Accelerated EPA's permitting efforts and providing more aggressive enforcement.

Municipal waste management has been governed primarily by state programs, after initial Federal activity in the late 1970s and early 1980s. The recently-signed RCRA municipal landfill rule, and the municipal combustor rules proposed under the Clean Air Act, are major steps toward improving the management of municipal wastes nationwide. EPA is just beginning to gather data on other types of waste. Those data will provide a baseline for tracking environmental improvements as those wastes are subject to requirements in the future.

MESSAGES RELATED TO SAFE MANAGEMENT

At the RCRA environmental indicators workshop, participants identified five messages related to safe management goals:

1. *Today's waste management controls are preventing future contamination and thus eliminating the need for future cleanups (both Superfund and RCRA corrective actions).*
2. *Grass roots and voluntary industry efforts, as well as regulation, are resulting in safer waste management.*
3. *RCRA is promoting safer and better waste management practices.*
4. *The RCRA program is ensuring that facilities are more safely designed and operated.*

5. *Controls on waste management are reducing threats to human health and are providing for a cleaner environment.*

These messages are captured by two general themes:

1. *Safer waste management is reducing threats to human health and the environment from RCRA wastes.*

2. *Safer waste management has been achieved by use of more protective methods for storing, recycling, treating and disposing wastes and by improved controls at waste management facilities.*

STATUS OF INDICATORS DEVELOPMENT

Ideally, RCRA indicators would reflect the substantial progress that has already been achieved by the Subtitle C (hazardous waste) standards toward requiring safe management of hazardous wastes. To report trends in total progress achieved, it would be necessary to include historical indicator data as well as data for 1992 and future years.

The safe management indicators discussed in this chapter are in the initial stages of development. Substantial work is still required to identify appropriate indicators, to determine data availability, to identify and test new methods for data collection (if needed), and finally to report on the indicators.

A number of safe management indicators can be partially reported with existing data sources -- RCRIS and BRS. Some of these short-term indicators will set the baseline for environmental trends reported in the future. Other short-term indicators will be temporary surrogates for more precisely-targeted future indicators, which may be developed as EPA and the states develop more comprehensive data systems.

OVERVIEW OF CANDIDATE INDICATOR CATEGORIES

Exhibit 4-1 lists indicator categories related to safe management that were considered, along with the environmental message supported by each. These indicator categories incorporate a range of indicator measures, from direct measures of environmental impacts to measures of the activities of EPA and others. It will be important to assess the validity of the link assumed to exist between the indicator category and improved environmental quality. For example, it will be more meaningful to report increased use of specific treatments for specific types of waste (e.g., incineration of non-chlorinated, non-metal-bearing organics) rather than simply total tons of waste treated by some means, because some types of treatment achieve more environmental benefit than others.

Exhibit 4-1

OVERVIEW OF CANDIDATE SAFE MANAGEMENT INDICATOR CATEGORIES

	Indicator Category	Reporting Timeframe*	Messages Supported**
1.	Quantity and Percent of Waste Managed by Method, by Type of Waste	S	3
2.	Number, Percent, and Status of Facilities Monitored and Evaluated	S	4
3.	Number and Percent of Facilities Using Designs, Operating Methods, and Closure Practices that Minimize Releases	M	4
4.	Number and Percent of Facilities Located in Areas that Minimize Releases, Exposure, and Environmental Damage	L	4
5.	Occurrence and Toxicity of Releases and Extent of Contamination from Waste Management	L	1,5
6.	Waste Management Capacity	L	3
7.	Trends in Cross-Media Transfers	D	3

* Reporting timeframe is based on data availability. *S= Short-term; M= Medium-term; L= Long-term; D= Deferred for Future Consideration*

** *Messages Supported:*

1. *Today's waste management controls are preventing future contamination and thus eliminating the need for future cleanups.*
2. *Grass roots and voluntary efforts are resulting in safer management.*
3. *RCRA is promoting safer and better waste management practices.*
4. *RCRA is ensuring that facilities are more safely designed and operated.*
5. *Controls on waste management are reducing threats to human health and the environment.*

EVALUATION OF CANDIDATE INDICATOR CATEGORIES

This section discusses the merits of each indicator category, provides examples of specific indicators, identifies data available to support the indicator, and presents OSW's decisions about short- and long-term. The indicators categories are presented in the order shown in Exhibit 4-1.

1. QUANTITY AND PERCENT OF WASTE MANAGED BY METHOD, BY TYPE OF WASTE

This category of indicators simply tracks changes in waste management methods over time. It can be used to demonstrate increasing use of more protective management practices.

Examples

Reductions in quantities of waste managed in land-based units without prior treatment, by type of waste.

Consolidation and improvement of land-based waste management, pre-1980 to 1990.

Quantities of waste incinerated or land disposed.

Quantity and percent of waste managed in units operating under full Subtitle C (hazardous waste) permits.

Data Availability

Data on quantities of waste managed by method are currently available for hazardous wastes from BRS. Limitations in the BRS descriptions of technologies and waste types may limit the usefulness of the data. In addition, some states will not report BRS data in a standard format until 1993, making national estimates difficult for 1992. Data on municipal solid waste management trends are available from Characterization of Municipal Solid Waste in the United States, 1960 to 2010, 1990 Update. Data to report on some specific indicators in this category are not available for Subtitle D industrial and special wastes.

Evaluation

Advantages

- Provides information on trends in practices that are believed to result in reduced contamination.
- Indicators will be most meaningful if trends can be reported for specific waste types and for specific types of treatment, since the environmental benefits of different practices vary by waste type. Ideally, practices would be ranked as more or less desirable for specific waste types.
- Data are available to begin partial reporting on this category in FY 1992.
- Some historical data may be reported based on past Biennial Reports, and other sources.

Disadvantages

- Indicating that some waste management practices are better environmentally than others may be controversial.
- Changes in waste management practices do not guarantee reduced contamination.

Recommendations and Next Steps

- Begin reporting on quantities managed by method in FY 1992, based on BRS and RCRIS data.
- Investigate the need for more detailed reporting on waste and technology characteristics in BRS and RCRIS, to support improved indicators.
- Evaluate the applicability of TRI data to support safe management indicators.

2. NUMBER, PERCENT, AND STATUS OF FACILITIES MONITORED AND EVALUATED

This category of indicators measures the number and percent of facilities conducting monitoring in compliance with RCRA regulations. It also measures the extent to which facilities have been inspected for contamination.

Examples

Number and percent of RCRA facilities conducting air monitoring (in compliance with RCRA regulations).

Number and percent of RCRA facilities conducting groundwater monitoring (in compliance with RCRA regulations).

Number and percent of facilities that have been inspected within the last year.

Data Availability

Data on compliance status are reported for Subtitle C facilities in RCRIS. Data on the quality of groundwater monitoring and on the frequency of inspections are not currently reported in RCRIS.

Evaluation

Advantages

- Provides a measure of the extent to which facilities are evaluated to detect contamination.
- Avoids false impressions of progress that might result from failure to monitor and evaluate facilities.

Disadvantages

- Measures of the adequacy of monitoring, beyond the simple presence or absence of monitoring, may be difficult to define.
- New reporting requirements would be required to track inspection frequencies.
- "Non-compliance" does not necessarily indicate environmental risk. Facilities can be out of compliance but not harming the environment (e.g., paperwork violations), or they can be in compliance but still not improving the environment.
- Extent of monitoring does not indicate whether facilities are causing contamination.

Recommendations and Next Steps

- Report the data available from RCRIS in FY 1992.
- Explore the merits of reporting additional monitoring data, by designing and evaluating specific indicators and determining what data system changes would be needed to support those indicators.

3. NUMBER AND PERCENT OF FACILITIES USING DESIGNS, OPERATING METHODS, AND CLOSURE PRACTICES THAT MINIMIZE RELEASES

This category of indicators measures trends in facility design and operation that result in reduced risks to human health and the environment. In doing so, it provides a direct measure of RCRA program effectiveness.

