Maryland's Environmental Indicators

A Draft Status Report

Winter, 1999

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A Draft Status Report

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Introduction

This report is the second in a series that provides a concise characterization, or "snapshot" in time, of some of Maryland's key environmental and public health parameters. The earlier report, issued in 1997, was the first step in a strategic planning process through which the State of Maryland and the U.S. Environmental Protection Agency have been redefining the federal-state relationship and have been advancing a results-based approach to environmental protection issues. As part of this process, the parties (known as Apartners@) have entered into two (fiscal years 1998 and 1999) environmental performance partnership agreements that seek to better coordinate efforts to protect human health and the environment. The environmental and public health conditions in Maryland and the partners' strategies for achieving their environmental and public health protection goals form the basis upon which the agreements were created.

For Maryland's environment and public health, broad programmatic goals may be defined in:

> Federal statutes, such as the Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act, Superfund, Endangered Species Act, or Food Security Act;
>
> State statutes, such as the Critical Areas Act; Nontidal Wetlands Protection Act; Lead Poisoning Prevention Act; Maryland Economic Growth, Resource Protection, and Planning Act; or the many sections of both the Environment and Natural Resources Article; and
>
> Executive Orders, executive policies, such as those ensuring Smart Growth, or directives from the Chesapeake Bay Executive Council.

For example, the restoration and protection of the Chesapeake Bay and its tributaries is an overarching goal for all of Maryland's environmental and resource protection programs. Consistent with that goal, Maryland committed to reducing nitrogen and phosphorus nutrients entering the Bay by 40% of the 1985 loads by the year 2000. Maryland also committed to achieving a 65% reduction by the year 2000 for certain types of toxic chemicals released into the water and air. Quantitative goals also have been established for the restoration of Bay grasses and the protection of sensitive riparian areas along Maryland's waterways.

Maryland established other important goals for the protection of environment and public health over the past decade. Local governments' solid waste management programs are to achieve 20% or 15% recycling rates (depending upon size of jurisdiction) according to statute and, in fact, have exceeded these goals in recent years. In 1998, the State's recycling rate was 32%. Federal and State regulatory standards also serve as specific benchmarks for achieving air quality, water quality, and safe drinking water.

The State of Maryland is committed to achieving these goals through implementation of environmental protection, resource management, and public health protection programs. Using its strategic planning process, the State is evaluating progress toward meeting its goals. Throughout this process, the State is continuing to seek the involvement of the public, interested organizations, and various federal, state and local agencies.

A New State-Federal Partnership

Enpa Background. In 1997, Maryland developed its first Environmental Performance Partnership Agreement (EnPA) with the U.S. Environmental Protection Agency (EPA). This agreement provided Maryland an important opportunity to refine its

environmental goals and outcomes, focus its programs toward results-based management, and assign appropriate State and EPA roles. In 1998, Maryland and EPA developed a second agreement. Both of these agreements used the 1997 indicators data to measure and report progress. Now the partners are developing a third agreement, which includes updated indicator information.

All of these agreements are key components of the National Environmental Performance Partnership System (NEPPS). EPA created NEPPS in 1995 as a new approach designed to provide greater flexibility, improved environmental outcomes, administrative savings, and strengthened partnerships between states and EPA. Under NEPPS, states and EPA may negotiate annual agreements that detail state priorities, goals, and performance measures, which help to ensure that states are accountable for meeting their goals. In turn, EPA will provide differential oversight of successful state programs and give states more flexibility in addressing local environmental and public health priorities.

EnPA Process. Maryland uses the following strategic planning process (see Figure 1.) The steps include:

Step 1. *Characterizing* Maryland's environmental conditions using public and ecosystem health indicators;

Step 2. *Assessing* the State's performance and effectiveness in addressing Maryland's environmental problems;

Step 3. *Establishing* priorities for targeting the State's resources needed to remedy problems;

Step 4. *Developing* an annual workplan that spells out what actions the State and EPA will take in order to achieve the desired environmental outcomes; and,

Step 5. *Implementing* the workplan and *evaluating* its effectiveness.

The EnPA process also helps fulfill Governor Parris N. Glendening's mandate for improving state agency performance on behalf of the citizens of Maryland through the results-based strategic planning process known as Managing Maryland for Results. This process also is consistent with the directives that state agencies have received from the Maryland General Assembly to improve various units of measurement and to focus management towards environmental and public health outcomes.

