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EPA
United States
Environmental Protection
Agency

Region 3
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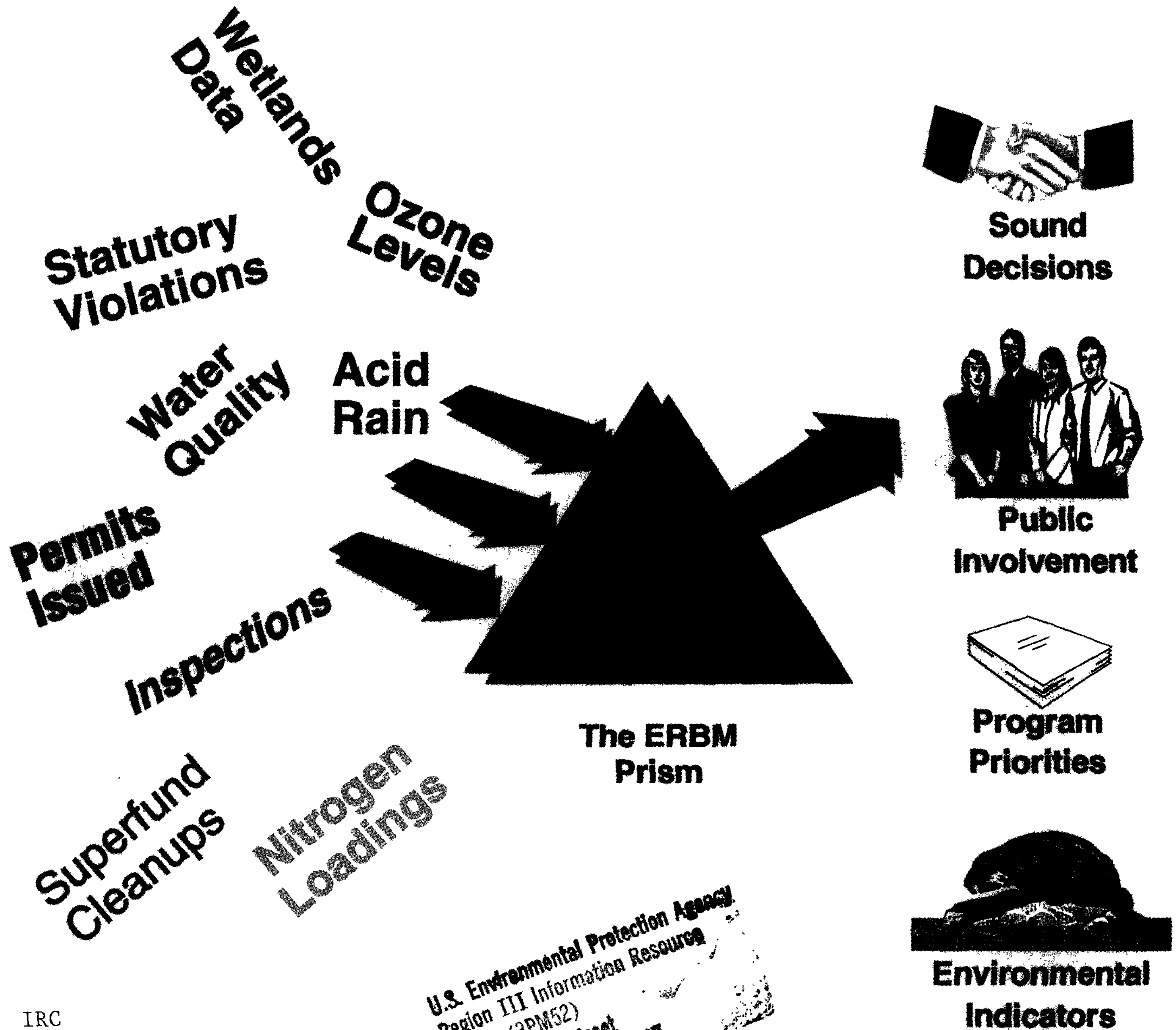
Environmental Results Based Management



in the Mid-Atlantic Region

Introduction

Region III - the Mid-Atlantic Region

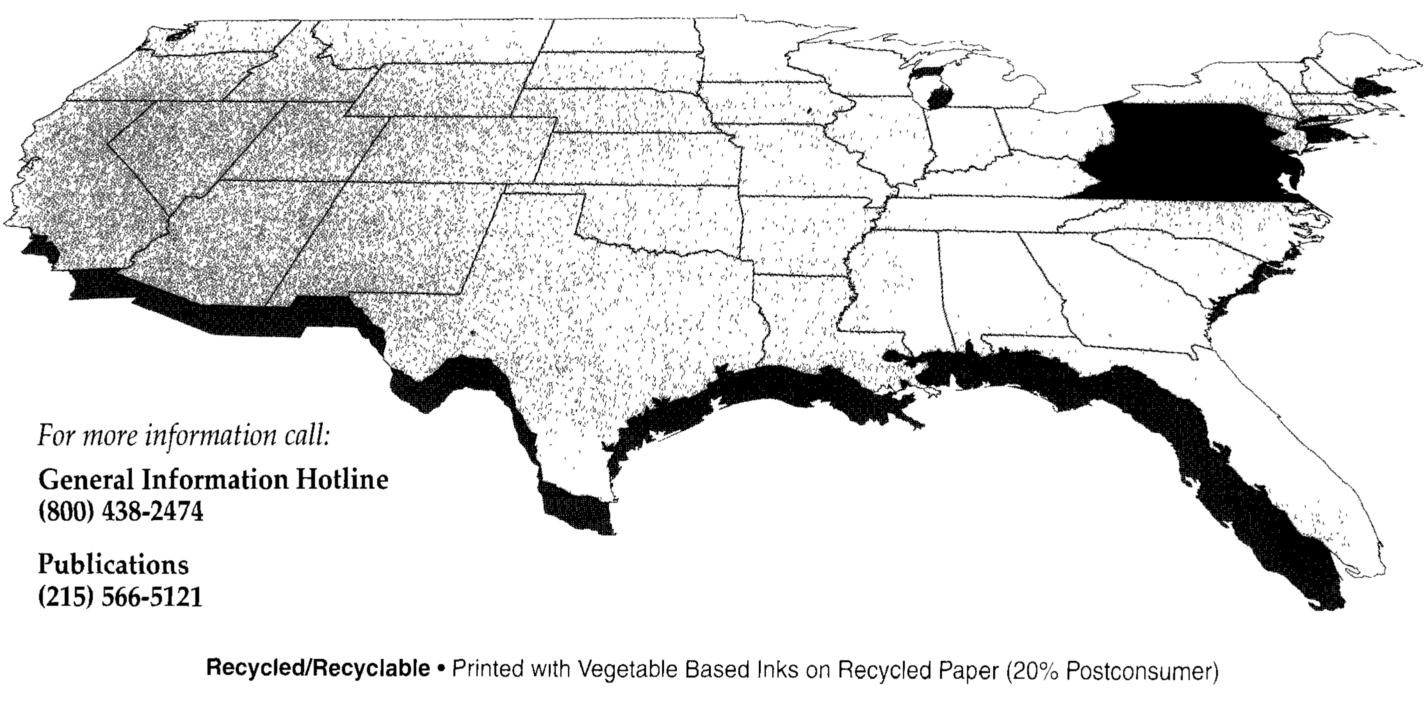
EPA's Region III, the Mid-Atlantic Region, contains examples of most of the Nation's ecological regions. It has a microcosm of the nation's major ecosystems, where only deserts and arid plains are virtually unrepresented. This diverse area, which includes the states of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia, as well as the District of Columbia, was one of the first settled in the country. It supports a varied and intense agriculture, and is the center of the original industrialized area of the United States.

Because of its history, the Mid-Atlantic Region faces significant environmental challenges. Water high in acid seeps from abandoned coal mines. Auto exhaust forms smog on warm summer days. Agricultural runoff pollutes rivers and streams. Development threatens vital habitats. Acid rain is deposited on fragile upland habitats and adds nutrients to the Chesapeake Bay.

For more than 25 years, EPA's Region III staff has been at the forefront of the effort to find balance between protecting the environment and recognizing the importance of a strong economy.

One of EPA's most important needs is ***sound data*** to form the basis for the delicate and complex decisions that must be made every day to maintain that balance.

This report is the first of a two-volume study of how Region III collects, analyzes, and uses data to make decisions. This volume presents an overview of the techniques we have developed to improve the quality of our decisions and the data behind them. Volume II, which will be prepared during 1997, will contain more detailed information than can be included here.



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Greetings from the Regional Administrator

EPA is charged with protecting the nation's public health and environment by enforcing a number of major environmental statutes, including, among others, the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Superfund Laws. For many years, our basic approach was a regulatory one; we looked no further than the requirements of the acts and tried to meet our broad charge by maximizing enforcement under the acts.

Over time, it became clear that we were placing too much emphasis on the regulatory process and not enough for the end product - the condition of the environment. When we realized that our initial approach was not getting the results we needed, EPA began to adopt approaches that focused on environmental improvement. Many of the techniques we developed did not take a regulatory approach, and did not concentrate on industrial sources to the exclusion of other potential sources of pollution.

In Region III, we call our particular approach ***Environmental Results-Based Management, or ERBM.*** Using ERBM means that we focus on environmental end points and adapt our program activities to achieve these end points. Sound data is essential to the ERBM approach.

EPA, like most governmental agencies, is inundated with large volumes of diverse data every year. In the ERBM approach, we redefine out data needs, analyses, and uses to serve our new program objectives.

The purpose of this report is to introduce you to the ERBM concept, to explain the data needs and approaches that we use in ERBM, and to give you a flavor of the breadth and depth of Region III's ERBM activities through a series of case studies. A later volume on ERBM is also planned; aimed at a more technical audience, it will provide more detailed information.

Last year at this time, we produced a report, **Our Mid-Atlantic Environment: 25 Years of Progress**, which focused on the state of Region III's environment on EPA's twenty-fifth anniversary. It has been well received. I hope that you will find this report as useful and interesting.

W. Michael McCabe
Regional Administrator

Philadelphia, PA
December, 1996

Using Environmental Data to Make Decisions

An important part of ERBM is understanding the different types of data and the relationship between them. Figure 1, *"EPA's Continuum of Measures,"* is a schematic representation that EPA has developed to define the types of information we have available to us and the relationships between them. The *Continuum* classifies six levels of data that EPA collects about environmental protection activities and their impacts.

The foundation or base level is resource and support. This includes staff, contract and grant dollars, legislation, public opinion, staff morale, and all of the other tangible and intangible resources that help EPA accomplish its mission. The base level is not considered to be part of the continuum.

- *The first level or type of information includes activities by EPA and state/local environmental agencies. This is in the form of permits issued, inspections undertaken, enforcement actions initiated, etc. It is the most readily available data.*

- *The second level includes actions taken by sources of pollution. This consists primarily of reports from major permitees which are industrial facilities that have emissions to the air and/or water.*

- *The third level includes measures of emissions by sources. There are several types of information here. One is the measure of air and/or water pollutants by permitted industrial facilities. A second is the estimate of hazardous material released based on industry reports to the Toxic Release Inventory (TRI). The third major type of information is estimates of significant pollutant loadings that do not come from specific facilities. For example, run-off from agriculture, vehicular emissions, and annual estimates of soot from forest fires are significant factors.*

- *The fourth level includes measures of ambient pollutant loadings. EPA has a sound data base for major air and water pollutants that goes back more than twenty years in some cases. However, the scope of data is limited to a relatively small number of major pollutants.*

- *The fifth level includes uptake of pollutants by organisms and ecosystems. Information here is frequently limited to laboratory analysis. Field tested data is difficult to develop.*

- *The sixth level consists of actual environmental or human health impacts or conditions. Most of our analysis is based on laboratory analyses and case-studies used to set standards. Collecting actual data for many impacts is very expensive and time-consuming.*

The point of the Environmental Results-Based Management approach is to use the best and most appropriate data available to make sound decisions. This data is drawn from all levels on the continuum. All of EPA's programs also strive to improve the quantity and quality of the data at each level on the continuum, so that future decisions will be based on better data.

Region III uses a model based on "input," "output," and "outcome" to classify and analyze data. "Inputs" are the types of actions that EPA can influence. "Outputs" are the direct results of the inputs, and "outcomes" are the ultimate changes that occur as a result of the outputs.

For example, "EPA/State Activities" are inputs to the pollution control process. "Actions by sources" and "emissions/discharge quantities" are outputs (the direct result of the inputs). "Ambient Levels," "Uptake /Body Burden," and "Health/Ecological Effects" are outcomes in this example.

Usually the data gaps occur at Levels 4 (measures of ambient pollutant loadings), 5 (uptake of pollutants by organisms and ecosystems), and 6 (actual environmental or human health impacts or conditions). The emphasis on developing data at these levels is an important long-term goal. However, as the case studies that are discussed in this report demonstrate, data at all levels of the continuum are valuable and useful.

Another common data gap is the availability of data at the local level. Many environmental standards are set by using exhaustive studies of particular problems in particular localities. When Region III and its states work to evaluate the success of their control efforts, they need to monitor local conditions and gather local data. Recent attempts by Region III to go beyond long-established national data sets has shown that it is difficult and expensive to generate new data. This further illustrates the importance of making optimum use of existing data using the ERBM approach.

The activities included in this report are presented as a series of case studies, beginning with the Chesapeake Bay Program. Case studies provide one of the best ways to explain how and what was done to respond to real problems. Other case studies address acid pollution activities, ozone pollution efforts, program-specific efforts, and the ways in which we gather and manage information.

The Chesapeake Bay Program has modified the continuum to better express its objectives. The case study from the Bay Program includes its environmental indicators based on the customized version of the general continuum presented here.

Later, in the section on "Environmental Indicators Development," we present an adaptation of the continuum which we call the Logic Model. The Logic Model is a planning tool that allows us to start with a desired environmental result and work to identify the programs and activities that we should undertake to achieve the desired result.

Each case study describes how the use of data guides decision-making. It describes how data help us to set priorities. This report documents situations where Region III has successfully used environmental data to set priorities, how we have used environmental indicators to measure progress toward established environmental goals, and how we base the management of our programs on these goals.

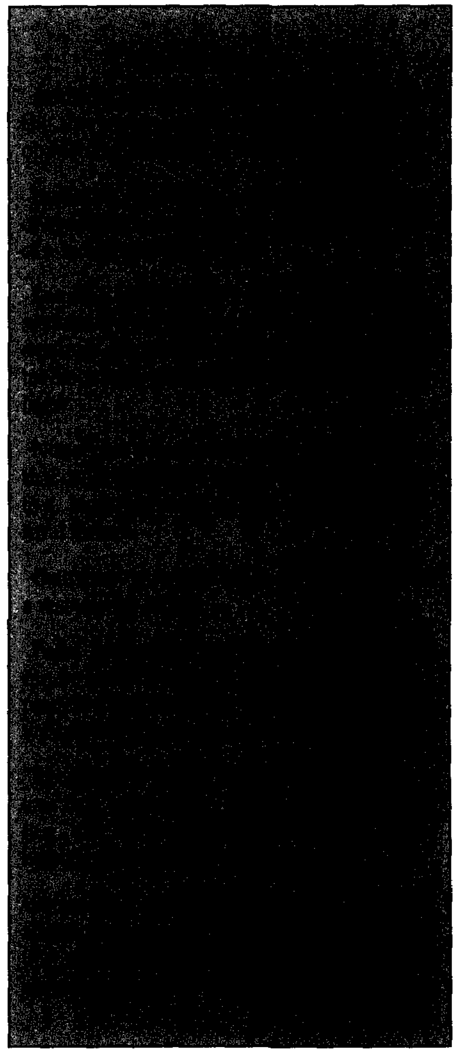
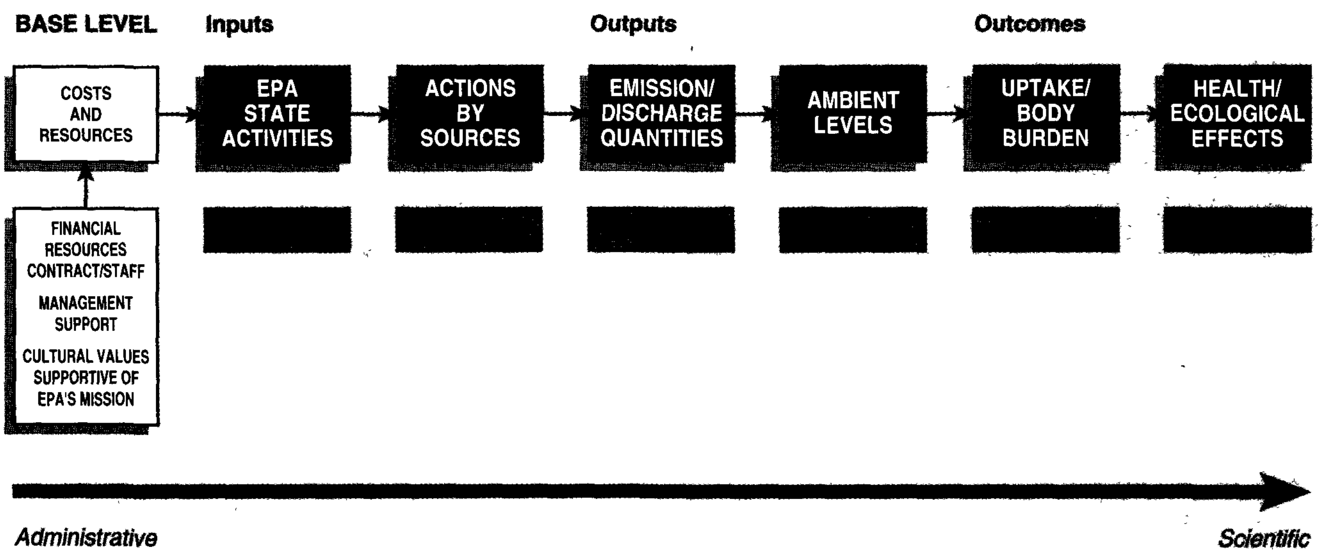


FIGURE 1
EPA's Continuum of Measures



The Chesapeake Bay

The Chesapeake Bay is the largest, most environmentally significant estuary system in the United States. In the 1970s, the public became concerned about environmental degradation in the Bay, particularly the loss of living resources. Congress responded by funding a $28 million, five-year study of the Bay.