Examples

Percent of facilities operating under Part B permits.

Percent of landfills and surface impoundments with minimum technology requirements in place.

Number of hazardous waste incinerators with adequate air pollution controls in place.

Number of inactive facilities that have completed adequate closure, by type of facility.

Data Availability

RCRIS provides information on the status of closures (e.g., units certified as "clean-closed.") Otherwise, there currently is no regularly-updated source of information on Subtitle C facility characteristics. Trend data could be developed through RCRIS reporting or through the BRS by asking permit writers, inspectors, or facility owners/operators to report on design (e.g., installation of liners or air pollution control devices) or operating practices. Some limited baseline survey data are also available on the characteristics of facilities managing municipal and industrial Subtitle D wastes, but there are no regular reporting mechanisms covering these facilities.

Evaluation

Advantages

- Provides information on trends in facility and unit design and operation that result in reduced contamination.
- Improvements in design and operation can generally be linked to RCRA program activities, and therefore can provide a measure of program effectiveness. Over time, it may be possible to further refine indicators in this category to correlate data on contamination with unit characteristics, to assess the effectiveness of different design and operating standards (e.g., double-synthetic vs. clay liners).

Disadvantages

- Changes in facility design and operation do not guarantee reduced contamination.
- Except for hazardous waste facility closure status, data are not available in existing sources to support this indicator category -- new reporting would be required.
- It may be difficult to define adequate closure practices, which are very site-specific.

Recommendations and Next Steps

- Explore the potential for reporting trend data on a regular basis through RCRIS or perhaps BRS.
- Explore the potential for reporting closure status using RCRIS data.

4. NUMBER AND PERCENT OF FACILITIES LOCATED IN AREAS THAT MINIMIZE RELEASES, EXPOSURE, AND ENVIRONMENTAL DAMAGE

This category of indicators measures trends in facility siting relative to locational attributes that affect the potential for human health and environmental risks.

Examples

Number and percent of land disposal units located outside wellhead protection areas.

Number and percent of hazardous waste incinerators located in areas where a certain number of people live close to the facility.

Number and percent of hazardous waste land disposal units located in areas with significant annual net precipitation.

Data Availability

The location of facilities managing hazardous wastes is identified in the Biennial Report (by ZIP code) and in RCRIS (by ZIP code and USGS river basin code). NPDES permit numbers are reported in all three sources, and other permits are identified in RCRIS. These identifiers may make it possible to characterize facility locations using other databases (e.g., GEMS data on population densities linked via ZIP codes). Further effort is needed to define location characteristics of interest and to identify potential sources of data to support "mapping" (e.g., definition of wellhead protection areas relative to waste sites). More research is also needed to determine whether Subtitle C permits contain useful data related to exposure potential and other location characteristics.

Evaluation

Advantages

- Provides information on trends in facility location characteristics that are believed to affect the likelihood or severity of contamination (e.g., floodplain or high net precipitation areas) or exposure (e.g., densely-populated areas or wellhead protection areas).

- Beginning reporting in the near-term would provide guidance for development of location standards and would provide a baseline for measuring the effects of future location standards and the effects of closures in unsafe locations.

Disadvantages

- Reporting on better and worse location characteristics may be controversial and may lead to public outcry and siting difficulties, until RCRA location standards are in place.

- Current data systems do not support reporting location characteristic trend data. New reporting would be required to support this category.

- Designating locations as more or less safe may be difficult and controversial.

Recommendations and Next Steps

- Investigate the potential for reporting location-related safe management indicators: can "safe areas" be defined? Can facility locations be characterized with existing data?

- Defer public reporting on location characteristics until location standards are in place.

5. OCCURRENCE AND TOXICITY OF RELEASES AND EXTENT OF CONTAMINATION FROM WASTE MANAGEMENT

This category of indicators measures the number of facilities with contamination and the extent and severity of contamination.

Examples

Number and percent of facilities with contaminated wells or contaminated air, soil, groundwater, or surface water.

Number and percent of facilities evaluated for corrective action that are determined to require remediation.

Number and percent of facilities reporting groundwater releases and percent requiring remediation of releases.

Concentration and toxicity of contaminants in groundwater downgradient from Subtitle C land disposal sites and detected in air monitoring of Subtitle C facilities.

Number of spills/explosions/transportation accidents resulting in toxic releases from wastes.

Data Availability

The status of groundwater monitoring at Subtitle C land disposal facilities is reported in RCRIS (i.e., units in detection vs. compliance monitoring). Data on groundwater monitoring at Subtitle C disposal facilities are reported to the Regions, but are not generally computerized or summarized in a standard format. Groundwater monitoring data are not available for Subtitle C non-land-disposal facilities. Monitoring data are not available for Subtitle D (industrial, municipal) facilities, although the new Municipal Solid Waste landfill rules will provide groundwater monitoring data for Subtitle D municipal landfills in the future. CERCLA reporting provides information on accidental releases.

Evaluation

Advantages

- Trends over time in the number of facilities with releases to the environment or requiring cleanup provides a direct measure of success in preventing contamination.
- The success of safe management (i.e., prevention) as opposed to cleanup can be tracked by distinguishing facilities that have never needed cleanup from those that have been or are currently being cleaned up.
- It may be desirable to report permitted vs. unpermitted (accidental) releases separately (e.g., predicted level of emissions allowed under incinerator permits as well as "illegal" releases).

Disadvantages

- Use of a single measure (does or does not require cleanup) may obscure differences in the severity of contamination, and may fail to show progress if the severity declines over time due to RCRA requirements.

- It may be difficult to distinguish the effects of prevention (safe management) versus cleanup.
- It may be difficult to aggregate and interpret monitoring data on numerous toxic chemicals.
- New reporting requirements would be needed to support this indicator category.

Recommendations and Next Steps

- Investigate the potential for reporting the number of operating facilities with no detected releases or violations in a given period using RCRIS data in FYs 1992-93.
- Design and investigate other data sources for specific measures in FYs 1992-93.
- Consider reporting in FY 1993 and beyond.
- Percentages as well as absolute numbers should be reported to reflect the expanding universe of facilities evaluated and subject to reporting.

6. WASTE MANAGEMENT CAPACITY

This category of indicators tracks RCRA's success in promoting the development of capacity to safely manage municipal and hazardous waste.

Examples

Number of states reporting sufficient capacity in place to manage municipal and hazardous wastes generated in state for the next period of years.

Total waste management capacity provided by facilities in the permitting pipeline, by state and type of waste.

Data Availability

The Superfund Amendments and Reauthorization Act (SARA) capacity assurance process provides most of the data required for this category. Capacity assurance reports incorporate data on waste generation provided by BRS on generation and current waste management practices. Therefore, the design of BRS will determine the degree to which data can be disaggregated by waste type and management practice.

Evaluation

Advantage

Tracks success in one major RCRA program area -- promoting development of sufficient permitted (i.e., "safe disposal") capacity to manage hazardous waste by disposal method and state.

Disadvantages

- There may be quality problems with state estimates of capacity and waste quantities, especially for future years.

- The effects of managing wastes in-state versus transporting wastes out-of-state on risks from waste management are unclear. In some cases, greater risk could result from increasing in-state management and reducing interstate waste shipments, if the greater risks associated with in-state locations offset the avoided transportation risks. It may therefore be difficult to interpret trends by state in risk-based as opposed to equity terms.

Recommendations and Next Steps

- Conduct feasibility analysis on reporting in FY 1992.

- Based on analysis, begin reporting data biannually in FY 1995, consistent with the BRS cycle.

7. TRENDS IN CROSS-MEDIA TRANSFERS

This category of indicators provides data on the transfer of risk among different media and can thus be used to track net risk reductions.

Examples

Trends in quantities of wastewaters discharged to publicly-owned treatment works (POTWs) or surface waters.

Changes in quantities of TRI chemicals released to the air or surface water from reporting entities as a result of source reduction or recycling practices.