Involving the Public. Meaningful stakeholder involvement is critical to a successful partnership agreement. The State continues to actively seek broad stakeholder review and comment on the reports. The State will engage a wide range of stakeholders, including environmental and public health advocacy groups, citizen groups, elected officials, agency advisory groups, business leaders, educators, scientists, natural resources users, among many others. The State is making the updated indicators document available to its stakeholders using a variety of outreach tools, which may include direct mailings, State agency Internet Homepages (www.mde.state.md.us and www.dnr.state.md.us), public libraries, newsletters, among others.

Maryland's Environmental Indicators

Background. Traditionally, government has used programmatic measures that focused on measuring and reporting activities related to, for example, issuing permits, inspecting industrial facilities, or counting the number of enforcement actions. While these measures are useful for making resource management decisions and for tracking personnel activity, their usefulness as measures of true environmental performance is very limited. To more accurately portray the environmental and public health conditions in Maryland, the State is using environmental performance indicators. These indicators also are being reported in MDE and DNR's annual Managing Maryland for Results document, which is the state government's commitment to using results-based, quality planning and management approaches to achieving its goals.

Environmental indicators describe and analyze scientifically-based information on environmental trends, conditions, and their significance. Indicators can simplify complex phenomena so that a reader may more easily understand what is

happening in the environment. Use of environmental indicators to identify trends and conditions and assess their significance requires a strong commitment to long-term monitoring by local, state, and federal agencies. Such monitoring includes water quality and water quantity, aquatic and terrestrial biological species and communities, and atmospheric parameters. Not only is monitoring vital to describing trends and conditions, but also in describing and ranking existing and emerging problems, and in evaluating program effectiveness. Along with monitoring, it is critical that the State maintain accurate data bases and routinely evaluate the data to guide environmental management efforts and communicate status and trends.

Maryland has developed nearly 50 indicators that are organized into either public health or ecosystem health categories. These indicators provide a snapshot of the status of critical environmental and public health issues that Marylanders face today; however, it is not possible to include indicators for every environmental or health issue. Some important environmental or public health issues are simply not easy to capture in the context of an indicator. Information may simply be unavailable in some cases. However, the indicators presented in this report relay important information about some aspect of the environmental and public health protection issues facing the people of Maryland. These indicators also provide the kind of information of interest to government and the public, and will continue to be revised and updated in response to public input and stakeholder comments.

Presentation of Indicator Information. The environmental indicators are organized using the following definitions:

Goals are broad policy statements of desired outcomes and conditions (i.e., air that is safe to breathe,)

Indicators are units of measure that describe information on environmental trends or conditions relating to the goal,

Consequences relate the effects of the condition to human or ecological health,

Status presents the current situation in relationship to the goal,

Stressors and sources refer to the underlying causes of the environmental condition,

Management Objectives present what approach the State is taking to achieve the goal, and

Benchmarks present a numerical or time-specific achievement used to measure progress toward meeting the goal.

Public Health Indicators

The following section presents Maryland's public health indicators. Most of these indicators first were presented in the 1997 report. In the public health area, researchers are challenged to demonstrate causal relationships between exposure to adverse environmental conditions and human health effects. For example, to analyze the effects of ozone levels on humans, scientists have used the number of hospital days for respiratory illness occurring on high-ozone days as an indicator of the relationship. Most often, epidemiological studies and statistical modeling are used to make the linkages between exposure and illness because it is very difficult to control for the large number of variables, such as:

- variability in data collection and reporting of hospital admissions,
- availability and effectiveness of health care among different socio-economic groups;
- additive or synergistic health effects from exposure to pollutants or infectious agents,
- differences in ozone exposure or dose due to geographic or demographic variations, etc.

While it is difficult to measure directly what changes in public health conditions result from environmental improvements or causes, it is reasonable to use reductions in emissions or ambient concentrations of pollutants known to adversely affect human health as indicators of improvements in conditions affecting public health.

The following indicators address public health protection issues related to protecting public drinking water, assuring that seafood and finfish are safe to eat, ensuring that the air is safe to breathe, minimizing exposure to lead-based paints, and requiring that public exposure to any hazardous material is minimized.

Maryland's Environmental Indicators
Winter, 1999

PERCENTAGE OF MARYLAND POPULATION LIVING IN AREAS THAT MEET FEDERAL AIR QUALITY STANDARDS FOR COMMON AIR POLLUTANTS

Data/Graph: Percent of MD Population Living in Attainment and Non-Attainment Areas for Common Air Pollutants

Goal: Ensure the air is safe to breathe.