The study identified nutrient overloads in the Bay's tributaries as the main source of the problem. Programs were proposed to limit nutrient loadings from point sources (e.g., sewage treatment plants), and nonpoint sources, such as fertilizer runoff from farms.

As result of the study, the *Chesapeake Bay Program* was established. The program is supported by the Chesapeake Bay Program Office (CBPO), which is administered by EPA Region III (see text box).

Monitoring the Bay

The Chesapeake Bay is one of the most carefully monitored bodies of water in the world. Data on all traditional water parameters have been taken at over 130 sites in the watershed and the open Bay since 1984. The trends database available from this monitoring program is one of the best in America.

These data are used to analyze water quality, evaluate living resources, and understand the overall nature of the Bay's problems. A watershed model was developed to study the Bay's water quality processes and the sensitivity of those processes to external nutrient loadings. From the model, Bay Program participants set the core program goal of 40 percent nutrient reduction by the year 2000.

More recent data have been used to validate the model and to construct other simulation models to assess the effectiveness of different pollution control strategies. Because these data serve as the foundation of its efforts, Chesapeake Bay Program staff have established quality control and assurances for all aspects of the monitoring programs in the Bay.

While environmental data are essential to program development, they were not originally used to inform the public of Bay conditions, environmental problems, or the restoration program's progress. Data and trends in the triennial **State of the Chesapeake Bay** reports focused almost exclusively on Bay water quality.

Environmental Indicators

In early 1991, the Bay Program's leadership decided to make the program more responsible and accountable to the public by defining and communicating the environmental results achieved by the restoration program. After interviewing other EPA staff about primary success measures, the CBPO developed a set of environmental indicators to support goal-setting and to serve as targets and endpoints for the restoration effort.

The Chesapeake Bay Program

In 1983, the Chesapeake Bay Agreement was concluded. Signatories were the Governors of Maryland, Pennsylvania, and Virginia, the Mayor of the District of Columbia, the Administrator of the Environmental Protection Agency for the United States, and the Chair of the Chesapeake Bay Commission, representing the State legislatures of the three states. All jurisdictions and agencies were to focus their existing pollution control programs on reducing their nutrient loads to the Bay. Subsequent agreements in 1987 and 1992 included commitments to specific and far-reaching goals tied to restoring the health of the Bay.

The Chesapeake Bay Program is a voluntary, consensus-based effort by the participants to complement the national and state-level environmental regulatory programs. The Bay Program works through a series of committees, advisory committees, and subcommittees that guide and advise the program in aspects of the Bay restoration activities. Formal subcommittees, special workgroups, and formal advisory committees for citizens, scientists, and local governments are important in program development and implementation. Because the solutions to the Bay's problems require the active involvement and behavioral changes on the part of industry, governments, and the public, widespread understanding of Bay problems and their causes is very important.

In 1984, EPA established the Chesapeake Bay Program Office (CBPO) to manage federal funds and to coordinate the activities, study, and planning of the signatory jurisdictions and the twelve other cooperating federal agencies.

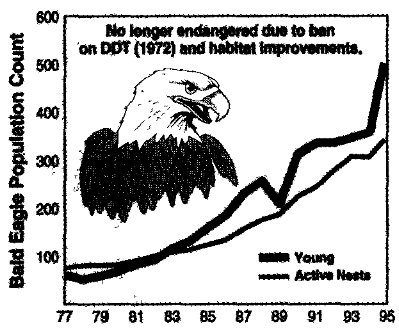
A cross-disciplinary EPA quality action team was formed to develop success measures and to discuss available databases and interpretation of the data. This team linked environmental outcome measures to strategic program goals (as noted in the 1987 Chesapeake Bay Agreement), and the three primary restoration objectives: reducing nutrient enrichment effects; protecting and enhancing living resources; and reducing adverse toxic impacts. The team also arrayed the proposed measures of success on the hierarchy of indicators.

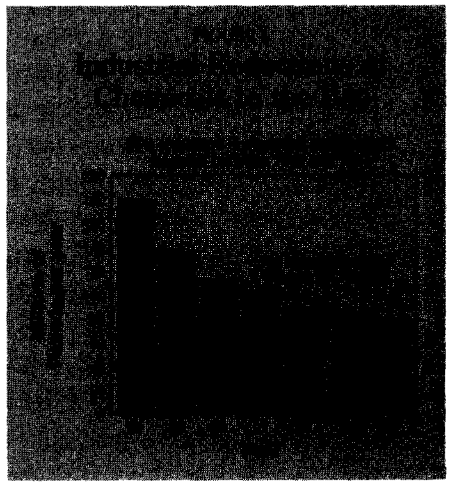
While EPA staff began this effort, states and other stakeholders helped refine the initial structure through the Bay Program's committee and workgroup structure. Workshops were held in 1994 and 1995 to build stakeholder involvement in the design and refinement of the measures and the communication products.

The Bay Program now uses about 30 environmental indicators to gauge progress. Each indicator is characterized by its position on the six-level hierarchy. Measures range from administrative actions, such as issuing permits, to those that are direct or indirect measures of ecological or human health. The basic hierarchy was shown in Figure 1. The Bay program's adaptation of the indicators hierarchy is shown below in Figure 2.

The three main tracks - nutrients, living resources (e.g., Figure 3), and toxics (e.g., Figure 4) converge on the same objective moving up the hierarchy towards level 6 indicators. The common measures of greatest importance for all the tracks are the living resource indicators (e.g., Figure 5).

FIGURE 3
Bald Eagles on the Rebound





Using environmental outcome information has affected the operation of the Chesapeake Bay Program. The approach has new modes of decision-making and new standards for accountability and responsibility, particularly to the public. It has enabled the Program to communicate a clear and consistent public message, has accelerated goal setting (e.g., Figure 6), has sharpened the program's ability to target resources and has improved the program's ability to evaluate its management strategies.

FIGURE 2
Hierarchy of Indicators
(How We Measure Environmental Change)

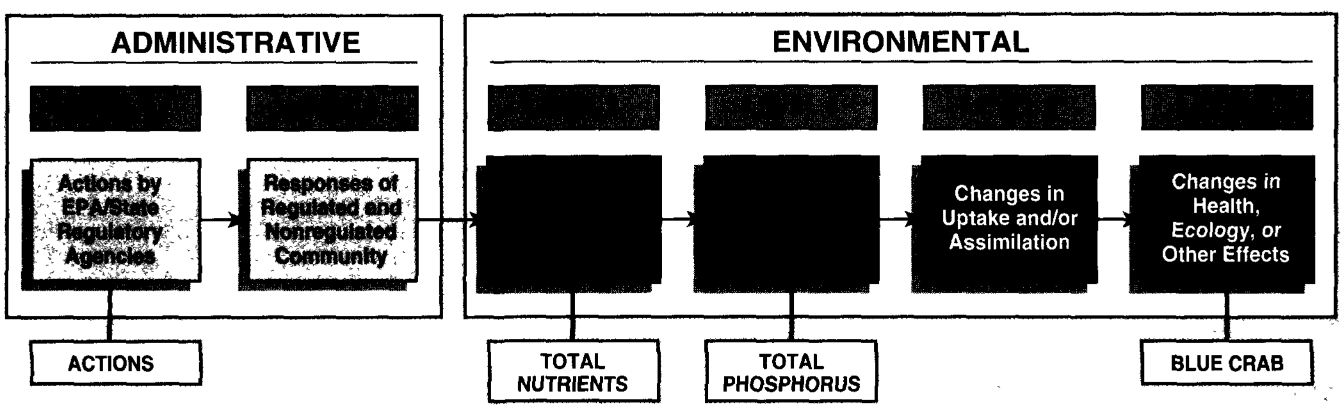
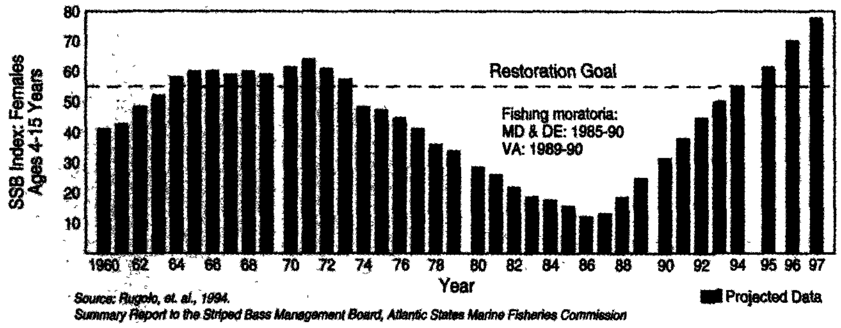


FIGURE 5
Striped Bass Spawning Stock
(Baywide Female Spawing Stock Biomass)



Source: Rugolo, et. al., 1994.
Summary Report to the Striped Bass Management Board, Atlantic States Marine Fisheries Commission

Other results and uses of using environmental indicators and outcome measures are:

• *support for goal setting for the Bay program, both in the multi-year Strategic Implementation Plan and in annual planning and budgeting. The Bay Program has over 25 measurable goals in place. Resources are targeted to measurable goals and strategic objectives. Outcome-oriented projects are preferred to projects with non-measurable objectives.*

• *development and evaluation of program strategies. These strategies require activity beyond traditional methodologies. Environmental indicators, rather than outputs, will be used to evaluate the success of tributary strategies.*

• *general intangible improvements on the Bay Program as a whole. Focusing on results has encouraged professional creativity in developing solutions to Bay problems, improving staff morale. Developing shared definitions of environmental measures has resulted in consistency in inter-state goal setting and progress measurement, and better communication with the public. Finally, improvements in environmental indicators have improved accountability.*

The Bay Program's approach to science and data requires considerable effort. About $2.5 million per year is spent by EPA alone to monitor air and water quality, living resources, and submerged aquatic vegetation. In fiscal year 1996, another $1.0 million in EPA funds was spent to operate computer simulation models to evaluate alternate strategies. In addition, state and local government, other federal agencies, and private organizations spent many times the EPA amount in support of these activities.

The value of this effort is in the public communication and understanding it brings. Over time, increases in population and development throughout the Chesapeake Basin have reduced the rate of progress toward the overall goal of a 40 percent reduction in nutrient loadings. Managers in some programs are unwilling to commit to long term goals because of the uncertainty in year to year activity and accomplishments.

By increasing public awareness of the complexity of the situation, the Bay Program's leadership hopes to gain increased acceptance of the fact that it will take considerable time and effort before observable results are available.

The lessons that the Bay Program has learned from its experience with indicators are:

• *It takes persistence to gain acceptance for using indicators. There are payoffs in public enthusiasm and interest, staff morale, and internal and external political support.*

• *Key parties must have consensus on the measures, data interpretation, and use before taking action.*

• *Not all systems need to be perfectly modeled or understood. Data and analytical problems will always exist. "Ballpark" information will inspire improvement.*

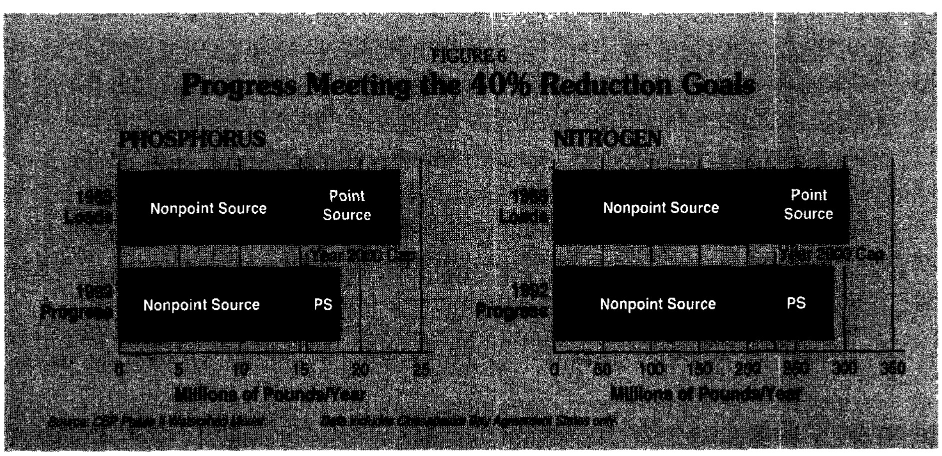


FIGURE 6
Progress Meeting the 40% Reduction Goals

• *Indicators must have a clear end use to be effective and linked to the strategic goals of the organization. Measures developed for their own sake detract from the focus of the program.*

• *The leadership must push for the development and use of indicators. The approach requires persistence, patience, and a long-term vision of the program.*

Developing outcome measures is proceeding in several directions:

• *The Bay Program is developing "super indicators" to provide more concise communication of the best measures and consolidate the information in the 30 existing measures.*

• *The Bay Program has placed high priority on localizing measures, i.e., developing more river-specific or sub-watershed measures rather than Bay-wide average measures. The public is interested in data that describe the condition of local resources. Another step in that direction is the current directive to develop local government indicators measuring progress by government units in advancing Bay goals.*

• *Reflecting the growing interest in sustainability, measures reflecting stewardship and land use are being emphasized. Sustainable use indicators will help the program measure trends in non-traditional areas such as social and demographic patterns. These are being developed with significant stakeholder involvement in the non-profit and private sectors.*

New communication tools will use these measures reinforce the core message of program progress. A "People's Version" of the indicators will be maintained in more simplified and less technical format. The "super indicators" will be developed in graphical form for media distribution in the coming year. Annual reports of progress to the Executive Council will use the data as well.

Estuary Programs

EPA oversees 28 National Estuary Programs across the US. Three of these - Delaware Bay, Delaware Inland Bays, and Maryland Coastal Bays - are overseen by Region III. All of the Estuary programs manage for data-driven environmental results using existing scientific data to characterize environmental resources, and directing research to fill data gaps. The management plans, including environmental indicators of progress, that have been developed for these estuaries are based on thorough reviews of all relevant data.

For the Delaware Estuary, the environmental characterization identified three priority issues: 1) land use, 2) habitat and living resources, and 3) toxics. Action plans were developed for each priority issue and were included in a Comprehensive Conservation and Management Plan (CCMP). The action plans protect and restore environmental quality by providing management alternatives and solutions to priority problems. Monitoring will determine the effectiveness of the CCMP action plans, and will measure progress in achieving environmental results. The participation of stakeholders has been an important part of all steps of this process.

The priority issue of "toxics" illustrates how this process has worked in the Delaware Estuary. During the environmental characterization phase, toxic substances were found in the water column, in sediments, and in estuarine organisms, and fish consumption advisories were in effect for various portions of the estuary. A list of toxic substances of concern was developed based on this information. Then, action plans were designed to mitigate the adverse impacts of these substances on living resources, to identify and reduce toxics loads to the estuary by establishing total maximum daily loads (TMDLs) that protect ecological and human health, and to improve the process by which fish consumption advisories are issued across the three estuary states.