Data Availability

BRS does not currently report quantities of hazardous waste that are managed in units exempt from the hazardous waste regulations or that are discharged to POTWs, unless the information is volunteered. No data currently exist on toxic releases associated with recycling processes. The Revised Biennial Reporting regulation, which will go into effect in the 1993 reporting cycle, asks whether the waste was discharged to surface water, or released to air, as a result of waste minimization.

Evaluation

Advantage

- Distinguishes between activities that result in net reductions in risk and those that simply transfer risks to different media.

Disadvantage

- Questionable whether self-reporting on activities that increased emissions to other media would be reliable.

Recommendation and Next Step

- Evaluate TRI data availability and reliability for this indicator.

SUMMARY OF RECOMMENDATIONS AND NEXT STEPS

OSW has identified a number of indicators related to types of waste management and facility monitoring and evaluation that will be reported beginning in FY 1992, based on BRS and RCRIS as data sources. In addition, during FYs 1992-93, OSW will investigate whether additional indicators can be reported, and if changes to BRS and RCRIS are desirable to support expanded indicator data for safe management. OSW will:

- Identify and evaluate specific indicators and investigate data sources for hazardous waste facility design, operating methods, and closure;

- Evaluate the potential for reporting on trends in facility location characteristics, including investigating the potential for defining "safe" locations;

- Assess data availability documenting safe management as a lack of evidence of releases of concern to media (groundwater, soil, surface water, and air); and

- Evaluate the potential for using Section 313 reporting data (the Toxics Release Inventory data) to support safe management indicators.

These investigations will result in a recommended plan of action for data collection and reporting in FY 1993 and beyond.

PROGRAM GOALS AND STATUS

The overall goal of the corrective action program is to prevent or reduce harm to human health and the environment from releases at RCRA-regulated facilities. EPA currently requires corrective action only for Subtitle C (hazardous waste) treatment, storage, and disposal facilities (TSDFs). However, the new rule promulgating the revised criteria for Subtitle D municipal solid waste landfills (MSWLFs), (which was signed on September 11, 1991 and will become effective in two years), will require corrective action for MSWLFs as well. To date, EPA has not proposed any corrective action requirements that would apply to facilities that manage only Subtitle D industrial or special wastes.[8]

The pre-HSWA Subtitle C corrective action program, embodied primarily in 40 CFR Part 264, Subpart F, applies to cleanup of releases to groundwater from land disposal units that received wastes after July 26, 1982 ("regulated units"). The goal is the removal or treatment in place of contaminants present in concentrations above the groundwater protection standard beyond the compliance point. HSWA substantially expanded corrective action authorities for both permitted and interim status facilities. The goal of HSWA section 3004(u) is to require corrective action for all releases of hazardous waste or constituents from any solid waste management unit (SWMU) at any TSDF seeking a permit, regardless of when the waste was placed in the unit. Section 3004(v) applies this same goal to releases beyond the facility boundary, where necessary to protect human health and the environment. The proposed Subpart S rule would provide the regulatory framework for implementing 3004(u) and (v). EPA is revising the current Part 264, Subpart F regulations to ensure consistency with the proposed Subpart S regulations for both regulated units and other SWMUs.

Several documents, in addition to the proposed Subpart S rule, discuss Subtitle C corrective action program goals and priorities. These include the National RCRA Corrective Action Strategy of 1986, the 1989 Corrective Action Outyear Strategy, the 1991 Operating Guidance, and the RCRA Implementation Study (RIS). The major goals and priorities of the Subtitle C corrective action program can be summarized as follows:

- Prioritize the assessment, stabilization, and cleanup of sites based on risk to human health and the environment;

[8]Section 3013 of RCRA authorizes monitoring, analysis, testing, and reporting requirements in the event of a "substantial hazard to human health or the environment" at facilities where hazardous waste has been stored, treated, or disposed. Section 7003 authorizes any actions necessary to protect human health and the environment in the event of "imminent and substantial endangerment to health or the environment" from solid and hazardous waste. For the purposes of this report, actions taken by the Agency under the authority of Sections 3013 and 7003 are not considered part of the corrective action program.

- Stabilize releases to prevent exposure and off-site migration;
- Clean up releases to specified performance standards for long-term remediation;
- Expedite the corrective action process; and
- Increase the use of effective and innovative technologies in remediation.

OSW is in the early stages of implementing the corrective action program for Subtitle C TSDFs. RFAs (i.e., problem assessments) have been completed at 2,264 of 4,541 facilities. OSW estimates that 15 to 20 percent of these facilities have no need for further action at this time. Conversely, an estimated 80 to 85 percent of facilities will need further action. EPA has already imposed RFIs on 37 percent of facilities with RFAs. In addition, 8 percent of facilities with RFAs are controlling contaminant releases.

MESSAGES RELATED TO CORRECTIVE ACTION

EPA managers have identified two important messages to convey to the public about RCRA corrective action:

1. *EPA is identifying and prioritizing problem sites and are addressing the sites with the greatest environmental and health risk first. New sites are incorporated into the system as identified.*
2. *The Agency is taking action to control immediate threats to human health and the environment; further contamination is being prevented; and final cleanup measures are being developed and implemented.*

STATUS OF INDICATORS DEVELOPMENT

The RCRA Corrective Action Environmental Indicators Workgroup reviewed indicators that have been reported or are being studied by the Superfund office and OGWP. The workgroup assessed the relevance of these indicators to the RCRA corrective action program. Indicators that were found to be relevant are included among those discussed in this chapter. However, while it is important to carefully consider indicators that are being developed or reported by other programs, differences among programs in terms of priorities, timing, and the availability of specific types of data can significantly affect the desirability and/or applicability of specific indicators to the RCRA corrective action program.

While OSW has made significant progress in developing indicators for the corrective action program, substantial work is still needed. OSW has identified some indicators that can be reported in FY 1992. However, many of the corrective action indicators will require additional evaluation and/or testing of new methods to collect and report the required data.

EVALUATION OF CANDIDATE INDICATOR CATEGORIES

The RCRA Environmental Indicators Workgroup reviewed six categories of indicators for the corrective action program, listed in Exhibit 5-1. Exhibit 5-1 also shows whether the Superfund program or OGWP is studying (or has reported) indicators in each category, and whether the category contains indicators that participants in OSW's session at the Baltimore Environmental Indicators Workshop

identified as promising. Exhibit 5-1 also shows the environmental message supported by each indicator category.

Each of these indicator categories is discussed below. Included in these discussions are examples of specific indicators, an assessment of data availability, a list of major advantages and disadvantages, and OSW's recommendations for further action.

The discussions of data availability focus on Subtitle C (hazardous waste) facilities only, for two reasons:

- Subtitle D (industrial and municipal solid waste) facilities are not currently required to perform corrective action. The newly-promulgated Subtitle D criteria revisions for municipal solid waste landfills will not become effective until two years from now, and there are no corrective action requirements for the remainder of the Subtitle D universe.

- Although EPA has conducted one-time surveys of Subtitle D facilities (e.g., the Municipal Landfill Survey; the Subtitle D Industrial Facilities Telephone Screening Survey), there are no Subtitle D reporting systems currently in place at the national level. This is because the Subtitle D program is implemented by the states.

Therefore, EPA is not likely to have the capability in the near future to report on any of the indicator categories listed in this section for the Subtitle D universe.

1. NUMBER AND STATUS OF ASSESSMENTS, INVESTIGATIONS AND ACTIONS TO REDUCE RISK AND CONTROL OR CONTAIN RELEASES IMPOSED OR UNDERWAY

This category is made up of indicators that track the status of RCRA facilities in the corrective action program. To demonstrate that EPA is addressing the sites posing the greatest threats first, this status could be tracked separately for sites with different priority rankings (i.e., high, medium, or low priority).

Examples

Number of facilities priority ranked as high, medium, or low.

Number of RFAs and RFIs initiated and/or completed (or number initiated and/or completed at high-priority sites).

Number of facilities where no further action is needed at this time.

Number of facilities/units with releases that have stabilization or remedy implementation measures initiated and/or completed (or number of high-priority facilities with releases stabilized, etc.).