Indicator: Percentage of Maryland population living in areas meeting federal air quality standards.

Consequences: The national ambient (outdoor) air quality standards are established for several common pollutants that are produced in substantial quantities throughout the country. The U.S. EPA has determined that these common pollutants have adverse health effects when outdoor air concentrations reach certain levels. The U.S. EPA has established national ambient (outdoor) air quality standards at levels which protect public health and welfare with an adequate margin of safety. Therefore, people who live in areas that meet federal air quality standards for a particular pollutant should suffer no adverse health effects from that pollutant.

Status: 100% of Marylanders live in areas that meet standards for the following pollutants: carbon monoxide, sulfur dioxide, particulate matter, nitrogen dioxide, and lead. 87% of Marylanders live in areas where health based standards for the 1-hour ozone standard are exceeded. Areas in Maryland that do not meet the 8-hour ozone standard have not yet been identified.

Stressors/Sources: Sources of air pollution may be stationary, and/or mobile. Ground-level ozone is formed from the chemical reaction of volatile organic compounds and nitrogen oxides in the presence of sunlight. The primary sources of these pollutants are motor vehicles, utilities and industries, and numerous small sources such as gas stations, and farm and lawn equipment. Carbon monoxide is primarily emitted by motor vehicles (cars, buses, and trucks) and some industrial processes. Sulfur dioxide is mostly emitted from industrial and utility sources. Particulate matter comes from industrial processes, motor vehicles, wood burning, and dust from roads, stockpiles, construction, and agricultural sites. Nitrogen dioxides mostly result from burning fuels in utilities, industries, and motor vehicles. Lead is emitted by transportation sources using leaded fuels, coal combustion sources, and smelters. Lead emissions have dramatically decreased since 1980 due in large part to the elimination of the sale of leaded gasoline to the general public.

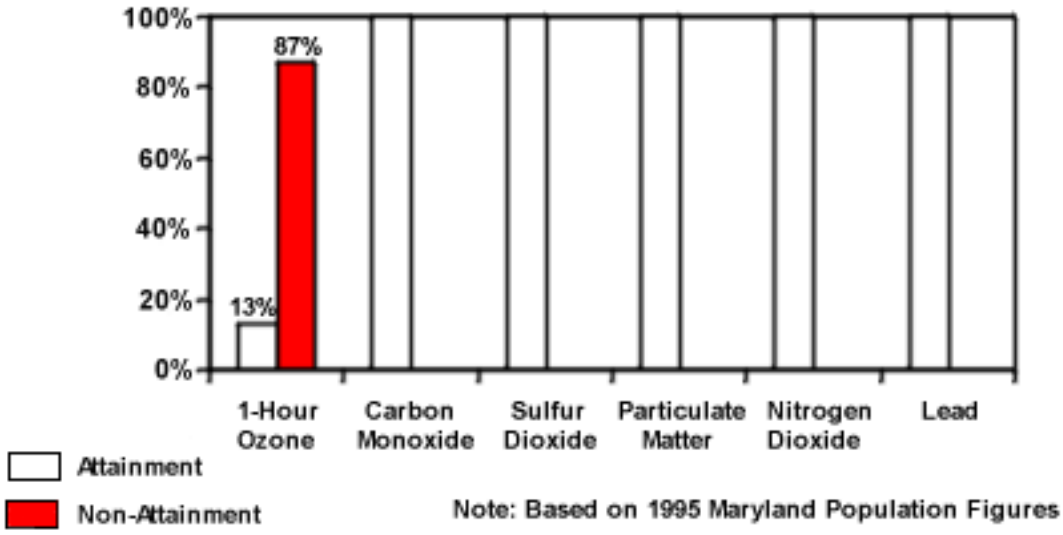
Management Objective: Implement and maintain control strategies so that all Marylanders live in areas that meet federal standards for all of the common air pollutants.

Benchmarks: All Marylanders, continue to live in areas that meet federal air quality standards for carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and particulate matter.