A monitoring program assesses trends in concentrations of the toxic substances in the waters, sediments, and organisms of the estuary on an annual basis, gauging actual concentrations against the desired TMDL's. These assessments, along with other "environmental indicator" information, will be published annually by the Delaware Estuary Program. From this annual evaluation, appropriate adjustments in management strategies can be identified and implemented.

Reducing Acid Pollution

Acid pollution is one of Region III's most serious environmental problems. Acid pollution occurs in two forms: **Acid Mine Drainage** comes mainly from coal mines that were active years ago, but are no longer being mined (a small portion may come from operating mines); **Acid Deposition** comes from the deposition of acidic ions from the atmosphere as either dry deposition or acid precipitation.

Region III's leadership decided to focus on Reducing Acid Pollution as a major environmental priority in 1993, based on data presented in the environmental data study. Separate efforts are being pursued to address Acid Mine Drainage and Acid Precipitation.

FIGURE 7
Areas Underlain by Coal in Region III and Ohio

Acid Mine Drainage in Region III

Acid mine drainage (AMD) is the most pervasive water pollution problem in Appalachia. In Region III, this area includes the coal-producing areas in the Appalachian Mountains in Pennsylvania, West Virginia, Maryland, and Virginia, which are shown in Figure 7. Despite extensive studies and the millions of dollars that have been spent on mine drainage control activities, the problem has not been eliminated.

It has been estimated that Appalachia has over 7,500 miles of streams impacted by AMD. Severely impacted streams have no fish or other aquatic life because of low pH levels and the smothering effects of iron and other metals deposited on the stream beds.

Additionally, the water quality impacts of mine drainage on aesthetics, fisheries, and tourism have created less desirable areas for visitors and recreational users, resulting in lost business opportunities.

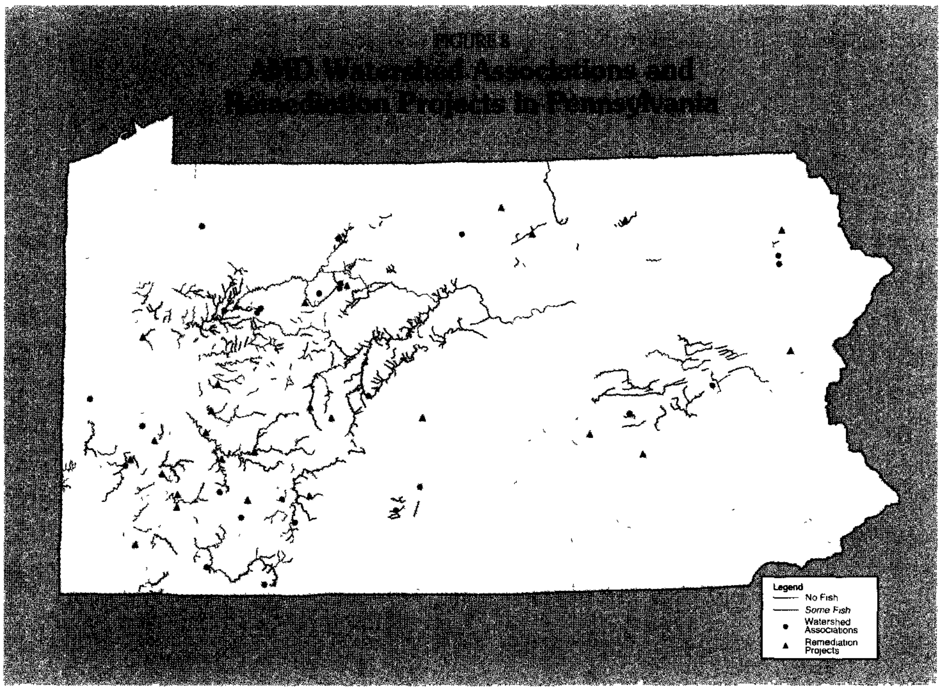
AMD forms when rocks containing acid-producing materials are exposed to water and air as a result of mining. The most common mineral is iron pyrite (fool's gold), which occurs in the rock strata that lie next to the coal-bearing layer. During mining, the pyrite is cracked and broken. Exposed to water and air, the iron-sulfide minerals react, in the presence of certain bacteria, to form acid that then dissolves other minerals in the rock.

AMD typically has low pH (less than 6.0) and elevated levels of sulfates and metals such as iron, manganese, and aluminum. These metals, most noticeably iron, often coat stream bottoms, resulting in the reddish-orange, so-called "yellow boy" stains familiar to the residents of mining areas throughout Appalachia.

Alkaline mine drainage (pH above 8.0) may also be a serious problem following mining; such discharges are alkaline, but may contain high levels of iron, manganese, and sulfates.

EPA-OSM Partnership

Region III has formed a partnership with the Office of Surface Mining, Reclamation and Enforcement (OSM) to address AMD. OSM initiated its Appalachian Clean Streams Initiative (ACSI) in 1994 to centralize the efforts of various groups that are involved in AMD cleanup. At the same time,

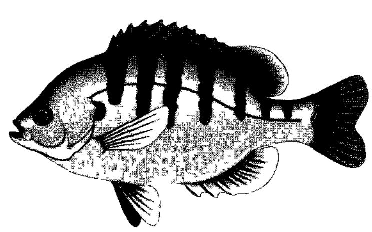


EPA Region III formulated its Mine Drainage Initiative (MDI). The OSM-EPA Statement of Mutual Intent (SMI) and Strategic Plan (SMISP) were born out of the ACSI and the MDI as a concept for partnership and progress in restoring streams.

Because aquatic life, especially fisheries, is very sensitive to low pH associated with AMD, EPA and OSM decided that AMD impacts on fisheries would be a good baseline environmental measure. The results of a 1995 survey of State biologists familiar with impacted fisheries in their territories are shown for Pennsylvania in Figure 8. Similar information is available for the states of Maryland, Virginia and West Virginia.

The basic methodology of the survey had the biologists color-code the impacted streams on USGS 1/100,000-scale topographic maps. Only streams that the biologists judged to have impacted fisheries were color-coded; streams without color codes in the study area may or may not be impacted. These data on impacted fisheries are based only on metals and low pH levels, and do not include the adverse impacts of sediment from mining.

Two levels of impacts were defined. The more severe level is "No Fish." A No Fish designation can include streams: (1) in which a few fish can be found surviving in an area where a tributary dilutes the stream, or (2) near where a large spring may feed the stream, enabling a few fish to survive.



The second level of impacted fishery is "Some Fish." Impacts to fisheries in this category include reduced number of species of fish and/or a reduced productivity.

All of these data have been entered into EPA's Geographic Information System (GIS), and are available in a wide variety of formats and data layers for analytical and planning use.

Implementation of the Statement of Mutual Intent and Strategic Plan began in federal Fiscal Year 1996. OSM and EPA staff have been meeting jointly with other federal agencies, states, and watershed groups to define roles and strengthen the existing strategic plan. Once a comprehensive inventory of activities is documented, the information can be shared with all interested parties.

Developing the SMISP centered on establishing goals that would marshal the available resources of all stakeholders to clean up pollution from abandoned mine sources. These goals included: (1) compiling technical and environmental data on stream conditions and remedial techniques, (2) guidance on how to organize a clean-up effort, (3) sources of potential funding, and (4) networking and technology transfer opportunities.

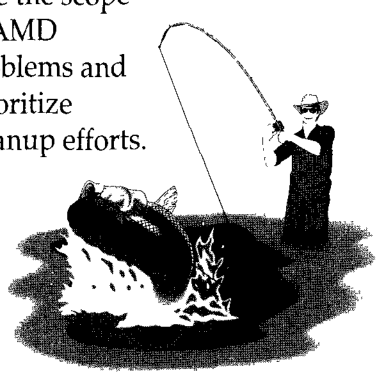
EPA also initiated active AMD cleanup programs in the Shaw Run and Quemahoning Creek watersheds in Pennsylvania and the Cheat River in West Virginia. These cleanups stressed partnerships with state government and local watershed associations.

Many of these decisions are being made based on data displays on maps generated by the GIS. Any data that include latitude and longitude coordinates can be located and illustrated as information on a computer-generated map.

For instance, if a stream has been sampled for water quality and measurements have been made of flows, this information can be displayed on a watershed map.

Additionally, water quality data can be "filtered" in any number of ways to show data of particular interest. For example, one could locate all places where the water quality of a stream is below pH of 6.0 and flows are less than 250 gallons per minute (gpm) by asking the GIS this query. A map is generated on the computer screen locating streams in the area meeting the conditions of the query (pH less than 6, flows greater than 250 gpm).

By adding data on active and abandoned mine locations, AMD discharges, geology, land use, roads, topography, property ownership, etc., to the GIS, groups trying to clean streams have an extremely powerful tool with which to analyze the scope of AMD problems and prioritize cleanup efforts.



EPA Region III has begun to enlarge its GIS data base beyond the fisheries impacts described above. The remediation projects and watershed association locations listed in the earlier tables have also been created as a GIS layer by EPA, as shown in Figure 8. West Virginia and Pennsylvania have also enhanced their GIS capabilities and increased their data layers. A cooperative effort among the states and OSM to add their GIS data layers into EPA's GIS repository has been spearheaded by EPA.

OSM, in cooperation with the Stoneycreek Conemaugh Rivers Improvement Project (SCRIP), is developing a pilot GIS for two watersheds of the Conemaugh River in western Pennsylvania (Shade Creek and South Fork) that will demonstrate the potential for the use of GIS in planning stream cleanup. If successfully demonstrated as a planning tool, this GIS will be the prototype for other groups beginning to scope out their watersheds' mine drainage problems.

An important aspect of AMD cleanup is remining abandoned mines for salvageable coal. Remining can assist reclamation and AMD reduction efforts. Although the Clean Water Act allows less stringent limits for remining, it also requires compliance with water quality standards. EPA and OSM are committed to promoting effective remining programs in the states.

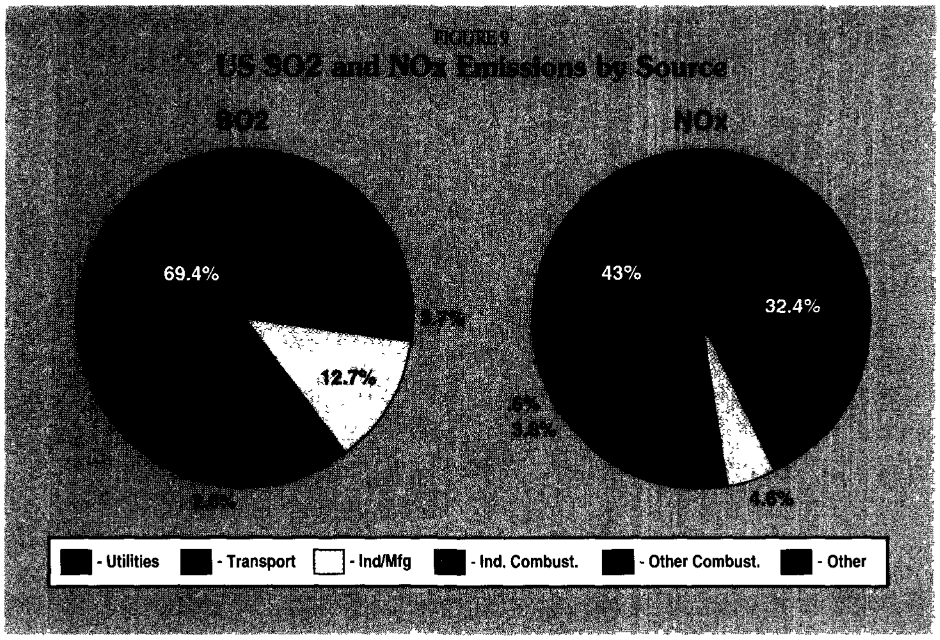
Eliminating barriers to remining and increasing environmentally acceptable incentives for the practice are important steps that allow industry to remine more abandoned mines and provide reclamation and pollution reduction in the process. The Energy Policy Act of 1992 requires OSM to propose rulemaking for some remining incentives. OSM and EPA are seeking input on an expanded list of barriers and incentives.

Acid Deposition in Region III

The Mid-Atlantic Region is a critical recipient of acid pollution from the atmosphere through either acid rain or the dry deposition of acid. Acid is formed through the release of sulfur oxides, principally sulfur dioxide (SO2), and oxides of nitrogen (NOx) into the atmosphere. These pollutants mix with water vapor to form sulfuric and nitric acids that, when deposited into lakes and streams, increase acid levels in these aquatic ecosystems to levels that are not conducive to sustaining healthy levels of plant and animal life. Some lakes and streams are so acidic that virtually no life exists within them.

The main sources of atmospheric SO2 and NOx are the combustion of fossil fuels (mainly coal) and internal combustion (e.g., automobile) engines (Figure 9).

The National Acid Precipitation Assessment Program, which conducted a survey in the mid 1980's, indicated that the continental center of minimum annual average rainfall pH (highest acidity) was in western

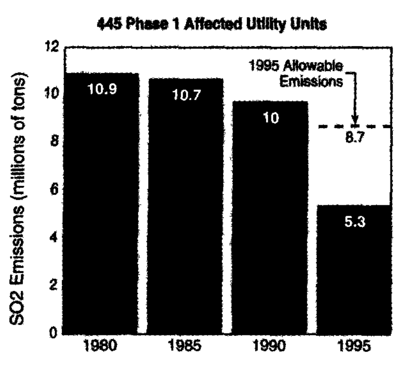


Pennsylvania. The record lowest measured rainfall pH for one rainfall event occurred in West Virginia, a rainfall with a pH of 2.0 in 1978, compared with pH of 6.5 to 7.0 for "normal" rainfall.

The National Park Service and the Forest Service have declared that areas designated Class I (most environmentally sensitive to pollutant loadings) in the Mid-Atlantic Region are impaired by acid rain. This impairment includes impacts to visibility, which is affected from the presence of sulfate particles in the air. These Class I areas include designated national park and wilderness areas. Using data collected from an established long-term monitoring program, it has been estimated that 68% of visibility impairment is from atmospheric loadings of sulfates.

SO2 emissions are dropping as a result of the Clean Air Act Amendments. Figure 10 compares SO2 emissions for 445 facilities that were affected by Phase 1 of the amendments. It shows that the facilities exceeded the 1995 target for reducing SO2. However, the academic community has predicted that, even after the provisions of the Title IV Acid Rain provisions of the 1990 Clean Air Act Amendments are implemented nationally, the Mid-Atlantic Appalachian Region may continue to be an area of the country still adversely impacted by acid deposition (Figure 10).

FIGURE 10
SO2 Emissions



Acid deposition, particularly NOx, in the Chesapeake Bay watershed can cause increases in the Bay's nitrification levels. Resultant effects to the Bay's ecology, particularly eutrophication, affect the ability of this ecosystem to maintain adequate levels of oxygen in the water, and also affects the growth of submerged aquatic vegetation. Both of these, in turn, affect the ability for sustained reproduction of shellfish and finfish populations. It is estimated that twenty-five to thirty-five percent of the total nitrogen loadings to the Chesapeake Bay are atmospherically related.

The Mid-Atlantic Region is a major producer and consumer of fossil fuels. The use of coal for power generation has increased in the United States by 60% over the last 20 years. The Mid-Atlantic Region is also a major source of acid rain precursors. For example, Pennsylvania is ranked third in the country for sources of electric utility SO2 emissions, the fourth largest source of total SO2 emissions, and the fifth largest source of all acid rain precursor emissions (SO2 and NOx). On a per capita basis, West Virginia has the nation's greatest emissions of acid rain precursor emissions.

Four of the Mid-Atlantic Region's States are among the nation's top 10 States in acid rain precursor emission density (tons per square mile). A significant portion of the acid deposition is also transported into the Region from sources located in the Midwest, and from as far away as the western and southwestern portions of the United States.

Region III's overall Acid Pollution Goal is to reduce acid pollution to protect and enhance the environment. To accomplish this, the Region's Air Program is implementing a planning effort to better define the problem and to create interim targets to meet the long-term goal. The plan contains six objectives designed to address the current nature and extent of the acid deposition problem.