Number of facilities at which the extent of contamination has been defined.

Number of groundwater pump and treat systems in place.

Number of actions taken to treat or remove significant sources of contaminant releases.

EXHIBIT 5-1. CATEGORIES OF CORRECTIVE ACTION INDICATORS EVALUATED BY THE RCRA ENVIRONMENTAL INDICATORS WORKGROUP

Indicator Category	Reporting Timeframe*	Messages Supported**	Source***
1. Number and Status of Assessments, Investigations, and Actions to Reduce Risk and Control, or Contain Releases Imposed or Underway	S	1, 2	• Superfund • Indicators Workshop
2. Number of Facilities (Undergoing Corrective Action) with On-site and/or Off-site Releases	M	1,2	• Superfund • OGWP • Indicators Workshop
3. Quantities of Waste or Contaminated Media Treated, Removed, or Prevented from Spreading	M	2	• Superfund • Indicators Workshop
4. Changes in the Level of Environmental Contamination due to Remedial Activities	L	2	• Superfund • OGWP • Indicators Workshop
5. Exposure to Releases from Waste Management Facilities	L	2	• Superfund • OGWP • Indicators Workshop
6. Health Effects and Environmental Damages Caused by Releases	D	2	

* *Reporting timeframe is based on data availability. S=Short-term; M= Medium-term; L= Long-term; D= Deferred for Future Consideration*

** *Messages Supported:*

1. *EPA is identifying and prioritizing problem sites and are addressing the sites with the greatest environmental and health risk first. New sites are incorporated into the system as identified.*
2. *The Agency is taking action to control immediate threats to human health and the environment; further contamination is being prevented; and final cleanup measures are being developed and implemented.*

*** Superfund means that the Superfund program has reported, or currently reports, indicators in this category. OGWP means that the Office of Ground Water Protection is currently evaluating indicators in this category. Indicators Workshop means that indicators in this category were voted to be the most promising among participants in OSW's session on RCRA indicators at the Baltimore environmental indicators workshop.

Number of actions initiated in geographically targeted areas (e.g., sensitive environments).

Data Availability

Data on the status of Subtitle C facilities in the corrective action pipeline are readily available from RCRIS. RCRIS currently provides reliable data on the number of RFAs, RFIs, and CMSs initiated and completed, and the types of remedies (stabilization and long-term clean-up measures) taken and completed at sites. In FY 1993, facility status (high, medium, low) will be reported as core data to RCRIS. Also in FY 93, RCRIS core data will include "number of facilities where no further action is planned."

For some indicators in this category, data are not currently available in RCRIS (e.g., number of corrective measures completed in different environmental media; number of actions taken to treat or remove significant sources of contaminant releases). As part of the RCRA Environmental Indicators Project, OSW will investigate the resources that would be needed to add these new data elements to RCRIS.

Evaluation

Advantages

- OSW can report on many useful indicators in this category now, using reliable data. The costs associated with reporting on most indicators in this category are very low.
- When translated into environmental messages, these indicators can communicate to the public that problem sites are being identified and addressed first, that actions are being taken to control further migration of existing contamination at those sites, and that permanent remedies are being installed.
- These indicators are easy to aggregate to the Regional or national scale and are useful for demonstrating interim progress.
- These indicators are directly related to the objectives and priorities of the corrective action program.

Disadvantage

- These activity measures do not measure environmental improvements at sites as a result of corrective action.

Recommendations and Next Steps

OSW has data available on selected indicators in this category through RCRIS. When reporting these indicators to the public, it will be important to explain the RCRA corrective action priority-setting system so that people understand that "high-priority" sites are those with the greatest potential risks, and that cleaning up these sites will provide the greatest human health and environmental protection. The

public will also need to be educated about the length of time needed to complete permanent remedies, so they can recognize the important of stabilization in protecting human health and the environment.

For indicators that rely on data not currently reported in RCRIS, OSW will investigate the costs and benefits associated with modifying RCRIS to collect the needed data. If this proves feasible, reporting could begin in FY 1994 or later.

Because indicators in this category are activity measures rather than strict environmental indicators, OSW will also identify and evaluate indicators that communicate information about the environmental results of these activities.

2. NUMBER OF FACILITIES (UNDERGOING CORRECTIVE ACTION) WITH ON-SITE AND/OR OFF-SITE RELEASES

This category of indicators tracks the number of facilities with on-site or off-site releases to groundwater (or other media such as surface water, air, and soil).

Examples

Number and percentage of facilities with releases to groundwater.

Number and percentage of releases that are on-site and off-site.

Data Availability

RCRIS contains voluntarily reported data on general releases. National data concerning on-site and off-site releases are available from a one-time EPA survey done July, 1991. OSW is pursuing the collection of on-site/off-site releases using RCRIS in 1992 with possible reporting beginning in 1993.

Evaluation

Advantages

- By tracking the number of off-site releases (and on-site releases that remain on-site) over time, EPA will be able to measure the success of its stabilization measures.
- Release information is a better indication of the level of risk a facility may pose to human health and the environment than activity measures. In general, off-site releases are more of a concern than on-site releases.

Disadvantage

- Simple reporting of a release does not reflect the severity of that release, nor the number of people exposed.

Recommendations and Next Steps

Pursue the inclusion of on-site and off-site releases in RCRIS. Begin reporting in FY 1993 or beyond.

3. QUANTITIES OF WASTE OR CONTAMINATED MEDIA TREATED, REMOVED, OR PREVENTED FROM SPREADING

This category tracks the volume of waste or contaminated media treated, contained, or removed as a result of corrective action.

Examples

Quantity of clean-up waste managed (treated, contained, removed).

Gallons of groundwater pumped and treated.

Mass of contaminants removed from groundwater.

Data Availability

Data for this category of indicators are not available in RCRIS. BRS provides information on the amount of waste removed as a result of RCRA corrective actions.

Evaluation

Advantages

- These indicators measure the physical actions of EPA, providing the public with something tangible.
- Data are easy to aggregate to the Regional or national scale and are useful for demonstrating interim progress.

Disadvantages

- Simple measures of quantities of wastes treated or removed do not reflect relative risk reduction.
- Indicators lack a reference point to the relative magnitude of the problem (e.g., what is the mass or volume of contaminants remaining to be treated?)

Recommendations and Next Steps

In FYs 1992-93, OSW will assess the feasibility and resources associated with reporting data for these, or other appropriate indicators. If feasible, reporting could begin in FY 1994 or later.

4. CHANGES IN THE LEVEL OF ENVIRONMENTAL CONTAMINATION DUE TO REMEDIAL ACTIVITIES

This category of indicators measures actual changes in environmental quality due to corrective actions, and offers the opportunity to track improvements over time. These changes can be measured and reported using many different types of metrics, such as statistics on pollutant concentrations in the environment, the number or percent of sites with contamination above a level of concern, or the quantity of an environmental medium (e.g., soil, groundwater) contaminated above a concern level. "Concern levels" could be defined using health-based levels (i.e., reference doses or risk-specific doses), MCLs, background, ambient water quality criteria, taste and odor thresholds, etc.

Examples

Median concentrations of contaminants in groundwater, surface water, soil, or air.

Surface area or volume of groundwater contaminated above concern levels.

Number of sites with groundwater contamination.

Number and percent of units with ground-water concentration reductions of a specified level (e.g., 25%, 50%, 75%, and 90%).

Number of units with soil contamination eliminated.

Number of sites with on-site/off-site contamination.

Number of sites with contaminated drinking water supplies.

Data Availability

RCRIS identifies the environmental media to which releases occur but does not provide concentrations of pollutants or comparisons of concentrations to concern levels. Moreover, the identification of environmental media is not currently treated as "core" data in RCRIS, meaning that Regions and states are not required to collect or report it to Headquarters. Facilities with on-site and off-site contamination of groundwater may be reported as core data to RCRIS as early as FY 1993.