All Marylanders live in areas that meet the 1-hour ozone standard by 2005

Indicator Development and Data Responsibility: *MDE's Air Quality Program, 410-537-3260.*

Percent of Maryland Population Living in Attainment and Non-Attainment Areas for Common Air Pollutants



Note: Based on 1995 Maryland Population Figures

Maryland's Environmental Indicators
Winter, 1999

AIR QUALITY DATA FOR COMMON AIR POLLUTANTS

Data/Graphs:

Maryland 1-Hour Exceedance by Year
Lead: Annual Arithmetic Mean
Nitrogen Dioxide: Annual Arithmentic Average
Inhalable Particulate (PM-10): Annual Arithmentic Mean
Carbon Monixide: Number of Exceedances of 8-Hour Standard
Sulfur Dioxide: Annual Arithmentic Average

Goal: Ensure the air is safe to breathe.

Indicator: Measured air quality data for common air pollutants.

Consequences: Adverse health and welfare effects can be expected if the health-based ambient (outdoor) air quality standards for common air pollutants are exceeded.

Status: All of Maryland meets federal air quality standards for all of the common air pollutants except ozone. All of Maryland outside of the Baltimore and Washington, D.C. areas, Kent, Queen Anne's and Cecil Counties meet the federal 1-hour ozone standard.

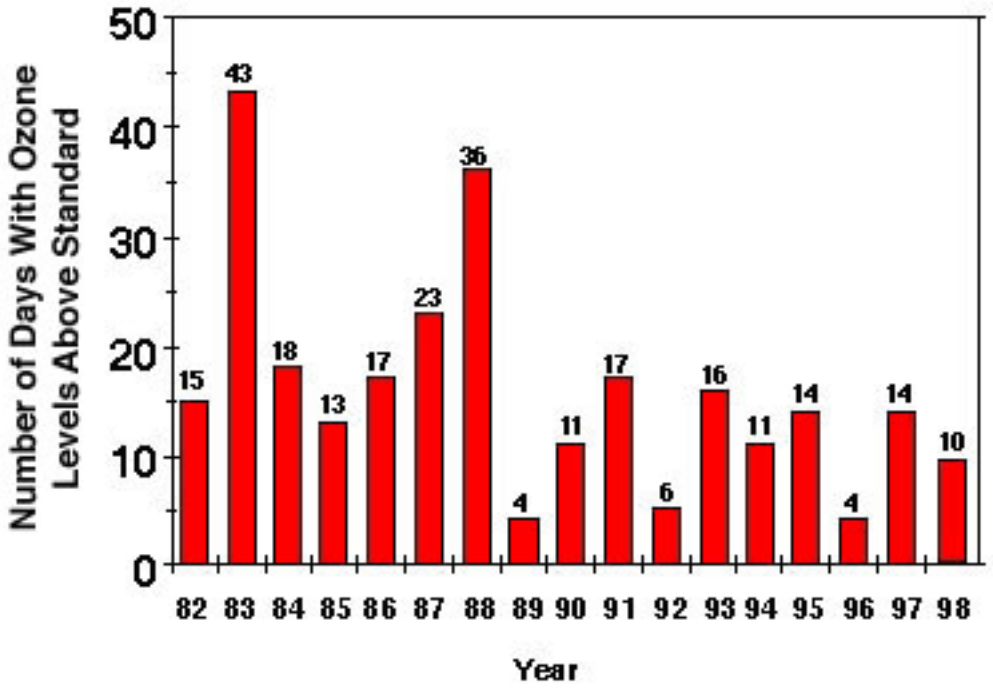
Stressors/Sources: Sources of air pollution may be stationary, and/or mobile. Ground-level ozone is formed from the chemical reaction of volatile organic compounds and nitrogen oxides in the presence of sunlight. The primary sources of these pollutants are motor vehicles, utilities and industries, and numerous small sources such as gas stations, and farm and lawn equipment. Carbon monoxide is primarily emitted by motor vehicles (cars, buses, and trucks) and some industrial processes. Sulfur dioxide is mostly emitted from industrial and utility sources. Particulate matter comes from industrial processes, motor vehicles, wood burning, and dust from roads, stockpiles, construction, and agricultural sites. Nitrogen dioxides mostly result from burning fuels in utilities, industries, and motor vehicles. Lead is emitted by transportation sources using leaded fuels, coal combustion sources, and smelters. Lead emissions have dramatically decreased since 1980 due in large part to the elimination of the sale of leaded gasoline to the general public.

Management Objective: Implement control strategies so that all areas of Maryland can meet federal air quality standards for all common air pollutants.