The objectives are:

- *Gathering, developing, and implementing techniques and data systems for measuring the progress (outcomes) of acid deposition activities, and for weighting SO2 and NOx emissions based upon their importance to the acid deposition problem in the Mid-Atlantic Region.*

- *Reducing emissions of SO2 generated regionally through the implementation of various SO2 control strategies and measures.*

- *Reducing NOx emissions generated regionally through the implementation of various NOx control strategies and measures .*

- *Reducing the amount of SO2 and NOx emissions that are generated outside the Mid-Atlantic Region, but are transported into the Region.*

- *Through the use of energy conservation practices and energy efficient technologies, reducing energy dependence and corresponding reductions in SO2 and NOx.*

- *Designing and implementing effective public educational and outreach programs that inform the public of the health and ecological risks of acid rain precursor emissions and what the pubic might do to contribute to reducing these effects. Building public and private sector partnerships that foster energy conservation.*

The planning process started by focusing on establishing baseline data on SO2 and NOx in Region III. Good baseline data are needed to define the scope of the problem and to allow reduction targets to be set.

Progress in meeting reduction targets for SO2 and NOx will become interim environmental indicators during the time that the reduction strategies are being implemented. Also during that time, outcome measures will be defined and baseline data set for them.

All of these Regional actions are meant to build on the strong foundation set by the implementation, nationally, of the Clean Air Act Amendments of 1990. We are undertaking them because these pollutants have a greater impact on Region III than they do on most of the rest of the country.

The data in Figure 10 show that implementation of the national program is beginning to have a measurable impact on SO2 emissions nationally. We are analyzing ambient data to see if comparable reductions in SO2 and acid deposition levels are observable in Region III.

The impact of these reductions spreads to other programs as well. For example, NOx is also a major contributor to the ground level ozone problem discussed in the next section of this report.

Data and Environmental Indicators

Data needs and the use of environmental indicators are driven by the need to define and assess the results of environmental stressors upon environmental conditions or systems. They may be health-related, or ecologically-related, or both.

There are many data bases that will influence the direction and outcomes of the Acid Pollution Strategic Goal. There are also various environmental indicators, both currently available and under development, that are useful in assessing the progress in reducing acid rain precursor emissions and corresponding environmental impacts.

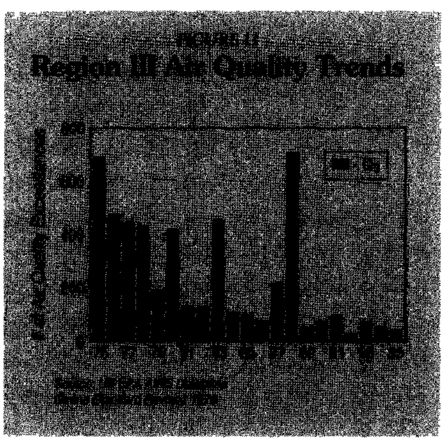
Examples of data that are available include annual source emissions inventories that distinguish and characterize changes in emissions trends. Also available are ambient air concentrations of SO2 and NOx, measured as NO2, that are compared to the National Ambient Air Quality Standards that are designed to protect public health and welfare. Measured pH levels in rain water, which typify acidic concentrations, are also available. Acid deposition rates, measured as sulfates and nitrates, are also available.

Environmental indicators data available from the Chesapeake Bay Program characterize changes in submerged aquatic vegetation acreage in the Bay and track low dissolved oxygen levels. These are used to assess the effects of eutrophication in the Bay.

Ground Level Ozone

Region III is currently experiencing significant ambient air quality problems with ground level ozone, commonly called smog. Human health problems associated with smog are increased respiratory ailments such as asthma, emphysema, and other chronic illnesses. Quality-of-life issues include paint and rubber breakdown, crop damage, and haze (also associated with acid pollution) that decreases visibility. Environmental problems are mainly damage to vegetation in forests.

Ground level ozone also contributes to the atmospheric deposition of compounds in the Chesapeake Bay watershed, which results in increased nitrification of the Bay, affecting the growth of submerged aquatic vegetation and reducing oxygen levels critical to the reproduction of shellfish and finfish populations. It is estimated that 25-35% of the total nitrogen loadings to the Bay's watershed are atmospherically-related.



Ozone is the most pervasive air pollutant problem in Mid-Atlantic Region, and the Region has more geographic areas experiencing ambient air quality violations from ozone than any other EPA Region (Figure 11). Violations of the National Ambient Air Quality Standards (NAAQS) for ozone vary in degree of severity from area to area, but are most prevalent in such major metropolitan areas as Baltimore, Washington, D.C., and Philadelphia.

Region III made Reducing Ozone Pollution a high regional priority in 1993. Much of the activity directed at achieving this goal is associated with the programmatic activity mandated nationally by the Clean Air Act Amendments of 1990.

The Region's Air Program is using the planning process described in the section on acid pollution to address ozone. The goal of the process is to: "Ensure that the ambient photochemical oxidant levels (measured as ozone) in the Mid-Atlantic Region are maintained at a sufficiently low level to protect the health of all citizens, to promote agriculture and forestry, and to promote an environment that will support a rich diversity of plant and animal life."

The plan includes six objectives designed to assess the ground level ozone problem, to focus on data analyses and interpretations to understand the problem, and to assess "real time" reductions in ozone precursor emissions (VOCs and NOx) more accurately. The objectives are similar to those shown in the preceding section on acid pollution.

The major constituents of ground level ozone are volatile organic compounds (VOCs) and oxides of nitrogen (NOx). Industrial operations and vehicular traffic are the greatest contributors of ozone precursors, but there are many other sources. VOCs are principally formed from operations such as refineries, petrochemical facilities, printing and surface coating operations, household products, dry cleaners, and automobile exhaust (Figure 12).

NOx is formed principally through the combustion of fossil fuels and, again, automobile exhaust. The presence of sunlight and high ambient temperatures (i.e., above 70 degrees Fahrenheit) are the other essential ingredients in the formation of ground level ozone (Figure 13). Finally, ozone recognizes no geographic or territorial boundaries, and may be transported for hundreds of miles from its point of origin.

Ozone and its precursor emissions were identified as national problems when the original NAAQSs were developed under the Clean Air Act of 1970. The Clean Air Act Amendments of 1990 reinforce the need to address the significant health and ecological impacts of ground level ozone. The Act relies principally on the implementation of ozone control

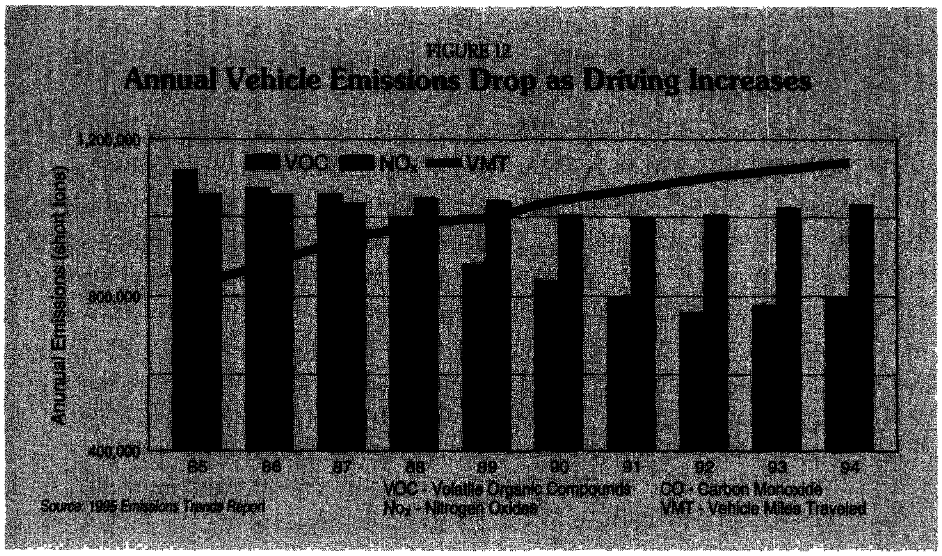


FIGURE 12
Annual Vehicle Emissions Drop as Driving Increases

strategies and regulations at the State and local level.

Reducing VOCs as an ozone precursor emission also has secondary benefits. Some VOCs are also considered to be toxic air pollutants. Examples include benzene generated from gasoline manufacturing and dispensing operations, perchloroethylene used as a dry cleaning solvent, and common household solvent-based cleansers.

In addition, there are multi-media activities that can influence ozone formation. For example, cleaning waste water at treatment plants can result in the release of VOCs. As the contaminated water is aerated to "strip" solvents from it, the solvents are volatilized (changed to vapor) and released into the atmosphere. These VOCs ultimately combine with NOx to form ozone.

The NAAQS for ground level ozone is 0.12 parts per million (ppm) measured over a one-hour period. Levels above 0.12 ppm are considered injurious to human health and the environment. Ambient levels of ozone are measured continuously, using ambient air monitoring equipment, throughout the Mid-Atlantic Region. Historic trends in ground level ozone concentrations are analyzed to evaluate progress in reducing VOC and NOx emissions and corresponding ozone air quality levels. One of the difficulties in comparing the reductions in emissions of VOCs and NOx and reduced levels in ground level ozone concentrations rests in the fact that these concentrations are weather-dependent. Typically, hot and sunny summers are most conducive to increased ground level ozone concentrations, although the ozone season in the Mid-Atlantic Region usually extends from April until September.

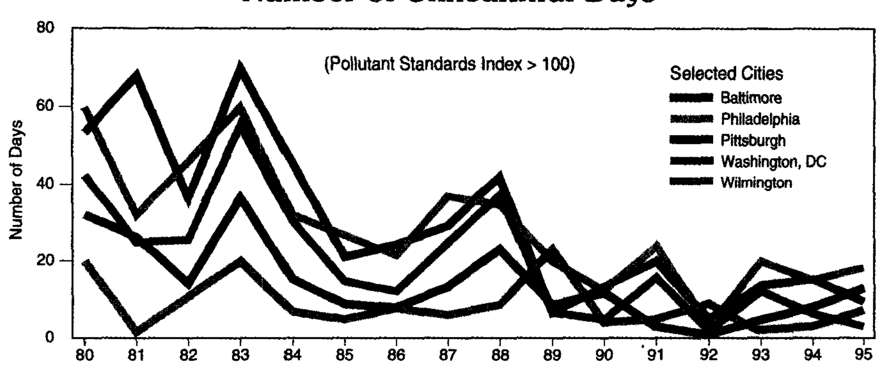
There are many data sets that will influence the direction and outcome of the Ozone Strategic Plan. There are also environmental indicators, either currently available or under development, that will be useful in assessing progress.

Examples of available data include annual emissions inventories, ambient ground level ozone levels that are collected hourly during the ozone season, and data on driving trends, patterns, and vehicle-miles traveled annually.

These are particularly important in assessing the ozone problem because, as stationary sources of VOCs and NOx are controlled, the number of total miles being driven has been increasing. Even though vehicles are more efficient and produce less pollution than in the past, the increase in vehicle-miles-traveled offsets other reductions.

Health-related data on the effects of ozone violations are not readily available. The type of information that needs to be developed includes

FIGURE 13
Number of Unhealthful Days



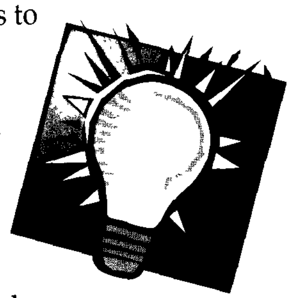
data on the rate of respiratory incidences reported during the ozone season, in a form that can be correlated with ozone concentrations.

Some of the data bases are driven by statutory or regulatory requirements. For instance, ambient air quality data trends are calculated from data collected to meet the requirement that States continuously monitor ambient ozone concentrations. Other data bases result from voluntary, non-regulatory actions. For example, under EPA's Green Lights program, public institutions and private firms are voluntarily switching their indoor lighting to more energy-efficient systems. These conversions result in reduced releases of NOx. NOx emission reductions can be calculated based upon the number of kilowatt hours saved. Regardless of how the data are obtained, the ultimate goal is to develop outcome-based measures that portray conditions and systems as accurately as possible under real-time conditions.

In summary, as part of meeting the Region's Strategic Goal for Ozone, EPA and its stakeholders will have to develop new sources of data on environmental conditions and health effects. Some of this information is available from existing data bases, but much of it will have to be collected from new sources.

EPA's Green Lights Program

EPA's Green Lights Program is a voluntary, non-regulatory program designed to reduce pollution through cooperation between the public and private sectors. Green Lights encourages the widespread utilization of energy-efficient lighting systems and technologies in public, private, and commercial buildings. To participate in the Green Lights program, an organization agrees to survey its domestic facilities and upgrade the lighting systems, where it is profitable to do so, within five years. EPA assists participants in obtaining the most current information about energy-efficient lighting and technologies, and helps them determine which technologies are most suitable for their individual situations. Green Lights has currently enrolled 40% of the Fortune 500 companies, in addition to 2,000 other public, business, and industry partners, both large and small. Region III has 423 participants who are reducing their lighting expenses by half, and who have already avoided using 239 billion kilowatt hours of electricity per year.



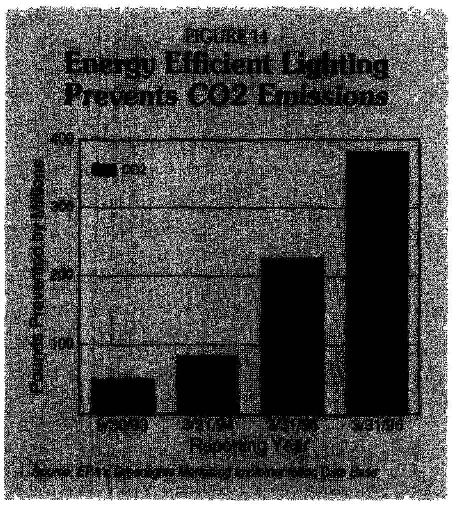


FIGURE 14
Energy Efficient Lighting Prevents CO2 Emissions

The reductions achieved through these energy technology transfers are equivalent to the planting of 73,817 acres of trees and taking 36,037 automobiles off the road per year. The City of Philadelphia has committed to upgrade approximately 8 million square feet of space with energy-efficient lighting. To date, 1.6 million square feet of space have been upgraded. These efforts have earned Philadelphia the award of 1996 Green Lights Partner of the Year in the City Government category.

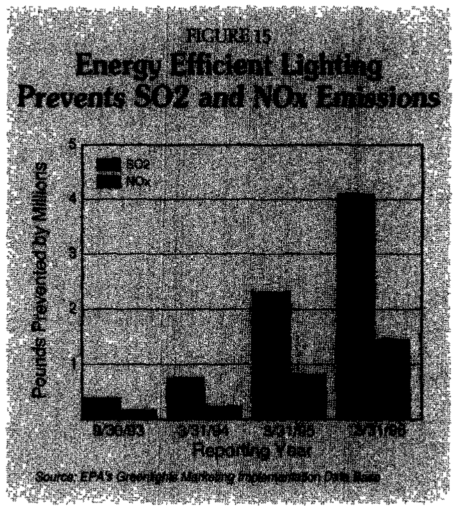


FIGURE 15
Energy Efficient Lighting Prevents SO2 and NOx Emissions

In the aggregate, these reductions have resulted in reducing air discharges equivalent to 381 million pounds of carbon dioxide (Figure 14), 4.1 million pounds of sulfur dioxide (SO2), and 1.3 million pounds of oxides of nitrogen (NOx) (Figure 15). Carbon dioxide is a greenhouse gas responsible for global warming, while SO2 and NOx are the primary precursors of acid deposition. In addition, NOx is a principal constituent in the formation of ground level ozone and contributes to increased nitrification, and resultant increased eutrophication, in coastal waters such as the Chesapeake Bay.