A considerable amount of information on contaminant levels in the environment is submitted by facilities to the Regions. However, most groundwater data on permitted Subtitle C land disposal facilities are submitted to the Regions in letter reports which are typically not in an electronic or standardized format.

Some Regions, most notably Region 7, do have groundwater data electronically stored. Region 7 has developed a computer database for electronically managing groundwater data. The Region 7 system (with modifications and enhancements added through Region-wide input) will soon be available to all Regions. Although systems such as this are not currently available in most EPA Regions, a national system such as that used in Region 7 would greatly enhance the feasibility of national reporting in these indicators in the future.

Evaluation

Advantages

- These indicators track and communicate real improvements in environmental quality as a result of RCRA corrective action.
- These indicators can be useful for demonstrating effects of interim progress.
- These indicators are directly related to the environmental objectives and priorities of the corrective action program.

Disadvantages

- Data are not currently available in a format that will enable reporting. Developing or modifying data automation systems and standardized data entry procedures will require a substantial commitment of resources at the Headquarters, Regional, and state levels.
- In some cases, achieving observable reductions in contaminant concentrations (particularly in groundwater) can take years or decades. OSW might not be able to show considerable progress based on this indicator for a long time.
- It is not clear how to aggregate data meaningfully for diverse sets of chemicals.

Recommendations and Next Steps

OSW is not likely to have the capability to report on this category of indicators during the next couple of years. However, OSW considers these indicators to be of high priority, and will therefore work with the Regions in FY 1992 and beyond to determine how to build the necessary reporting capabilities. OSW will use the work currently underway in Region 7 as a starting point for this effort.

5. EXPOSURE TO RELEASES FROM WASTE MANAGEMENT FACILITIES

This category of indicators includes measures of either (1) the number of people exposed to releases, or (2) the number of actions taken to reduce the number of people exposed.

Examples

Number of actions taken to control/remove actual/imminent exposures to contaminated media.

Number of people protected as a result of actions taken to control actual or imminent exposures to contaminated media (e.g., drinking water well closures, provision of alternate drinking water supplies).

Number of people exposed or potentially exposed to contaminated groundwater, surface water, soils, or air.

Percent reduction in actual and potential human health and/or ecological exposures to releases from TSDFs.

Data Availability

Of the above examples, the only indicator for which data are currently available is the first, which is essentially an activity measure reported in RCRIS. Information on the number of people exposed or potentially exposed to contamination, or the number protected as a result of corrective measures, is not available from either RCRIS or the BRS. However, it would be possible to use population data available from GEMS to use with existing RCRA data.

Evaluation

Advantages

- Reporting to the public the number of actions taken to limit human exposure (or, even better, the number of people protected as a result of these actions) is compelling evidence of program success.
- Reporting the number of people protected is an *environmental* indicator rather than an activity measure.
- These indicators are easy to aggregate to the Regional or national level.

Disadvantages

- Data are not currently available in RCRIS or BRS.
- For most types of remedial actions, it will be very difficult for EPA staff or facility owner/operators to estimate the number of people protected.

Recommendations and Next Steps

Although OSW recognizes that there are advantages to be gained by reporting this indicator, OSW does not assign it high priority at this time. In Fys 1992 and 1993, OSW will examine the feasibility and utility of collecting these data and incorporating the data into existing data systems. If OSW proceeds with this indicator, data would be collected in FYs 1993 and 1994, and reporting would begin in FY 1994 or beyond.

6. HEALTH EFFECTS AND ENVIRONMENTAL DAMAGES CAUSED BY RELEASES

This category of indicators measures the extent to which corrective action reduces human health and environmental damages resulting from releases at RCRA facilities.

Examples

Incidence of adverse human health effects in communities located adjacent to RCRA facilities.

Health of ecosystems (measured in terms of such factors as species diversity) near RCRA sites.

Data Availability

This information is not tracked in RCRIS or BRS, nor is it collected as part of the corrective action process. It is very difficult to establish a link between observed human health or environmental effects and releases from specific sites.

Evaluation

Advantage

- These indicators reflect the ultimate *environmental* benefits of RCRA corrective action.

Disadvantages

- It is very difficult to link data on human health effects or environmental damages to releases from RCRA facilities.
- This information is difficult to aggregate at the Regional and national levels.
- Data are not currently available. Given the difficulties associated with attributing observed health or environmental effects to releases from RCRA facilities, reliable information is not likely to become available in the years to come.

Recommendations and Next Steps

Given the significant problems associated with reporting this category of indicators, OSW is assigning it low priority and has deferred further consideration at this time. OSW will reassess the desirability and feasibility of reporting on these indicators over the long term.

SUMMARY OF RECOMMENDATIONS AND NEXT STEPS

OSW has identified some indicators that can be reported beginning in FY 1992, based on information already available in RCRIS. These are indicators related to the status of facilities in the corrective action pipeline.

Starting in FY 1992 and continuing in the years to come, OSW will place high priority on assessing the feasibility of reporting on additional indicators. OSW's activities will include the following:

Evaluating the resources and desirability associated with modifying RCRIS to provide the following types of information:

Additional detail on the corrective action status of facilities (such as the number of corrective measures completed for each environmental medium); and

Quantities of waste or contaminated media treated or removed.

- Working with the Regions to assess the feasibility of developing computerized systems to automate groundwater monitoring data and to standardize data entry format. Efforts currently underway in Region 7 will serve as a case study.

- Examining the feasibility of collecting data on the following categories of indicators:

  - Achievement of health and environmental goals set for individual facilities; and

  - Exposure to releases.

OSW is assigning low priority to the remaining indicator category -- health effects and environmental damages caused by releases -- because of severe difficulties associated with collecting reliable data for these effects and linking the effects to releases from RCRA facilities. OSW will reassess the utility and feasibility of these indicators over the long term.

INTRODUCTION

The previous three chapters have identified categories of indicators for the waste minimization, safe management and clean-up goals of RCRA, and made recommendations for further action. The recommendations address categories of indicators -- more work is needed to define specific indicators, assess the availability of data to support specific indicators, collect data where available, and report and interpret the indicators. OSW and the Workgroup have completed sufficient review of the indicator categories to establish priorities for this further work, based on the merits of each category and the likely availability of data to support indicators in the short-, medium-, and long-term. This chapter describes OSW's plans for further development and implementation of RCRA indicators.

TASKS AND SCHEDULE

OSW has assigned indicators to one of three implementation phases, based on the availability of data for reporting:

- **Short-term:** indicators which can be reported with available data in 1991-1992;
- **Medium-term:** indicators for which data exist, but additional time is required for data compilation, review, and analysis;
- **Long-term:** indicators which cannot be reported because data are either not presently collected, or are not readily accessible. OSW anticipates that it will take at least two to five years before reporting can begin.

In addition to reporting short-term indicators OSW, in cooperation with the Workgroup, will conduct further analysis to identify and evaluate indicators for the medium and long term. Specific activities are summarized in the chart at the end of this chapter and are discussed below. Note that activities falling under short-, medium-, and long-term indicators are in some cases undertaken concurrently, especially preliminary assessment activities. The plan is for the Workgroup to break down into smaller teams to better manage these activities.

Short-Term Indicators

In January of 1992, OSW submitted data summaries, analyses, and graphics on select RCRA short-term indicators to be included in the Agency-wide environmental indicators draft report prepared for the Deputy Administrator by EPA's Office of Policy, Planning and Evaluation. Tasks remaining in 1992 include: reconvening the RCRA Environmental Indicators workgroup to sort roles and

responsibilities for future indicators analysis; finalizing the draft environmental indicators report for the Deputy Administrator; identifying additional short-term indicators which can be reported using existing data; and identifying a "short list" of medium-term indicators and beginning preliminary data assessment of these indicators. In December of 1992, OSW will complete a FY92 RCRA Environmental Indicators Progress Report.

Medium-Term Indicators

Although data generally exist for the medium-term indicators in sources such as RCRIS and BRS, additional time is needed to compile, review, and analyze the data. From 1992 to 1993, OSW, in conjunction with the Workgroup, will refine and establish priorities for the medium-term indicators and will conduct assessments of data quality and interpretation.