Program-Specific Activities

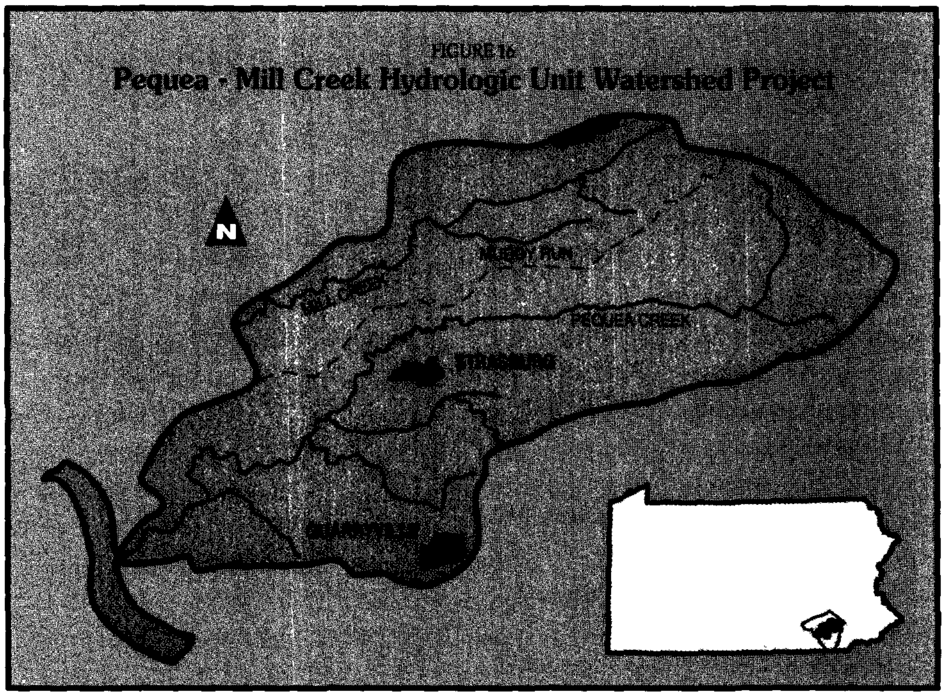


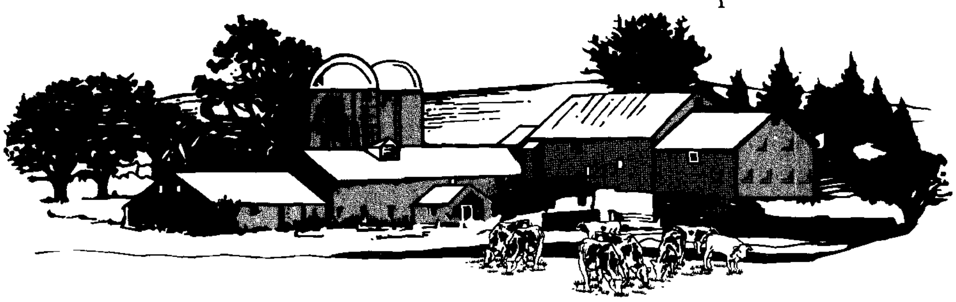
FIGURE 16
Pequea - Mill Creek Hydrologic Unit Watershed Project

The preceding descriptions of the integrated use of various kinds of data to focus the specific goals of the Chesapeake Bay Program, the Acid Pollution Program, and the Ozone Pollution Program are highly visible examples of Region III's commitment to using Environmental Results-Based Management Techniques in the Mid-Atlantic region. However, ERBM is a very useful tool in other important, though perhaps not so publicly-visible, programs carried out by Region III. The next several pages introduce a series of examples, or "case studies" that demonstrate the widespread use of data in orienting program-specific activities within Region III.

CASE STUDY: Pequea and Mill Creeks Comprehensive Watershed Initiative

Pequea and Mill Creeks watersheds are southeastern Pennsylvania watersheds in Lancaster and Chester Counties (Figure 16). The watersheds total 135,000 acres; land use in the watersheds is predominantly agricultural, with 63% of the land devoted to cropland and 13% to pasture. The watersheds are home to approximately 55,000 dairy cattle, 5,500,000 poultry, and 122,000 swine. These watersheds are recognized as high priorities by State, Federal, and local agencies, being listed in the top 10% of Pennsylvania's nonpoint source (NPS) priority watersheds, identified on Pennsylvania's 303(d) list, and given priority status in the Chesapeake Bay Program, the Ground Water Protection Program, and the Public Drinking Water Supervision Program.

According to the Pennsylvania Department of Environmental Protection (PaDEP), more than 58 stream miles in these watersheds have been degraded by agricultural NPS pollution. The primary pollutants are nutrients and suspended solids.



Nitrate nitrogen has been detected above 10 mg/l (the Federal drinking water standard) in 43% of samples from Pequea Creek.

State and local coordinating committees have been formed to implement a comprehensive watershed initiative. These committees have been meeting regularly for several years. The U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Cooperative Extension, Farm Services Agency, EPA Region III, the US Geological Service (USGS), PaDEP, Pennsylvania Department of Agriculture (PDA), the Lancaster Conservation District (LCCD), several private crop management consulting organizations, and the Pennsylvania Fish and Boat Commission are the principal members of the committees.

The following goals have been established:

1. Identify the type, location, and magnitude of existing and potential causes of surface and ground water quality and ecosystem degradation

Determine the most environmentally sound and economically feasible management strategies to reduce existing water quality and ecosystem degradation and protect against future impacts

3 Implement comprehensive surface and ground water restoration and protection programs

USDA chose the Pequea and Mill Creeks watersheds as a hydrologic unit area in February 1991. Under this designation, USDA agencies provide accelerated technical and financial assistance to farmers in the watershed for the implementation of best management practices (BMPs) to protect the ecosystem. The watersheds are being used in a cooperative computer modeling effort between the PaDEP, Bureau of Land and Water Conservation, Penn State University, and NRCS. Land use, farming practices and other data will be used in the development of the National Agricultural Pesticide Risk Assessment (NAPRA).

NAPRA evaluates the potential offsite impacts from pesticide use by comparing the concentrations of pesticides in runoff and leachate to established maximum allowable contamination levels set by State law. Significant efforts have been made providing education, training, technical assistance, and cost-sharing for BMP installations. Since 1991, there have been approximately 70 public service announcements on local radio stations, numerous newspaper articles, and at least 3 field days conducted each year for farmers. Nutrient management and pesticide certification meetings have been held with private vendors. In addition, monitoring was initiated for evaluating the cause/effect relationship of implementing stream fencing.

A Wellhead Protection project for two public water supply well fields within the watershed is also being developed. These well fields provide drinking water for the New Holland and Blue Ball municipalities. An EPA laboratory has conducted a fracture trace analysis from aerial photography and, through this, has delineated potential protection areas. Local township and borough officials, LCCD and PDA are inventorying the existing sources of contamination within these protection areas, and are developing ordinances to protect the pubic wells from contamination. In addition, EPA Region III's Ground Water Protection program is spearheading the development of a Geographic Information System (GIS) for the watersheds. A workgroup of state, local, and federal agencies has identified data layers that should be developed and analyzed.

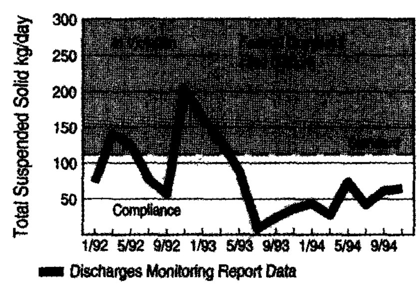
CASE STUDY: NPDES Permit and Compliance Enforcement

In Region III, the National Pollutant Discharge Elimination System (NPDES) program, a program that permits and monitors surface water discharges from many industrial and commercial facilities, is delegated to the States. This gives the States the primary responsibility to enforce NPDES regulations promulgated under the Clean Water Act (CWA). Currently, EPA measures the success of state NPDES enforcement programs based on the initiation of "timely and appropriate" enforcement actions, which are directly linked to the term "significant noncompliance" (SNC).

EPA tracks the number of major facilities that have compliance problems. Each quarter, EPA and the states discuss how these facilities will be addressed. There are several limitations inherent in using this type of data: 1) the criteria are only applied to major dischargers, 2) only monthly average limitations are evaluated, 3) SNC rates may not include violations at facilities under existing enforcement actions, and 4) the NPDES exceptions list of sources in SNC for two or more quarters allows some noncomplying facilities to be excluded.

FIGURE 17

Federal Impact on NPDES Compliance



Because of these limitations, this administrative approach used State and federal time and money inefficiently with respect to the resulting environmental benefits. A preferred approach was the selection of enforcement actions based on degree of actual or potential environmental harm/

impact. Region III used available data from the Chesapeake Bay drainage area to develop and refine this alternative approach.

Under this approach, the delegated State programs would remain charged with the task of tracking and reducing the SNC rate and exception list number. EPA would routinely issue a notice of violation (NOV) to all dischargers reported on the exception list. EPA would not focus solely on SNC in case selection, but would look primarily to its "federal enforcement agenda" for cases.

This federal enforcement agenda is outcome-oriented, focusing on out-of-compliance dischargers with the largest discharges, or with the most significant adverse impacts on surface waters, or with high precedence or priority for other reasons. To implement the proposed federal agenda, with enforcement actions focusing on those cases where data show that water quality is being degraded, EPA relies on 1) a quarterly screening of Daily Monitoring Report data to identify dischargers not meeting outcome-oriented criteria; 2) a coordinated effort with the Environmental Assessment and Protection Division to use water-body system information; 3) a review of all EPA inspection reports to determine compliance; 4) exchange of information between the Chesapeake Bay Program and the NPDES Pretreatment team; and 5) notification to the delegated states of all facilities targeted for federal enforcement.

The result of the new approach is shown in Figure 17. A sewage treatment plant in Virginia reported regular violations of the limit for Total Suspended Solids. As soon as federal enforcement action was taken, the plant met its limit.

In essence, a number of environmental databases are used to determine where significant water quality problems are occurring. NPDES enforcement actions are then focused on those facilities that contribute to that specific location of water quality degradation.

CASE STUDY: Superfund Screening Tables and Environmental Objectives

Region III's Superfund program has developed two important screening tables to evaluate data from Superfund sites. Project managers use these tables to evaluate site conditions, plan field work, and develop remediation goals for soil, ground water, and surface water. These tables also provide important benchmarks for human health and environmental quality. In terms of goals, the tables are a useful reference for EPA's Superfund program in Region III, and for many State hazardous waste programs as well.

The first screening table is a "Risk-Based Concentration [RBC] Table" (Figure 18), which is used to screen field data for potential human health threats. It is widely distributed to federal and state agencies and other professionals. The table includes safe levels of nearly 600 chemicals in soil, drinking water, and air. The table is updated regularly with new toxicological information. The second table is a "Ecological Screening Table" (Figure 19), prepared by Region III's Biological Technical Assistance Group (BTAG) in 1995. This table includes protective concentrations for about 130 common contaminants in water, sediment, and soil. These concentrations are the lowest safe levels for the most sensitive organisms in each medium.

The RBC and Ecological Screening Tables are good examples of the environmental objectives of the Superfund program and many State programs in Region III. If initial sampling shows that contaminants exceed the levels in the tables, further site studies and appropriate cleanup technologies can be given focus. When site

FIGURE 18

EPA Region III Risk-Based Concentrations (Smith, 1995)

CONTAMINANT	CAS #	RISK-BASED CONCENTRATIONS*				
					Soil Ingestion	
		Tap Water (mg/l)	Ambient Air (mg/l)	Fish (mg/kg)	Industrial (mg/kg)	Residential (mg/kg)
Arsenic	7440382	11	1.1	0.41	610	23
Cadmium	7440439	18	.00099	0.68	1000	39
Mercury (inorg.)	7439976	11	0.31	0.41	610	23
Nickel	7440020	730	73	27	41000	1600
Selenium	7782492	180	18	6.8	10000	390
Silver	7440224	180	18	6.8	10000	390
Zinc	7440666	1800	180	68	100000	3900

** Table structure has been simplified for illustrative purposes.*

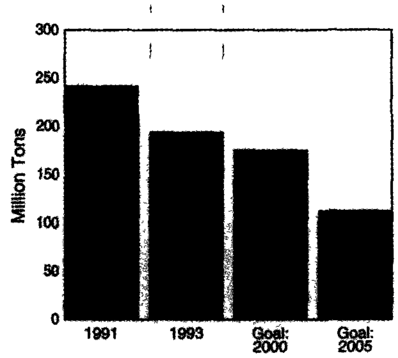
cleanup achieves the levels of contaminants in the tables, a site no longer poses a public health or environmental threat; such a cleaned-up site can be used without any additional restrictions. Where total cleanup is too costly or impractical, wastes can be effectively isolated to prevent any further threats from the remaining contaminants.

In a program as complicated as Superfund, it is often easy to lose track of the basic goal - cleaning up sites so they no longer pose a threat to human health or the environment. Region III's two screening tables provide a practical reference to the cleanup goals for contaminants commonly found at Superfund sites. The program strives to meet these goals at the nearly 200 Superfund sites in Region III.

CASE STUDY: RCRA Actions

The Resource Conservation and Recovery Act (RCRA) charges EPA with protecting human health and the environment from discharges of hazardous and solid waste from land disposal, incineration, treatment facilities, containers, tanks, surface impoundments, and underground storage tanks (USTs).

FIGURE 20
Hazardous Waste Reduction



Hazardous Waste Reduction Rates

One key component of resource conservation is the concept of waste minimization/pollution prevention. This practice not only conserves valuable resources such as surface water, groundwater, and the air by reducing degradation created by toxic pollutants, but also conserves valuable raw materials that otherwise end up as pollutants. Over 215 million tons of hazardous waste were generated in 1993. Any loss to the environment is considered to represent an inefficiency. Thus, a key indicator currently being measured by the hazardous waste program is the amount of such waste generated each year. The trend of hazardous waste generation is down (Figure 20); EPA's national plan calls for a 25% reduction by the year 2000 and a 50% reduction by the year 2005.

Solid Waste Recycling

Another key area of RCRA is solid waste management. Until municipalities began recycling solid waste, the bulk of this waste ended up in landfills, creating many sites with major impacts on drinking water and surface waters. Two key measures in this area are the number of municipalities that have implemented recycling programs, and the percentage of solid waste recycled. EPA uses these data to promote public awareness, education, and outreach.

Underground Storage Tanks (USTs)

By the mid-1980's, more than 2 million USTs were in use for gasoline storage. As these steel tanks began to deteriorate and the improper handling of gasoline persisted, many groundwater supplies became polluted, and explosive vapors in nearby dwellings created threats to human health, sometimes resulting in deaths from explosions. The number of releases being reported, and the number of cleanups initiated, are key indicators of environmental and human health threat associated with underground tanks. EPA tracks these data to show the success of the program efforts.

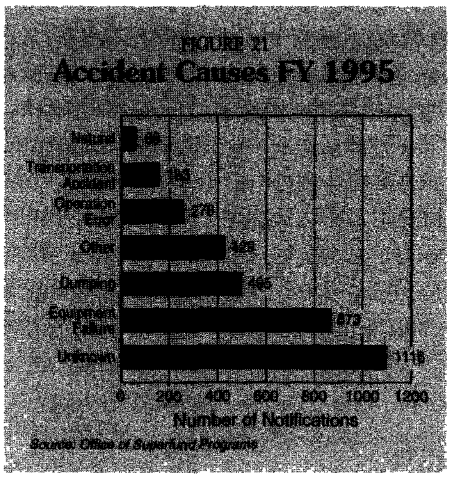
FIGURE 19
EPA Region III BTAG Screening Levels (parts per billion) *

CONTAMINANT	AQUATIC Marine		AQUATIC Fresh		SOILS		SEDIMENT		BCF's
	Flora	Fauna	Flora	Fauna	Flora	Fauna	Flora	Fauna	
Fluorides			2000	2700	1000				
Iron				320	3260000	12000			
Lead	5.1	5.6		3.2	2000	10		46700	726 (fish)

* *Table structure has been simplified for illustrative purposes.*

CASE STUDY: Accident Prevention

The Superfund Program uses data to target Accident Prevention Program activities. The data used include the Emergency Response Notification System (ERNS), Toxic Release Inventory (TRI), and information from the Region's Urban Initiatives such as Chester, PA, and Baltimore, MD.



We have compared the facilities in the ERNS database with those in TRI, the Regional Initiatives, and sites where accident prevention activities have been conducted. Based on this data review, meetings will be initiated with Local Emergency Planning Committees to discuss Chemical Safety Audit (CSA) targeting. Particular facilities may be targeted for CSAs or follow-up CSAs.

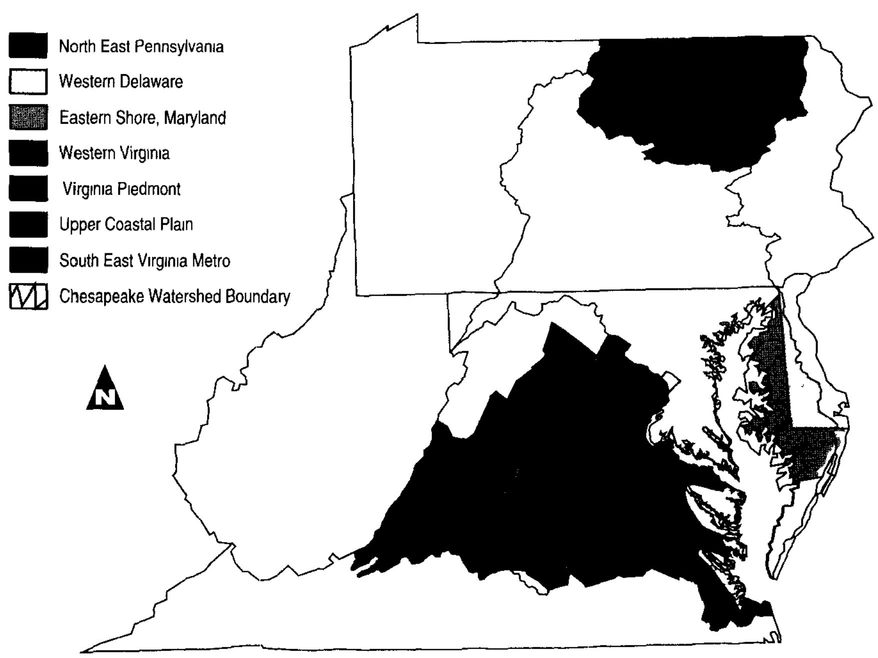
The ERNS evaluation indicated that most accidental releases in Region III were from fixed facilities (Figure 21). Releases on the highways also accounted for a significant portion of these accidents, especially in the populous eastern areas of Region III. Equipment failure appears to be a leading cause of these releases. Dumping also accounted for a significant proportion of the releases. Air and land appear to be the primary media affected by accidental releases.

CASE STUDY: Wetlands

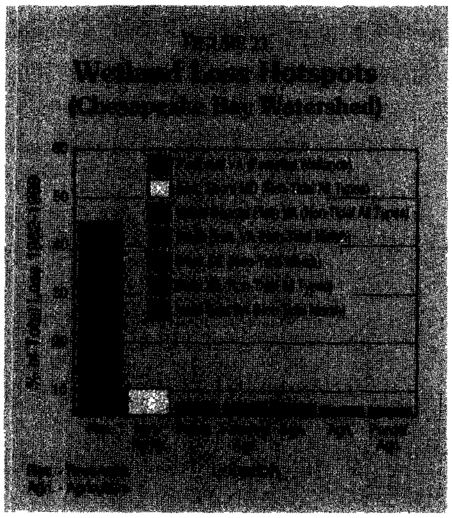
Using environmental data to manage our wetland resources is a priority of Region III. Our goal is to continue to implement a focused wetlands enforcement program where Region III is the lead Federal enforcement agency. A data-driven examination into the causes and locations of loss of Wetlands in Region III from 1982-1989 (Figures 22 and 23) showed that the largest areas of wetland losses were in Piedmont Virginia; the Tidewater area of Virginia; Eastern and Western Pennsylvania; Delaware Inland Bays/Southern Delaware, and the Anacostia River Basin. The largest sources of loss, in order of magnitude, were flooding for reservoirs and lakes, agriculture, pond construction, and urban/suburban development. Changes in wetland type, from forested to emergent, due to forestry practices were also significant. Management priorities were then realigned to include participation in the Virginia Raw Water Workgroup, opposition to the Churchman's Marsh Impoundment, and sponsorship of the Storm Water/Wetlands Task Force. Region III has increased its surveillance activities in the targeted areas, initiated appropriate enforcement activities for known violations, and developed communication strategies to provide a deterrent effect for others in the targeted areas or sectors. Region III is also developing a computerized database that will include site-specific information on enforcement actions, Section 404 permit actions, and enforcement actions by the Army Corps of Engineers. These data systems will facilitate future targeting efforts.

The data-driven strategy currently employed was developed in the Wetlands Enforcement Strategic Plan. Surveys were sent to

FIGURE 22
Wetland Loss Hot Spots
(Chesapeake Bay Watershed)



Sources of Data
Geographic Information Center, EPA Region III Prepared by R O.W Sciences, March, 1995 ROW-GIS.061



numerous Federal and State resource agencies to determine the high-value wetland resource areas in their jurisdiction that were deemed at-risk. These high-value/high-risk areas were targeted, and agreements with the Corps' Pittsburgh, Baltimore, Philadelphia, and Norfolk Districts were revised to give Region III lead enforcement status in all areas. We also developed revised Interagency Agreements with the US Fish and Wildlife Service to provide field support in these areas.

To facilitate future enforcement actions and targeting efforts, and to provide a means of assessing the success of the enforcement program, a computerized database of all permit and enforcement actions will be developed. Initially, measures of success tracked will include: geographic initiatives completed, cases resolved through voluntary compliance, administrative actions taken, civil/criminal referrals made to the Department of Justice, civil/criminal referrals that result in a final court order, and number of permit applications. Proposed new measures would be the number of environmentally beneficial Supplemental Environmental Projects developed and implemented, and the number of press releases resulting in favorable news reporting on enforcement actions taken. Eventually, as the database is developed, measures of success will be keyed to the number of actions taken in targeted areas or by activity classification, and to the number of wetland resources restored or otherwise protected by the actions. This can be determined by acreage, location in a priority watershed, and/or functional value.

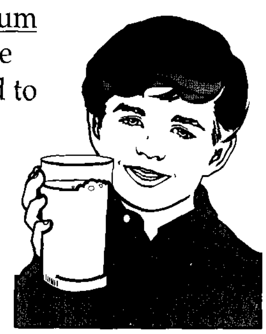
A real measure of success may be shown, over time, to be a decrease in the number of violations and an increase in the number of permit applications within the targeted areas. Finally, proactive efforts such as the development of advanced identification studies, public meetings, training classes may be held in the target areas.

CASE STUDY: Gunpowder River Watershed Project, Maryland

The Gunpowder River watershed, in Baltimore and Carroll Counties, MD, with a small portion in PA (Figure 24), lends itself to the application of the concept of "watershed planning." It is a sensitive watershed, containing public water supply reservoirs and trout streams that need protection. It is adjacent to highly urbanized areas, has rapid growth in some areas, but also has significant agricultural acreage, and serves as a significant recreational resource. Local jurisdictions are facing urgent programmatic (i.e., regulatory/permitting) complexities in sub-watersheds of the Gunpowder that could be resolved by approaching watershed management in a comprehensive and holistic manner.

There are several key permit issues of current concern in the Gunpowder River watershed. The first concerns the proposed expansion of an existing wastewater treatment plant that empties to Piney Run, a sub-watershed of the Gunpowder. The locality served by this facility has been designed as a growth area by Carroll County. The permit for this plant has been appealed and will be heard within the next several months. The basis for the disagreement is downstream impacts, an issue typical of watershed concerns.

Another key concern is reservoir protection. The Gunpowder watershed serves as the primary source of water supply for 1.5 million residents of the greater Baltimore metropolitan region. A catchment area of 303 square miles provides an average of 180 million gallons per day to this important region. Emerging drinking water quality concerns such as disinfection by-products, herbicides and pesticides, and the disinfectant-resistant pathogens Cryptosporidium and Giardia are directly related to land use in watersheds across the U.S. As a result, watershed management is vitally important to the continued efficient and economic provision of safe drinking water for the region's residents.



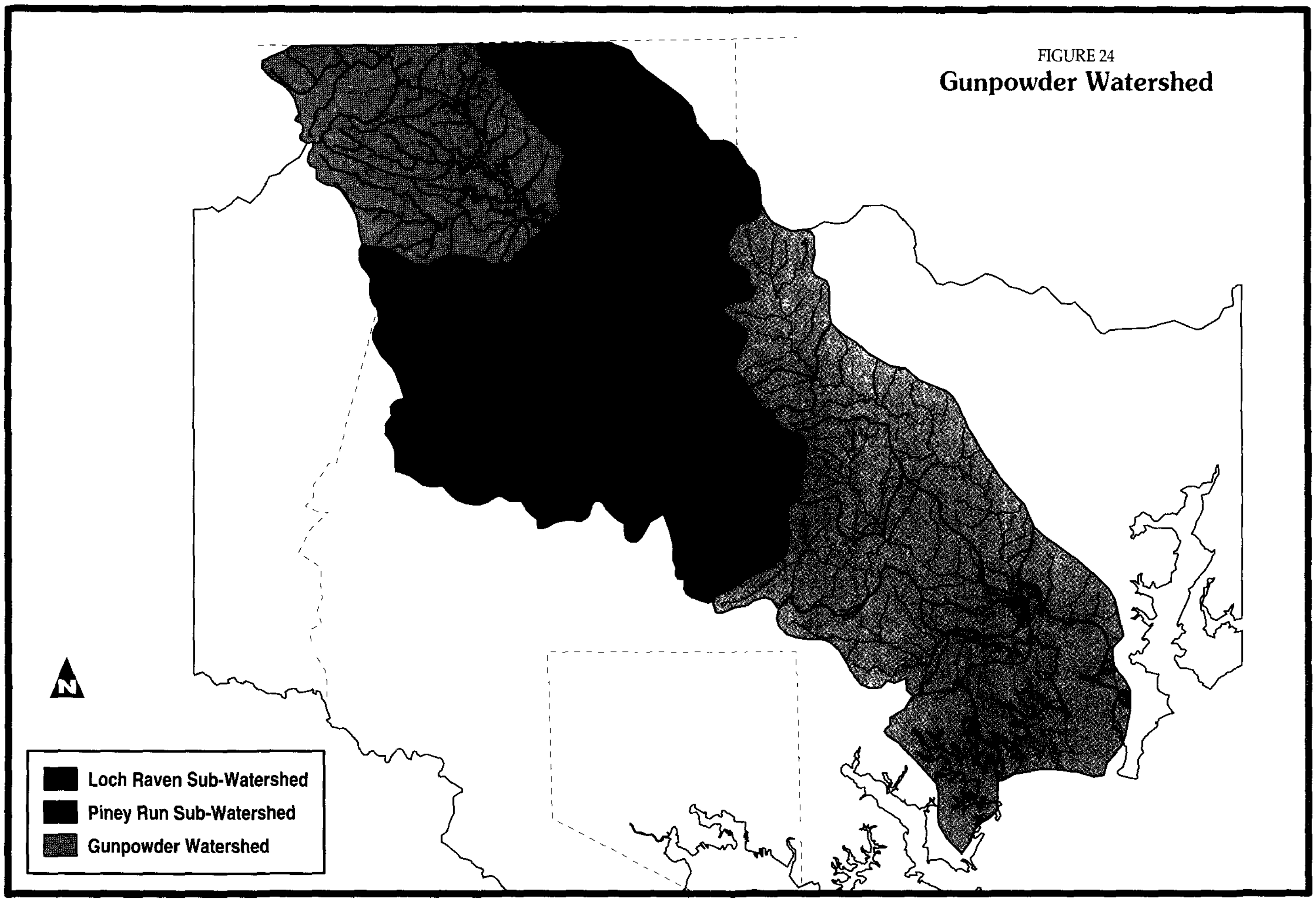


FIGURE 24
Gunpowder Watershed

In spite of extensive rural conservation zoning, there is continuing pressure for development in this watershed. The use of mountain bikes in the reservoir protection area is now being debated. There are also citizen concerns about the Parkton landfill, which presents a potential ground water threat. All of these issues, plus water appropriation and erosion/sediment control, are related to the issuing of permits or regulatory programs.

Concurrently, an ongoing study is being conducted by Baltimore County in the watershed of Loch Rave reservoir, another sub-watershed of the Gunpowder River, as part of the conditions for an NPDES stormwater permit. Results of this study, which are to be available by September of 1996, will contribute greatly to our understanding of the watershed, especially for nonpoint pollution sources.

There is a need to evaluate the relative contribution of loadings from nonpoint sources, both urban and agricultural, and point sources within the watershed for nutrients and toxic materials, as well as for changes in physical parameters such as temperature and volume of stormwater runoff. In addition, there is a need to link the chemical loadings and changes in physical parameters to resource degradation (both water quality and habitat). The increased understanding of these impacts will allow a determination of the best combination of point source controls, agricultural and urban nonpoint source controls, and resource-based restoration strategies.

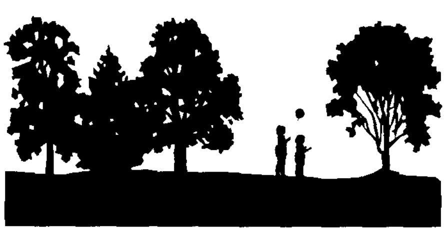
Assessments of these or similar issues have been done in the past, but each aspect of the problem (e.g., permit modeling, urban nonpoint source, agricultural nonpoint source impacts, landfills) was evaluated in isolation. Conducting a holistic watershed assessment of the Gunpowder can answer specific concerns related to growth and development, water supply protection, excess nutrients, elevated temperatures, increased stormwater flows (volume and quality) and their effects on stream erosion, while also providing an opportunity to link these concerns, prioritize resource management options, and guide program implementation.

CASE STUDY: Sustainable Development

Region III's Strategic Planning Team selected Sustainable Development as a Regional priority for Fiscal Year 1996. A workgroup preparing an Action Plan began by developing goals and objectives, and then conducted roundtable discussions with six organizations experienced in Sustainable Development to share their perspectives on what EPA's role in Sustainable Development should be.

The organizations were: The Nature Conservancy, Environmental Law Institute, Pennsylvania Environmental Council, Heritage Conservancy, Urban Land Institute, and the Citizens Network for Sustainable Development. The feedback from these stakeholders was consistent - they want access to EPA's data and information for identifying trends in sustainability and making better decisions. Sharing data and information thus became a key objective of the Action Plan.

Another key component of the Action Plan is the Sustainable Development Challenge Grants Program, a new grant program intended to catalyze community-based and regional projects that promote sustainable development, and to build partnerships that increase community long-term capacity to protect the environment. Communities will need to find and use reliable information and data as they implement these projects.



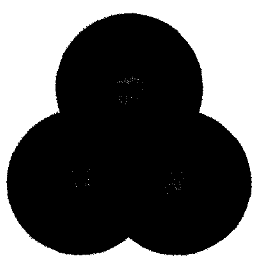
The Action Plan developed by the Workgroup includes four major goals for Sustainable Development in Region III.

These are:

1. Develop partnerships with other organizations to advance Sustainable Development.
2. Integrate Sustainable Development into EPA's infrastructure.
3. Increase awareness that environmental health goes hand-in-hand with economic well-being and community values.
4. Define the long-term vision of sustainability for the Region.

FIGURE 25
What is Sustainable Development?

Sustainable Development meets the needs of the present without compromising the ability of future generations to meet their own needs.



To address Goal 4, Region III is developing key social and economic indicators that, when combined with EPA's comprehensive environmental indicators, will give a snapshot view of where the Mid-Atlantic Region is on the continuum of sustainability.

These indicators are being created through a combined effort of the Region's Data Team and Sustainable Development Workgroup, with a preliminary set of six indicators being developed in mid-1996. The Workgroup will use these indicators to identify trends and pinpoint information gaps.

The ultimate goal of this project is the development of a comprehensive set of indicators that clearly demonstrates trends in the environment, economy, and society, and the use of these data to set priorities for Region III. The interaction of these trends is shown schematically in Figure 25.

Developing Sustainability Indicators is a work in progress that will build upon other efforts underway in the Region, including the Chesapeake Bay Program's Land, Growth and Stewardship, and Sustainable Use Indicators project. This project is being supported by a workgroup composed of over 40 people representing a diverse group of non-profits, local government, States, and other Federal agencies. The work group has selected key ecological, community/social, and economic indicators, and now plans to develop these indicators using data from a variety of sources.

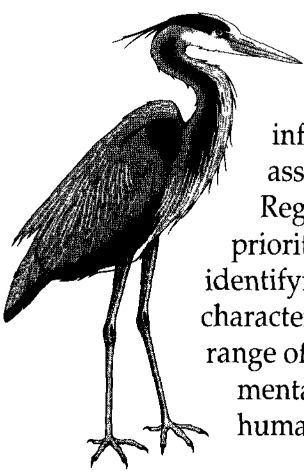
The development of Sustainability Indicators is a data management challenge because the data exist in many different forms, are located at the County, State and Federal levels, and are owned by different organizations. However, the indicators developed from these indicators will be a valuable management tool to EPA and show the connection between economic, social, and environmental policies.

Environmental Indicators Development

Region III's Senior Leadership Team decided in 1992 and 1993 to focus on improving the quality of environmental data and developing Environmental Indicators, especially at levels 5 and 6 on the continuum of measures. A key part of the decision was a study which attempted to collect data and develop environmental indicators to change the way management set priorities.

The presentation of the study results also led to the decision to focus on reducing Acid Pollution and Ozone Pollution and on restoring the Chesapeake Bay as the important Region III environmental efforts. Based on the study, Region III decided to institutionalize and continue the process of using data to make decisions and establish priorities for the Region. Ultimately, we hope to have a full set of Environmental Indicators available for each of the Region's environmental objectives.