From February 1992 through June 1992, the Workgroup will review and evaluate potential medium-term indicators for each of the indicator categories under the three goals, and will identify which indicators have the most merit. From June through September, OSW will assess the availability and quality of data for the selected priority indicators. In December 1992, the Workgroup will prepare a draft report on the results of this effort, and will outline a proposal for reporting on these indicators in 1993 and beyond.

Long-Term Indicators

The long-term category represents indicators for which data are not presently available for one or more of the following reasons: (1) data have not been routinely collected (for example, survey data); (2) data have not been consistently collected using standard methodologies; (3) the data that have been collected (for example, RCRA land disposal facility groundwater monitoring data) may not be automated to make the data readily accessible; or (4) data on potential indicators have not yet been collected, as is the case in the municipal and corrective action programs.

In 1992, categories of indicators under the three goals will be refined, and one or two potential indicators will be identified for each of the categories. Once this is accomplished, the Workgroup will examine the feasibility and utility of acquiring the data to support reporting of long-term indicators. This evaluation will consider technical issues, such as whether the data are already collected in some form, or if new collection efforts are needed. Data management, compatibility with existing information management systems, costs, and resource burden will also be addressed. By December 1992, OSW will prepare a prioritized list of potential long-term indicators and will prepare a report outlining the plan for data assessment and collection. The report will also include recommendations for data management and reporting.

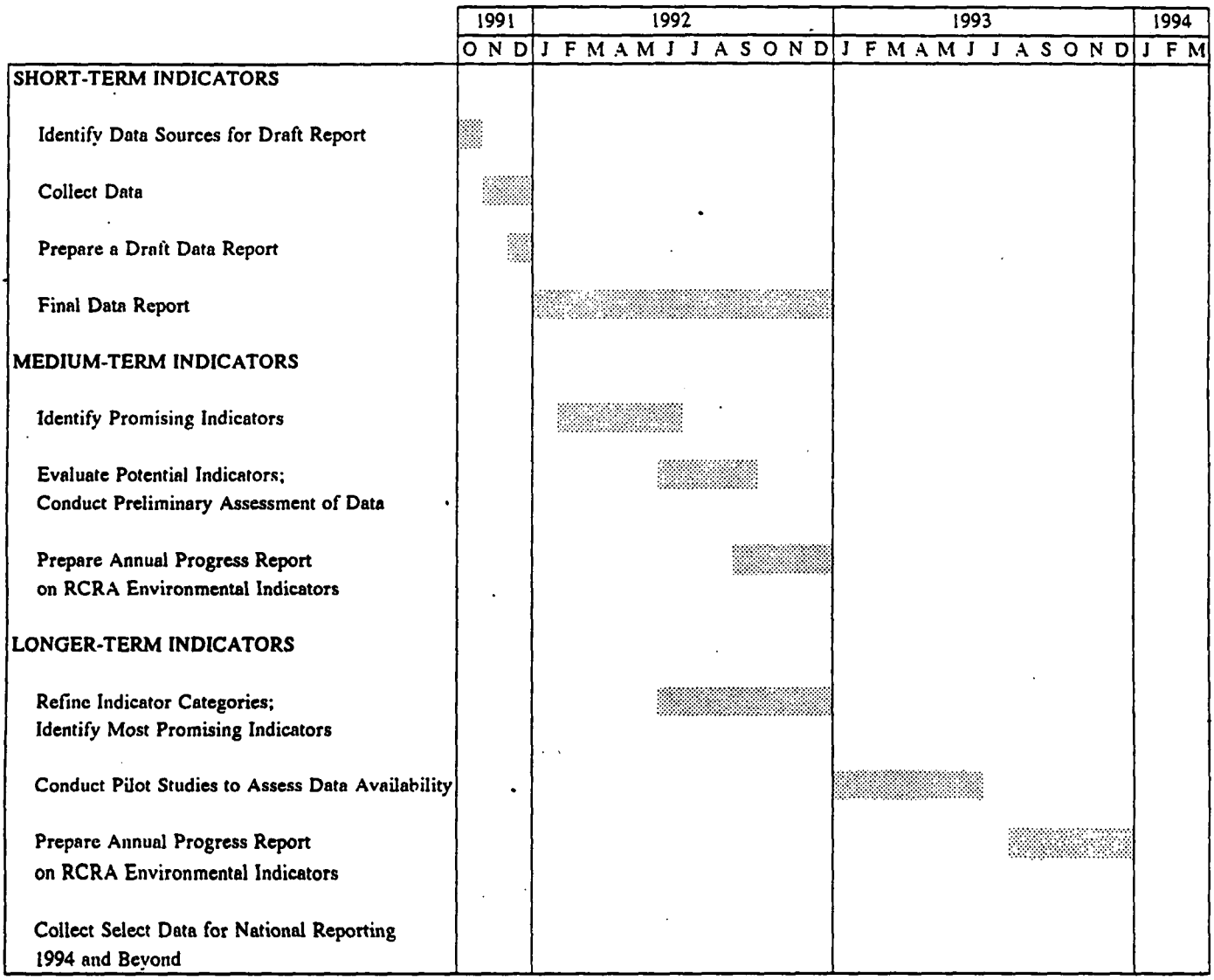
In 1993, OSW, in conjunction with the Workgroup, will initiate pilot studies to assess data availability for one or two selected indicators. "Lessons learned" from the data collection and analysis of the medium-term indicators will weigh heavily in selecting an appropriate methodology for data collection for the long-term indicators. In December 1993, the Workgroup will prepare a draft report on the results of this effort for the selected indicators and, if appropriate, will outline a proposal for national reporting of RCRA long-term indicators in 1994 and beyond. In subsequent years, the same process will take place for additional indicators.

WORKGROUP PROCESS AND RESPONSIBILITIES

The RCRA Environmental Indicators Workgroup, formed in August 1991 and expanded to include state representatives, will play a major role in the development and implementation of RCRA indicators. The workgroup as a whole will be asked to provide input on the definition of "indicators" and on setting priorities for data collection, assessment, and reporting. In addition, subgroups of the workgroup will be assigned responsibility for specific tasks, including tasks related to data assessment and development of messages to be supported by indicators.

OSW will prepare an annual RCRA Environmental Indicators progress report, summarizing results of short-term, medium-term, and long-term efforts, and discussing future work. OSW's Communication, Analysis and Budget Division (CABD), will have lead responsibility for developing RCRA indicators, including coordination of the Workgroup's efforts. The Regulatory Analysis Branch and the Information Management Branch of CABD will share responsibility for this effort.

IMPLEMENTATION SCHEDULE FOR RCRA ENVIRONMENTAL INDICATORS



REFERENCES

EPA. "EPA's Environmental Progress Report: Strategies, Goals, and Environmental Results." January 1992.

EPA/OPPE. "Environmental Indicators Vision Statement." ERFB. July 1991.

EPA/OPPE. Concept Paper: "Environmental Indicators and Activity Measures in the Management System." Environmental Results and Forecasting Branch, Office of Policy Planning and Evaluation (OPPE). August 1990.

EPA/OPPE. "Environmental Indicators for Strategic Plans, and Their Relationship to Risk Analysis." Environmental Results and Forecasting Branch. January 1990.

EPA/OPPE. "A Proposal for Developing National Environmental Indicators." Environmental Results and Forecasting Branch. February 1989.

EPA/OPPE. "The Use of Indicators in Strategic Planning." Management Systems Division. January 1986.

EPA/OSW. "Characterization of Municipal Solid Waste in the United States, 1990 Update." EPA/530-SW-90-04. June 1990.

EPA/OSWER. "The Nation's Hazardous Waste Management Program at a Crossroads. The RCRA Implementation Study." July 1990.

Versar, Inc. "Development and Use of Indicator Statistics to Track the Progress of the RCRA Program." Prepared for EPA/OSW. March 1989.