The overall objective of the effort to develop environmental indicators is to collect and use scientifically defensible data and information to assist in setting Regional priorities, by identifying and characterizing the range of environmental and human health risk threats in Region III, and to aid in environmental results-based decision-making throughout the Region by federal, state and local agencies.



Regional staff from all programs are working together to develop better data and indicators for Acid Mine Drainage; Acid Deposition and Ozone Pollution; and Sustainable Development.

Data from all programs is also being gathered to create a "State of the Environment in the Mid-Atlantic Region" Report, which will be made available to EPA staff and to the general public.

The report will be published in hard-copy in the future (probably in 1997). As each section is completed, it will be installed on the World-Wide Web. This process should be underway by the end of 1996.

Region III staff is also working with staff from EPA's Office of Research and Development (ORD). A team representing both organizations is working to enhance the science, technology, and information management capabilities and experience of Region III, ORD, as well as other federal agencies, state/local governments, and regional academicians.

The Region's staff is working with internal and external customers, partners and stakeholders to:

- *define realistic environmental goals and related environmental assessment questions;*

- *characterize ecological resources conditions for the geographic area (e.g., ecoregions, watersheds) based upon exposure and effect information;*

- *identify possible association with stressors including landscape attributes that may explain impaired conditions for both specific resources and the overall ecosystem;*

- *manage for the long term, providing the set of multiple uses of ecological resources that society now desires without undermining the system's capacity to provide these and other uses in the future;*

- *target geographic areas and critical resources for protection, restoration, or other management action;*

- *measure environmental progress;*

- *improve the quality of environmental science; and*

- *promote the use of "good science" in environmental decision making for greater environmental results.*

Some of the programs for which we have specific plans for cooperative efforts include the Environmental Monitoring and

Assessment Program (EMAP), the mid-Atlantic Highlands Assessment (MAHA), the National Biological Survey's Gap Analysis Program, the Chesapeake Bay Program, the Delaware Estuary program, the Maryland and Delaware Coastal Bays Program, the Virginia Coastal Bay Program, the Forest Service Forests Integrated Assessment, and the National Oceanic and Atmospheric Administration's (NOAA) Coastal Change Analysis Program.

The information developed is being applied to regional needs, such as the Environmental Partnership Agreements, State of the State reports, programmatic strategic planning, and sustainable development planning.

In applying the data assessment process, an orderly sequence is followed:

1) EPA personnel develop "first cut" assessment questions based on their organizations' perspective;

2) an Assessment Team is formed of scientists and managers from various EPA organizations, other federal (NOAA, U.S. Geologic Survey, Forest Service, etc.) and/or state organizations;

3) an Assessment Workshop is held where EPA personnel present the first cut questions for discussion. Team members from other federal organizations and states discuss their research and monitoring programs and present the assessment equations which their organization have been addressing. Questions are compiled and edited using a consensus approach.

4) revised Assessment Questions are sent to all Assessment Team members for review and comment; and

5) final Assessment Questions are agreed upon.

Assessment workshops have been held for Estuaries and Coastal Waters, Surface Waters (Streams), and Land use/Landscape. Each of these workshops followed the process identified above. Assessment questions have been developed for each resource. Assessment Workshops are also planned for Agriculture, Air, Forests, Ground Water, Wetlands, and Socio-Economics. Each Assessment Workshop will produce a document summarizing the process and including the Assessment Questions. The Region III/ORD team is coordinating the productions of the Workshops and subsequent reports.

Once the inventory is complete, all staff working on indicators will start the process of identifying and filling data gaps. This is expected to be a long and iterative process which will take a systematic approach over several years.

Logic Model

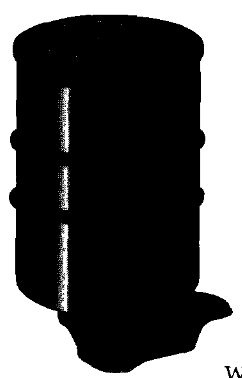
Region III relies on a logic model (see Figure 26) to develop the data sets which support outcome based plans of action. The model is a special adaptation of the Environmental Indicators continuum which was developed to use more practical terminology that was generally familiar to the Region's program staff.

As in the other versions of the continuum, the broadest environmental measures - receptor and stressor conditions - are at the top. Administrative measures are at the bottom. The model is based on the premise that it is necessary to use data at all levels to manage for environmental results. This also means that data at all levels are considered equally important in the process once their position and relevance in the model has been determined.

For example, if the receptor of concern is preservation of wetlands, administrative measures that show the level of resources available to the wetlands program, or activity measures such as the number of permits reviewed and issued, are important indicators of our commitment to preserving wetlands. The role of the model is to integrate this information with information about the environmental condition of wetlands and use the resulting analysis as a planning tool for future action.

The model can be used to plan at different levels. For instance, senior managers can use the model for "big picture" strategic planning for an entire organization. In EPA, this means comparing model information from several sets of stressors-receptors, since our strategic plans set cross-media priorities.

Within media or programs, the model can be used to set priorities for a program component (e.g., wetlands), a geographic area (e.g., wetlands in the Pocono Mountains), or a specific resource (e.g., wetlands in the Pocono Mountains with marketable quantities of peat moss).



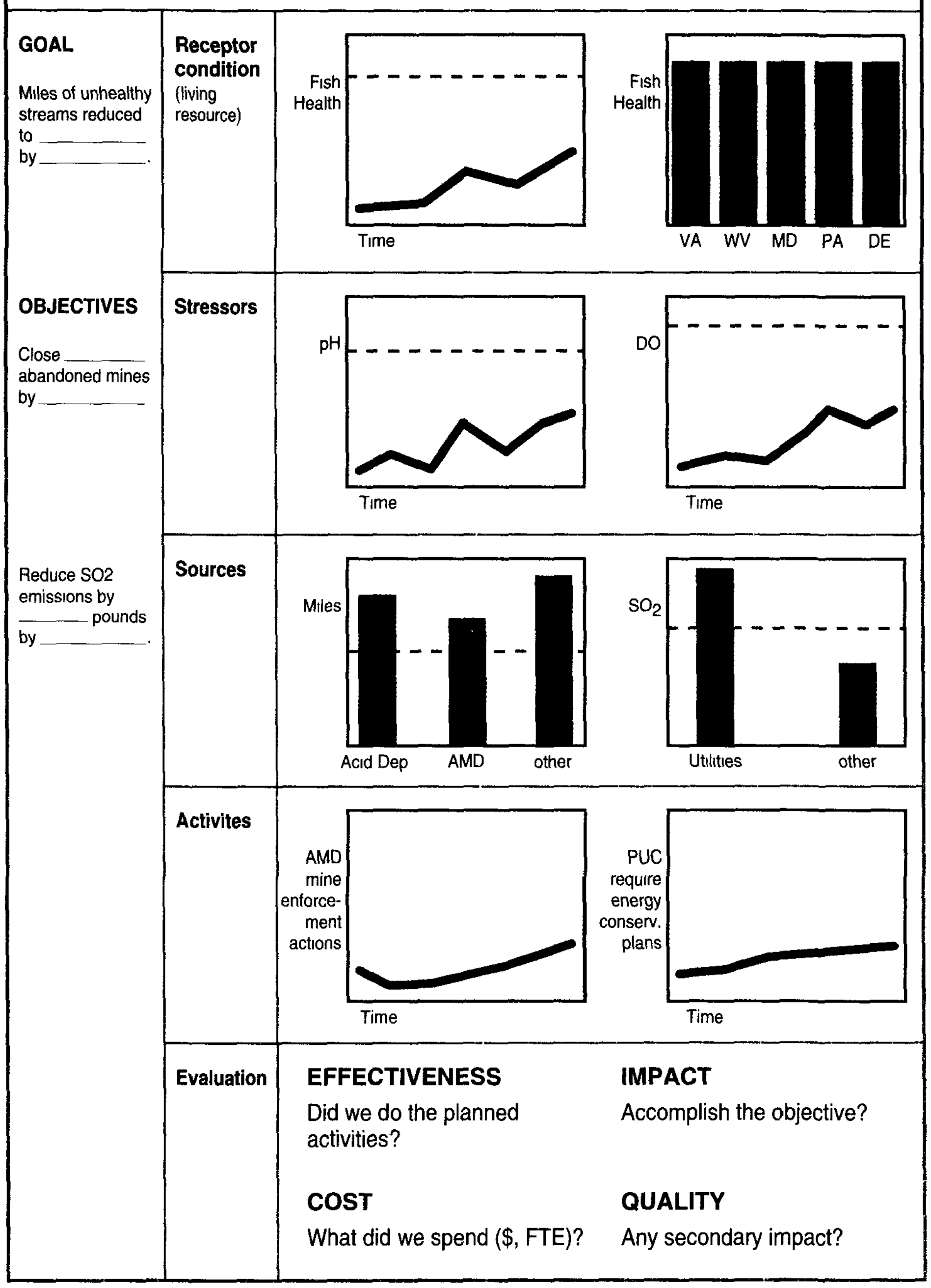
In each case, the model allows us to see the relationship between program elements and very different types of data.

Our experience in using the model has also reinforced one of the most basic lessons of the ERBM approach: use all available data that are known to be reliable.

We frequently find that we must make decisions, to meet external deadlines, before it is possible to develop data at all levels of the model. In these cases, we use the best available data on stressors, sources, and activities.

Data gaps are addressed by using surrogate measures, usually activity reports and ambient concentrations.

FIGURE 26
LOGIC MODEL for Environmental Planning



This way, we can project the probable course of future activity.

Our overall concern, and our long-term objective, is to:

- *develop accurate, up-to-date, reliable information on stressors and receptors for all major ecological regions and systems in Region III, as well as all major environmental causes of adverse human health conditions;*

- *develop models that allow us to relate EPA/State activities and actions by sources to the stressors of concern; and*

- *gain wide-spread acceptance for the use of the model as a major planning and evaluation tool in the Region.*

Meeting our objective will take several years. The most difficult part will be developing data in the field. It is an expensive, time-consuming process. Our commitment to improving data and developing environmental indicators is dependent on our ability to meet this challenge.

Using Data to Define Programs

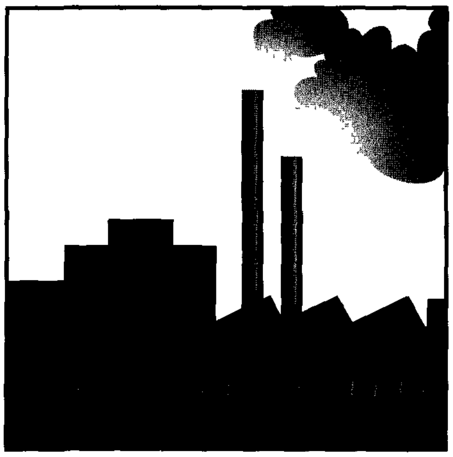
One of the basic uses of data in management is to change priorities and program direction based on the story told by the data. This section presents some examples of how expanded data collection and expanded capabilities to manipulate data can change program direction.

Toxic Release Inventory

Congress created the Toxic Release Inventory (TRI) in the mid-1980s. Under TRI, EPA listed 300 chemicals that were considered toxic. Businesses that make or use any of the listed chemicals are required to make annual reports to EPA. Section 313 of the Emergency Planning and Community Right-to-Know Act of the Superfund Amendments and Reauthorization Act (SARA) of 1986 established the TRI requirements, which were subsequently expanded under the Pollution Prevention Act of 1990. The reporting requirement applies to facilities that have 10 or more full-time employees, that are classified by Standard Industrial Codes (SICs) 20 through 39, and that process or otherwise use a listed toxic chemical in excess of specified threshold quantities.

The first reporting year was 1988, with facilities reporting within six months after the end of the calendar year. EPA publishes the "Public Release" in the spring or summer of the year following the reporting of the data. TRI data are available to the public in public and federal depository libraries nationwide. Since the number of chemicals that must be reported is dynamic, with chemicals being added or delisted during any given year, the report is a "snapshot" of the year. The exact number of chemicals, and variations of the chemicals, is not always reported in the year's publication; however, the following list indicates the general increase in the number of chemicals inventoried through this program:

1987 > 300	1988 > 300
1989 328	1990 > 300
1991 320	1992 > 300
1993 316	1994 343
1995 650	



The initial TRI reporting requirements led to two immediate responses: the companies filing the reports began to change their operations when they saw that there were potential cost-savings available if they were more careful in managing the flow of chemicals through their processes, and EPA initiated the "33/50" program, a voluntary effort to reduce the release of 33 chemicals by 50% in five years. The initial five-year period ended in December 1995, but it will be mid-1997 before the results are known.

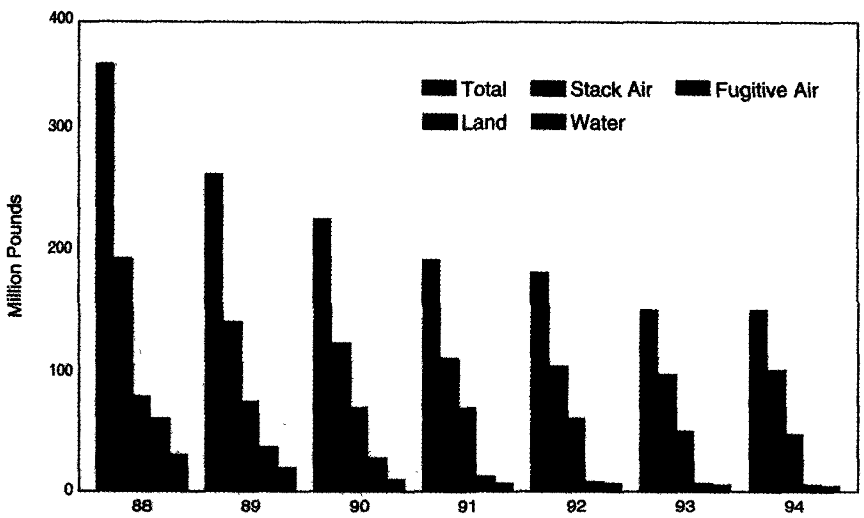
EPA also uses TRI data to identify potential problem areas. By comparing facilities filing TRI reports with facilities on other data bases, EPA can find sources that should be inspected to see if they are subject to other regulations. Information on the reports has also been used as background information in developing new regulations.

The record of companies reducing emissions is very impressive. Since 1988, manufacturers in Region III have reduced releases of toxic chemicals from 344 million pounds to 161 million pounds in 1993, a reduction of 53%. Although there was a slight increase in Region III from 1993 to 1994, nationally there was an 8.6% decrease in emissions. A preponderance of the emissions and corresponding reductions are related to air pollution sources and facilities. Figure 27 shows Region III emission trends in the 1988-1994 time frame.

Region III facilities reduced their air releases of ozone-depleting chemicals from nearly 15 million pounds in 1991 to about 5.3 million pounds in 1993. Air water, and land releases of carcinogens declined from about 23 million pounds in 1991 to about 16 million pounds in 1993, and approximately the same amount in 1994. Manufacturers have reduced toxic chemical wastes shipped off-site for treatment and disposal by 41%, from 196 million pounds in 1988 to 139 million pounds in 1993. 1993 TRI data indicate that manufacturers in Region III have recycled 45.2% of their toxic chemical wastes.

The majority of these reductions in toxic chemical releases and

FIGURE 27
TRI Releases 1988-1994
(EPA Region III)



wastes were not required by law. Rather, they were the result of an increased focus by industry on environmental improvements, and an effort to adopt measures to reduce toxic chemical releases. These measures include raw material substitutions with non-toxic chemicals, process modifications to implement recycling, improved maintenance to reduce air chemical leaks, and increased usage of nontoxic cleaning solvents and degreasers.

Water Quality Information Assessment

When Region III's Water Pollution Control programs were reorganized under EPA's reinvention and streamlining initiative, some basic concepts were changed about how the programs operate and implement legislative mandates such as the Clean Water Act, the Safe Drinking Water Act, and the Coastal Zone Reauthorization Act. One major change expanded the process of using data on which to base our decisions and to help drive the program's priorities and resources. The environmental problems we are addressing today are much more complex than those that caught our attention twenty-five years ago. Also, we are dealing with larger areas (watersheds) and different contaminants. Figure 28 illustrates how this approach can be used; the figure shows the percent of major Pennsylvania watersheds affected by various pollutants.

The need for better data and more specific levels of data to go beyond the current level of information available resulted in the formation of a team to obtain better data to address these new challenges.

For the most part, the status of the water quality in the Region can only be addressed in very broad terms, such as at the state level, since there is no comprehensive data base of most water resources at a more specific (i.e., watershed) level. Some data are available, but they are not easy to access or compile. The environmental data gathered for regulatory and management purposes are developed for specific pollutants or permit applications, and are scattered throughout various databases and agencies. Many of these databases and collection efforts are important, but they do not contribute to a comprehensive data base that can be used to answer questions about the integrity of the Region's waters, nor can they be easily accessed and understood by the public.

As a first step in improving the utility of these data, the various EPA databases were collected, compiled, and synthesized to form a fluid database that will determine what is known and what is not known. To augment and fill in the data gaps, databases from other Federal agencies, state and local governments, and universities are being added. The goal is to be able to share the information, identify common priorities and problems, and work together to jointly develop solutions to solve environmental problems.

FIGURE 28
Water Quality Non-Attainment
(PA River Systems)

CAUSE	% AFFECTED
Metals	77.6%
Suspended Solids	73.5%
Organic Enrichment	71.4%
Nutrients	67.3%
Pathogens	49.0%
pH	46.9%
Priority Pollutant Organic Compounds	38.8%
Pesticides	26.5%
Thermal Modifications	24.5%
Salinity/Total Dissolved Solids	20.4%

Geographic Information Systems

A major tool being used by the EPA to synthesize databases is

ARC/INFO, a type of Geographic Information System (GIS). GIS is a computerized system used for the storage, manipulation, display, and analysis of spatial environmental data. It is a data integration tool that combines sophisticated mapping capabilities with a large computing capacity. It enables extensive multi-media analysis and evaluation in geographic areas that were previously too time-consuming or difficult to investigate. Given these capabilities, it is an excellent tool to synthesize the various databases to describe the state of the water resources in the Region, describe and measure trends, and help to identify and prioritize environmental policy.

Protecting the environment is a job that is inherently geographic in nature. Understanding the spatial relationships among natural resources, human populations, and known or potential pollution sources is critical to accomplishing the Agency's mission. GIS provides a set of tools that allows us to integrate and analyze existing environmental data in a spatial context. With GIS, we can dynamically combine data about air, water, and soil to better visualize and understand the natural interactions among these media, and highlight areas of environmental interest or concern.

EPA is one of the largest consumers of spatial data in the civilian government. The Agency s experience with GIS began approximately eight years ago with the phased development of GIS capabilities in each of the EPA's ten Regional offices, Headquarters, and the Laboratories. EPA currently uses Environmental Systems Research Institute's ARC/INFO GIS products on a network of Data General and Sun Unix workstations. There is currently a GIS support team of five to ten GIS professionals in each of the ten Regional Offices.

GIS is used to help EPA, States, and the public better understand the often complex nature and extent of problems caused by environmental pollution. For instance, EPA collects large volumes of monitoring and sampling data for each hazardous waste site that is investigated. GIS has proven to be an effective tool in both managing and analyzing this data, and in presenting results in a form that can be readily understood by nontechnical staff and the public (for example, several of the maps in this publication were generated from EPA's GIS system). GIS has been used to model soil and ground water contamination, providing EPA scientists with much needed information. Maps are then produced and used in public meetings, graphically portraying the nature and extent of contamination.

EPA is charged with insuring that environmental laws are enforced equally, without respect for race, ancestry, or economic status. To do this, it is necessary to identify the spatial relationships between potential environmental hazards and the demographics of human populations. GIS is being used to provide EPA staff and the public with detailed demographic information about potentially exposed populations. To date, maps and statistics have been created for hundreds of EPA-regulated facilities. These are used by EPA staff to help insure that minority and low-income populations are not disproportionately exposed to potential environmental hazards.

Another area where GIS has been extensively used is the Radon Program. This Program is charged with characterizing the extent of radon in the Region, and assisting the states to realize their goals in addressing the radon problem. GIS is used to aggregate the sampling data by zip code and county; from this, maps are produced showing the percentage of readings above a maximum acceptable level. These maps have been sent to state and local governments for use by their radon programs. They have also been used in public hearings, and distributed to the American Lung Association, Housing and Urban Development, and some Congressional Offices. GIS has also been used to identify schools that are in high radon areas. The results are used to determine where schools should be tested for radon.

With the Agency's emphasis on place-based management, the reliance on GIS technology will continue to increase. A further use of GIS technology is to place this software at the desktop so that EPA technical staff can have better access to spatial data and analytical tools.

All Region III States are also utilizing GIS technology to help their technical staff better understand environmental problems. EPA is developing spatial data libraries that can be shared by EPA, States, and other Federal Agencies in order to make better use of the GIS technology.

Environmental Partnership Agreements

Environmental Partnership Agreements (EnPAs) represent a new approach to creating meaningful partnerships between EPA and the States to achieve positive environmental results. Mutual agreement between the state and EPA is the key to EnPA development.

Each agreement is developed as the product of a joint planning and priority-setting dialogue between an EPA Region and a state. In part, the dialogue is guided by analysis and strategic direction set by EPA National Program Managers. Senior program managers from the state and region structure and lead the dialogue. State program self-assessments (an evaluation by the state as to how they have performed in protecting or remediating the environment) are the basis for the dialogue.

The purpose of the dialogue is to:

- *reach an understanding regarding environmental conditions in the state, together with probable causes of environmental problems and opportunities for environmental gains;*
- *agree on the appropriate national and state-specific environmental goals, program-performance indicators, and multimedia activities, along with state commitments for specific deliverables and types of activities that address environmental and programmatic opportunities and/or weaknesses;*
- *agree upon the allocation of federal resources toward shared goals and priorities, the work to be done, and any disinvestment made necessary due to limits on available resources;*
- *agree on commitments for specific and more integrated federal technical assistance for targeted program elements that need improvement (e.g., training, IPAs, etc.);*
- *agree on any joint ventures or shared enterprises to better accomplish environmental results that reflect regional, pollution prevention, or ecosystem goals.*

The outcome of this dialogue is an EnPA that reflects state and federal interests, concerns, choices, and commitments for sound environmental performance. The agreements are signed by the state's Environmental Secretary and EPA's Regional Administrator. In Region III, the first EnPA was negotiated with the State of Delaware and signed at the beginning of Fiscal Year 1996.

A core element of any EnPA is an increased reliance on environmental indicators; such emphasis is essential for ensuring a sustained focus on environmental outcomes. While activity measures such as number of inspections conducted per month or year still provide valuable insight into program effectiveness, and can complement environmental indicators, the basic goal of an EnPA is to shift the primary focus of the EPA and state dialogue from "bean counting" to identification of environmental priorities for each state, and the selection of appropriate actions to address those priorities. Previously, too much attention had been directed to counting actions, rather than to the outcomes and values of those actions, or to alternate actions that might be pursued to achieve the same objective.

The Delaware EnPA

For the Delaware EnPA, each division in Region III and the Delaware Department of Natural Resources and Environmental Conservation (DNREC) was involved in drafting the agreement. At least one senior person from each division or office was a core group that directed the process from inception to signing and into implementation. In Region III, a different division director has been assigned the lead to develop an EnPA with each state.

Prior to the development of EnPAs, National Program Managers would determine the goals and commitments for each of the EPA's programs. The regional programs would then translate or transfer these requirements to each state through state grants, delegation agreements, or other vehicles. Implementation of an EnPA requires a paradigm shift; under an EnPA, goals and commitments are established in concert by both the state and EPA regional office, and are based on environmental needs of the state as demonstrated by existing data. These commitments are incorporated in the EnPA, and are then reflected in the agreements that the particular EPA region has with EPA Headquarters.

The guiding principle of the EnPA is the Family of Measures (FOM). The FOM uses the Logic Model to link environmental indicators to the stressors that contribute to the environmental condition, then to the sources of the stress, and finally to the activities necessary to impact the sources. In other words, we can determine what to do about the sources of stressors, having identified the environment at risk, and the stresses that threaten it. It is at the activity levels that program integration can be demonstrated. This is where air, waste, and water programs can clearly see how their activities contribute to a single goal.

The example discussed here is taken from the Delaware EnPA. It is shown in Figure 29 and uses the goal of controlling point and non-point pollution to show how related objectives all combine to achieve that goal. Because the sources of point and non-point pollution are multiple and occur through different media (e.g., air, water, solid waste), the ERBM approach is to consider all of these sources, propose reasonable measures to reduce the sources, and implement practical measures to restore environmental features already affected by these stressors. Thus, the ERBM approach proposes the reduction of TRI emissions, the reduction of pollutant loadings to public wastewater treatment plants, the incremental cleanup of affected surface waters, and the implementation of selected action items from an approved management plan. This holistic approach uses existing regulations, environmental data, management plans, and other programmatic elements in a practical mix to address a well-recognized environmental problem. As Figure 29 illustrates, the approach identifies realistic numerical goals and incorporates strategies from a number of existing programs.

FIGURE 29

KEY GOAL: Improve Surface Water Quality
(Objectives to reach Key Goal)

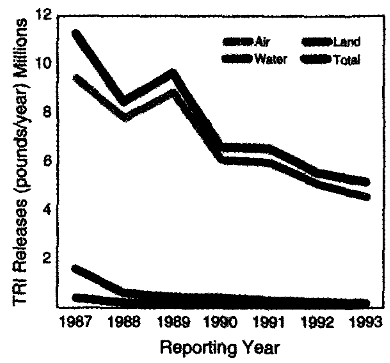
1. Reduce TRI emissions by 30% as compared to 1989 levels.
2. Reduce loadings of pollutants by 5% to publicly-owned wastewater treatment facilities through voluntary pollution prevention means, with concurrent reduced releases from the treatment facilities.
3. Increase the number of river/stream miles and lake/pond acres meeting designated uses by 5%.
4. Implement at least 5% of the CCMP's action items in Delaware's portion of the Delaware Estuary and the Inland Bays Estuary.
5. By the year 2000, reduce 1993 actual SO2 emissions by 6,770 tons/year via the Phase II Acid Rain Control Program.
6. Increase the number of approved marina Operation & Maintenance (O&M) plans by 10%.
7. Increase the linear footage of shoreline stabilized with rip-rap or vegetation by 20% per year.

The background data on TRI emissions and SO2 in Delaware are shown as Figures 30 and 31.

Although these data by themselves are important to evaluating the health of the environment, the long-term objective of the ERBM process is to trace the relationship between the emission reductions and actual water quality. The same objective holds for data from treatment plants and other sources of stressors contributing to degraded water quality.

FIGURE 30

Toxic Chemical On-Site Release Trends in Delaware



Use of environmental data also levels the playing field because it clearly describes the prevailing environmental conditions, stressors, and causes. Once the data are on the table, negotiation of priorities and commitments can proceed without the traditional programmatic issues. Use of environmental data serves to put everyone on the same page with the same goal in mind.

Some of the environmental indicators used in the EnPA are output-based, not result-based or outcome-based. This was anticipated during the first years of the agreement in order to add structure to the state's and region's commitment to indicator development.

The following objectives were incorporated into the agreement.

- *We will significantly increase our utilization of environmental goals and indicators in all of our programs.*

- *We will elevate the quality of our environmental indicator systems.*

- *We will improve the integration of environmental goals and indicators with other environmental management tools, techniques, and methodologies.*

- *We will establish a network of policy-makers and technical professionals from our respective agencies who have a broad interest in environmental management and specific interest in goals and indicators.*

- *We will identify shortcomings in data management, develop a plan to better integrate databases, and begin to implement a data management system that will maximize the utility of the DNREC's data for its users, other federal/state/local agencies, and citizens to support identification and use of environmental indicators and for other purposes.*

- *We will identify a common set of indicators drawn from available sources that we can use as the foundation for the development of an indicator system appropriate for Delaware's environment.*

During the first year of the agreement, Delaware and Region III have inventoried all existing environmental data, and are in the process of selecting the appropriate suite of indicators for future development and use.

FIGURE 31

1993 SO2 Actual Emissions for Acid Rain Sources and Future Allowance

FACILITY NAME	POINT DESCRIPTION	Annual Emiss. in Tons	Allowances 2000-2009	Allowances 2010 & Beyond
City of Dover, McKee Run Power Plant	Boiler # 3	1,261.04	2,570	1,843
City of Dover, Van Sant Generating Station	Unit # 1 Gas Turbine	2.17	136	137
Delmarva Power Edge Moor	Boiler # 3	2,806.00	3,527	3,550
Delmarva Power Edge Moor	Boiler # 4	5,716.86	6,243	6,283
Delmarva Power Edge Moor	Boiler # 5	9,000.05	6,408	6,450
Delmarva Power - Hay Rd. Power Complex	Combustion Turbine # 3	1.66	156	158
Delmarva Power Indian River	Boiler # 1	4,961.49	2,972	2,992
Delmarva Power Indian River	Boiler # 2	5,131.48	3,156	3,176
Delmarva Power Indian River	Boiler # 3	8,869.29	5,396	5,431
Delmarva Power Indian River	Boiler # 4	12,880.68	13,300	13,088
	TOTALS	50,631.72	43,864	43,108

Voluntary Programs

An EPA priority is preventing pollution at the source. Pollution Prevention (P2) is a multimedia program. Data sources such as TRI, Emission Inventories, and the Chronic Index are used to rank priorities based on geographic areas of concern. In a given area, critical receptors are identified, e.g., streams, drinking water sources, airsheds, human populations, etc., using ambient condition databases.

Industrial waste streams are the focus for determining pollution prevention opportunities. Industrial processes are examined for possible reductions of the chemicals and solvents released through air emissions, stream discharges, and landfilled wastes. The Region III P2 program is developing means to encourage voluntary reporting by acknowledging a company's participation, and is beginning to require the use of the Environmental Indicators' Continuum for describing state P2 program activities. The following examples of Pollution Prevention are from the 1995 Pennsylvania Governor's Pollution Prevention Awards.

Small Business: by changing dye suppliers and replacing manganese sulfate with hydrogen peroxide, the producers of tanned leather were able to reduce their volume of solid wastes by greater than 80%, and significantly reduce the levels of antimony and beryllium in their biosolids. These changes have 1) reduced water use by 6 million gallons per year, 2) allowed the company to turn its treatment sludge into a new and valuable soil conditioner, and 3) dropped chemical usage from 100,000 pounds per year of manganese sulfate to 1,000 pounds of hydrogen peroxide.

Large Business: a major electroplater's former wastes included spent alkaline cleaners, acid-based etch solutions, and cyanide plating solution. Closed-loop recycling and evaporators with a closed-loop system on the cyanide rinse waters allowed the return of chemicals to the plating baths. As a result, 38,000 pounds of hazardous sludge were eliminated, 86,000 gallons of cleaner solution are recycled annually, 35,000 gallons per year of waste acid solution were eliminated, and 6,700 gallons per year of cyanide solution is no longer discharged into the local wastewater treatment plant.

Looking Beyond

Region III has been using the ERBM approach for several years. This report has focused on presenting examples of how we use available data to make decisions. During 1997, we plan to publish a companion volume that will have much more detailed information on our programmatic uses of data.

In reviewing our progress in implementing ERBM, Region III can count many successes. The Chesapeake Bay Program has developed a set of environmental indicators that are widely accepted and that are being used to define program goals. GIS technology has been applied to a number of programs, most notably Acid Mine Drainage. Both Ozone and Acid Precipitation are being addressed through data-driven strategic planning processes. The "Logic Model" is being used in the data assessments that each State must perform as one of the first steps in negotiating an EnPA.

Readers who are interested in more detailed discussions of particular approaches should be able to find such discussions in Volume II of this report. To request a copy, contact the Region III Publications number or the General Assistance Hotline. Volume II is expected to be available in the second half of 1997.

A Region III "State of the Environment" report is also under preparation. We expect to load the information for that report on our website as it becomes available. A hard copy summary may also be prepared.

When Region III's senior leadership team decided to focus on the ERBM approach, our motivation was to improve the scientific basis of our programmatic decisions so that we could focus the Region's resources and attention to the most important issues. In particular, we wanted to incorporate information on relative risk and human health or environmental quality into the equation.

Shortly after Region III decided on the ERBM focus, Congress passed the Government Performance and Results Act (GPRA). Under this Act, all federal agencies must develop their budgets according to a strategic plan, and must prepare detailed cost analyses of their operations. EPA will have to use long-term environmental trend information to show the efficiency and success of its programs.

The work that Region III is doing to develop ERBM supports the new legislation. As EPA implements GPRA nationally, Region III will continue its work to incorporate ERBM into the process. We hope that ERBM will become part of EPA's national response to GPRA.

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