APPENDIX A

SUPERFUND INDICATORS

ENVIRONMENTAL INDICATOR FACT SHEET

CURRENT STATUS: Superfund environmental indicator (EI) data portray cleanup progress at both NPL and non-NPL sites in terms of 3 indicators:

1. **Reducing Immediate Threats: Controlling Threats to People and the Environment**
2. **Progress Toward Permanent Cleanup Goals**
3. **Bringing Technology to Bear: Removing Contamination from the Environment**

The second EI report, "Superfund: Reporting On Progress Through Environmental Indicators, FY 1991 Update," is expected to be published in November 1991 and will portray program progress through December 1990. The report will show that:

1. **Reducing Immediate Threats: Controlling Threats to People and the Environment**

   - Actions are taken to reduce risk at sites whenever there is an imminent threat to human health and the environment.
   - Superfund has completed actions to reduce immediate threats at 1,760 NPL and non-NPL sites.
   - At the 507 NPL sites where actions have been completed, the potential risks posed by exposure to hazardous waste have been reduced for 23.5 million people who live in a 4 miles radius.
   - A population (450,000) equivalent to that of Atlanta, Georgia has been provided with a safe alternative water supply.
   - A population (30,000) equivalent to a near-capacity crowd at Boston's Fenway Park has been relocated from site's posing immediate risks.

2. **Progress Toward Permanent Cleanup Goals**

   Long-term (permanent) cleanup goals established for a site ensure that the site is protective of human health and the environment both now and in the future.

   - Achieving long-term cleanup goals for sites posing problems that were decades in the making is an incremental process. Just as the cleanup of our rivers occurs years after sewage treatment plants are constructed, progress toward Superfund's site cleanup goals occurs incrementally over time.
   - The surface is now clean at 196 NPL sites; and

373 NPL sites have completed actions resulting in progress toward permanent cleanup (e.g., achieving long-term health and environmental goals).

3. **Bringing Technology to Bear: Removing Contamination from the Environment**

   - o Over 54% of NPL sites with Progress Toward Permanent Cleanup have used treatment technologies.

   - o Superfund is increasing its use of treatment technologies - in 1990, 79% of the remedies selected to control the source of contamination included treatment technologies.

   - o Superfund has handled large quantities of waste in its cleanup activities. Wastes handled to date include:

     - -- Nearly 13 million cubic yards of contaminated soils and other solid wastes, a volume which would cover a football field more than a mile high;

     - -- Over 6 billion gallons of groundwater, enough to provide the population of New York City their drinking water from nearly 5 years;

     - -- Over 1 billion gallons of liquid wastes, or 4 gallons for every person in the United States; and,

     - -- Over 300 million gallons of surface water, or 1 gallon for every person in the United States.

DEVELOPMENTAL WORK: Superfund continues to investigate the feasibility of implementing additional environmental indicators beyond the three that are currently in use. The indicators undr investigation include measures of population protected, the ecological benefits and contaminant concentraton reduction. Other potential enhancements include use of a Geographic Information System (GIS) to refine the precision of exisiting population estimates and to determine population characteristics such as ethnic and socio-economic groups. (GIS) may also be used to identify and characterize environmental resources potentially threatened by Superfund sites. Recommendations about the feasibility of implementing ecological and contaminant reduction indicators will follow the results of two Regional pilot studies, the results of which will be released in October. Recommendations about the overall use and development of Superfund environmental indicators will follow the formation of an OERR EI workgroup in FY 92.

APPENDIX B

RCRA GROUND-WATER INDICATORS IDENTIFIED AS "PROMISING" BY PARTICIPANTS IN OSW SECTION OF OPPE ENVIRONMENTAL INDICATORS WORKSHOP IN BALTIMORE

GROUND-WATER INDICATORS IDENTIFIED AS "PROMISING" AT RCRA SESSION OF ENVIRONMENTAL INDICATORS WORKSHOP IN BALTIMORE

1. Areal extent of ground-water contamination (VOC, priority pollutants, Appendix 9 constituents, MCLs, background)

2. Number of sites with ground-water contamination in areas that are potential supplies of drinking water

3. Number of sites or units where the corrective measures study (CMS) has been achieved

   - With on-site contamination
   - With off-site contamination
   - With off-site contamination to drinking water

4. Number of sites/units with releases that have corrective actions imposed

5. Number of people/industrial users/ecosystems exposed or potentially exposed to ground-water contamination [this was controversial because some representatives of sparsely populated Regions felt that they would be denied resources based on this indicator]

6. Number of units by phases of ground-water monitoring

   - Detection
   - Compliance

7. Reduced biological hazard

8. Mass of volatiles removed from ground water

9. Degree of aquifer restoration

10. Reduction in concentration of contaminants in ground water

11. Number of sites/units with risks to the maximally exposed individual (MEI) greater than 10^{-4}, 10^{-5}, 10^{-6}

APPENDIX C

RCRA ENVIRONMENTAL INDICATORS WORKGROUP

LIST OF PARTICIPANTS

RCRA ENVIRONMENTAL INDICATORS
WORKGROUP MEMBERS
HEADQUARTERS

		PHONE	MAILCODE
Loretta Marzetti	CABD	260-9394	OS-310
Barnes Johnson	CABD	260-4500	OS-311
Sara Rasmussen	CABD	260-3409	OS-311
Myra Galbreath	CABD	260-4744	OS-312
Kevin Phelps	CABD	260-2220	OS-312
Tricia Henry	CABD	260-5235	OS-312
John Fogarty	CABD	260-7922	OS-312
Jim Lounsbury	MISWD	260-4807	OS-301
Ellen Pratt	MISWD	260-7597	OS-301
Ambika Bathija	CAD	260-7438	OS-333
Monica Barron	CAD	260-6977	OS-331
Carolyn Loomis	PSPD	260-7801	OS-341
Vern Myers	PSPD	260-4685	OS-341
Peter Feldman	PSPD	260-6657	OS-343
Janice Johnson	OSW	260-7559	OS-301
Rose Lew	OWPE	260-6720	OS-520
Karen Milne	OWPE	260-8286	OS-520
Debbie Villari	OWPE	260-1787	OS-520
Diane Niedzialkowski	OPPE/CABD	260-3388	PM-222A
Ed Weiler	OPPE	260-2996	PM-222B
John Sager	IMB	260-5029	OS-312
Fred Chanania	OSW	260-3098	OS-300
Jim Brown	PSPD	260-3240	OS-341
Jim Craig	OPPE	260-4168	PM-222B
Jim O'Leary	CABD	260-9391	OS-310
Robin Heisler	OGWP	260-7770	WH550-G
Donna Perla	WMD	308-8402	OS-320W
Mike Taimi	WMD	308-8440	OS-321
Patricia Whiting	WMD	308-8421	OS-323W
Robert Burchard	PSPD	308-8450	OS-321
Jackie Tenusek	CPB	308-8482	OS-321W
Susan Absher	OSWER	260-4510	OS-110
Dick McDermott	OGWDW	260-2438	WH-550G

RCRA ENVIRONMENTAL INDICATORS
WORKGROUP MEMBERS
EPA REGIONS

	NAME	FTS PHONE	FTS FAX NUMBER
II	* Agathe Nadai	264-1015	*264-2613*
	Zintars Zadins	264-5996	*264-7613*
		(Commercial #)	212/264-7613*
	* Barbara Pastalove	264-3052	264-8100
III	* Peter Bently	597-7188	215/580-2013
IV	* John Lank	257-7603	257-5205
V	* Rich Traub	886-6136	886-9096
	Susan Swabs		
	Walt Francis		
VI	* Guy Tidmore	255-6794	255-6460
	Henry Onsgard	255-6750	255-6460
	Keith Phillips		
VII	* William Pedicino	276-7629	276-7467
IX	Herb Levine	484-2314	484-1916
	* Chris Prokop	484-2045	484-1916
	Bill Wilson		
	Rebecca Smith		
X	* Susan Hutcherson	399-2852	399-0124
	Claire Rowlett		
	David Tieter		

* = Lead contact

STATE CONTACTS:

New Jersey:

Frank Coolick
Assist. Dir. Haz. Waste Reg.
Department of Environmental Protection
Division of Hazardous Waste Management
401 E. State Street - 5th Floor East
Trenton, NJ. 08625

609/633-1418
609/633-1454 (fax)

Georgia:

Jennifer R. Kaduck
Program Manager
Environmental Protection Division
Georgia Department of Natural Resources
Floyde Tower East, Suite 1154
205 Butler Street, S.E.
Atlanta, GA 30334

404/656-7802
404/651-9425 (fax)

Louisiana:

Peter Romanowsky
Deputy Assistant Secretary
Department of Environmental Quality
Office of Solid and Hazardous Waste
Post Office Box 82178
Baton Rouge, Louisiana 700884-2178

504/765-0355
504/765-0617 (fax)

Oregon:

Stephanie Hallock
Oregon Department of Environmental Quality
811 Southwest 6th Avenue
Portland, OR 97204

503/229-5356
503/229-6124 (fax)

CONTRACTORS	PHONE	FAX NUMBERS
Nancy Hammett Industrial Economics, Inc. 2067 Massachusetts Ave. Cambridge, MA 02140	617/354-0074	617/354-0463
Joanne Colt ICF, Inc. 9300 Lee Highway Fairfax, VA 22031-1207	703/934-3284	703/218-2668

APPENDIX D

RCRA ENVIRONMENTAL INDICATORS WORKSHOP, SEPTEMBER 1991

LIST OF PARTICIPANTS

STATE REPRESENTATIVES

Bet Flores
Connecticut Department of
Environmental Protection
20 Trinity Street
Hartford, CT 06109
(203) 566-5369
FAX: (203) 566-5255

Frank Coolick
Assistant Commissioner
Hazardous Waste Management
New Jersey Department of
Environmental Protection
401 East State Street
Trenton, NJ 08625
(609) 633-1418

Philip Retallick
Director
Division of Air and Waste Management
Delaware Department of Natural
Resources and Environmental Control
89 Kings Highway
P.O. Box 1401
Dover, DE 19903
(302) 739-4764

Jennifer Kaduck
Hazardous Waste Branch
Georgia Environmental Protection
Division
Room 1154E
205 Butler Street
Atlanta, GA 30334

Bill Radlinski
Illinois Environmental Protection
Agency
2200 Churchill Road
Springfield, IL 62706
(217) 782-9898

Michael Savage
Assistant Chief
Division of Solid and Hazardous
Waste Management
Ohio EPA
1800 Watermark Drive
P.O. Box 1049
Columbus, OH 43266-0149

Peter Romanowsky
Acting Administrator
Hazardous and Solid Waste Division
Louisiana Department of
Environment Quality
P.O. Box 44307
Baton Rouge, LA 70804

Dennis Downs
Director
Solid and Hazardous Waste Programs
288 N. 1460 W.
P.O. Box 16690
Salt Lake City, UT 84116-0690

Ted Rauh
Department of Toxic Substance Control
P.O. Box 806
Sacramento, CA 95812-0806

Tom Haton
Solid and Hazardous Waste
Management Division
Washington Department of Ecology
Olympia, WA 98504
(206) 459-6316

REGIONAL REPRESENTATIVES

Frank Ciavattieri
Deputy
Hazardous Waste Division Director
U.S. EPA Region 1
John F. Kennedy Federal Building
One Congress Street
Boston, MA 02203
FTS-833-1770

Agi Nadai
Hazardous Waste Facility Branch
U.S. EPA Region 2
26 Federal Plaza
Room 1038
New York, NY 10278
FTS-264-1015

Steve Smagin
U.S. EPA Region 3
841 Chestnut Building
Philadelphia, PA 19107
FTS-597-9492
FAX: FTS-597-3150

Beth Rolle
Lead Region Coordinator
U.S. EPA Region 4
345 Courtland Street, NE
Atlanta, GA 30365
Ms. Rolle

Tricia Herbert
RCRA Waste Branch (RCRA-2)
U.S. EPA Region 4
345 Courtland Street, NE
Atlanta, GA 30365

John Dickenson
Chief
Waste Compliance Section
RCRA Federal Facility Branch
(RCRA-2)
U.S. EPA Region 4
345 Courtland Street, NE
Atlanta, GA 30365

Sally Swanson
RCRA Program Management Branch
5-HR-13
U.S. EPA Region 5
230 S. Dearborn
Chicago, IL 60604
FTS 353-8512

Guy Tidmore
U.S. EPA Region 6
First Interstate Bank Tower
at Fountain Place
12th Floor
1445 Ross Ave.
Dallas, TX 75202

Bill Pedicino
Chief
Hydrogeology Section
U.S. EPA Region 7
726 Minnesota Ave.
Kansas City, KS 66101
Mr. Pedicino

Terry Anderson
Chief
Hazardous Waste Branch
U.S. EPA Region 8
999 18th Street, Suite 500
Denver, CO 80202-2405

David Schaller
Chief
Solid Waste Section
U.S. EPA Region 8
999 18th Street, Suite 500
Denver, CO 80202-2405

Karen Schwinn
RCRA Enforcement Branch Chief
U.S. EPA Region 9
75 Hawthorne Street (H-4)
San Francisco, CA 94105
FTS-484-2120

Betty Weise
U.S. EPA Region 10
1200 6th Ave. (HW-105)
Seattle, WA 98101
FTS 399-2808

HEADQUARTERS REPRESENTATIVES

Jeffrey Denit
OSW-OS-300
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4627

Loretta Marsetti
CABD-0S-310
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-2791

Jim O'Leary
CABD-OS-305
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4743

Sara Rasmussen
CABD-OS-311
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-3409

Myra Galbreath
CABD-OS-312
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4744

Kevin Phelps
CABD-OS-300
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-9391

Tricia Henry
CABD-OS-300
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-9391

Patty Catherwood
CABD-OS-300
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-9391

Debbie Villari
OWPE-OS-520
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-7787

Karen Milne
OWPE-OS-520
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-7787

Liz LaPoint
CAD-OS-330
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4637

Jim Lounsbury
MISWD-OS-302
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4807

Jim Brown
PSPD-OS-321
U.S. EPA Headquarters
401 M Street, N.E.
Washington, D.C. 20460
(202) 260-7240

Carolyn Loomis
PSPD-OS-321
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-7240

Dick McDermott
OGWP-WH-547
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-6742

Kim Devonald
OPPE-PM-222A
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4900

Diane Niedzialkowski
OPPE-PM-222A
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4906

Stan Laskowski
OPPE-RM-222A
U.S. EPA Headquarters
401 M Street, S.W.
Washington, D.C. 20460
(202) 260-4900

FACILITATORS

Jeff Kable
MNG
1600 Wison Blvd.
Suite 1200
Arlington, VA 22209
(703) 516-9100

Vern Myers
U.S. EPA
PSPD-OS-321
401 M Street, SW
Washington, D.C. 20460
(202) 260-6671

Scott Nonken
MNG
1600 Wison Blvd.
Suite 1200
Arlington, VA 22209
(703) 516-9100

Donna Perla
U.S. EPA
WMD-OS-311
401 M Street, SW
Washington, D.C. 20460
(202) 260-4792

Patty Schafer
MNG
1600 Wison Blvd.
Suite 1200
Arlington, VA 22209

Ann Price
PSPD-OS-341
U.S. EPA
401 M Street
Washington, DC 20460
(202) 260-6725

Amy Morasco
MNG
1600 Wison Blvd.
Suite 1200
Arlington, VA 22209
(703) 516-9100

Sonja Cohen
Technical Resources, Inc.
3202 Tower Oaks Blvd.
Rockville, MD 20852
(301) 231-5250

Shirley Banks
Technical Resources, Inc.
3202 Tower Oaks Blvd.
Rockville, MD 20852
(301) 231-5250

Debra Steward
Technical Resources, Inc.
3202 Tower Oaks Blvd.
Rockville, MD 20852
(301) 231-5250