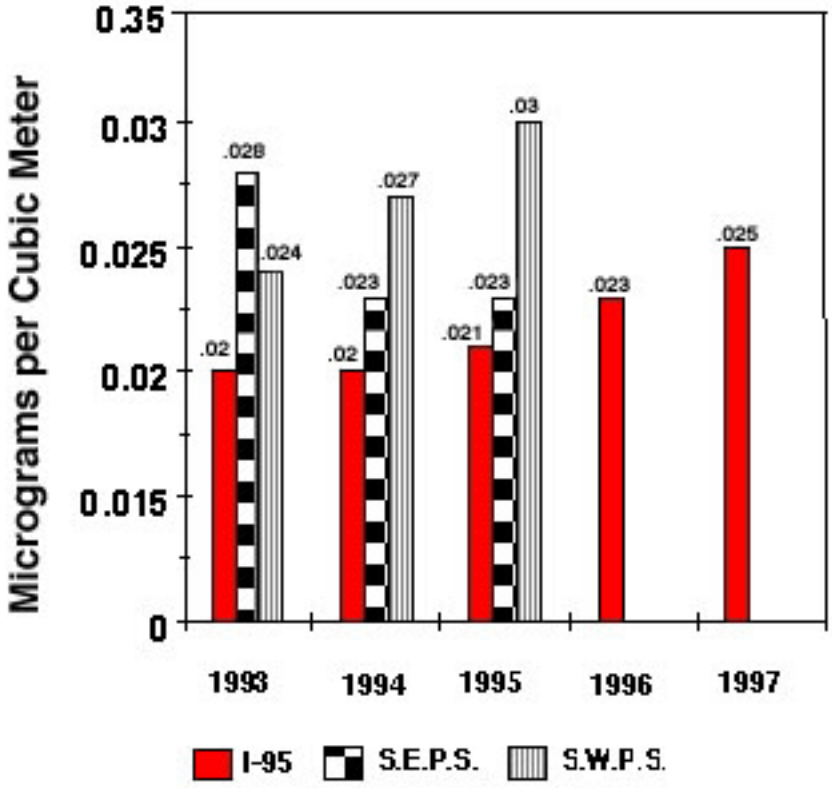
Benchmark: Meet the federal 1-hour ozone standard in all areas of Maryland by 2005, and continue meeting air quality standards for all other common air pollutants.

Indicator Development and Data Responsibility: *MDE's Air Quality Program, 410-537-3260.*

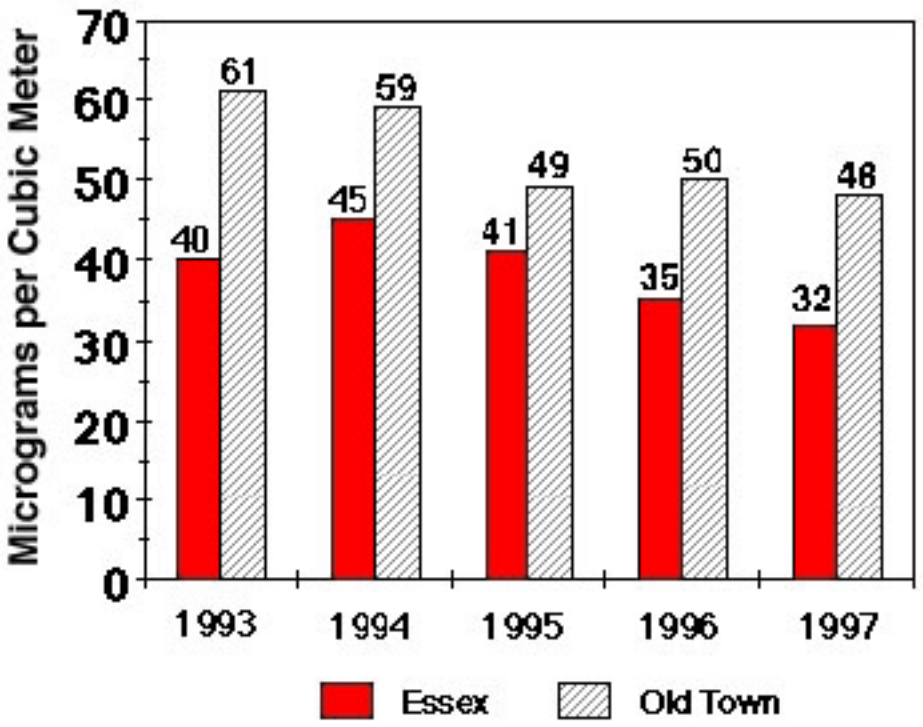
Maryland 1-Hour Exceedances by Year



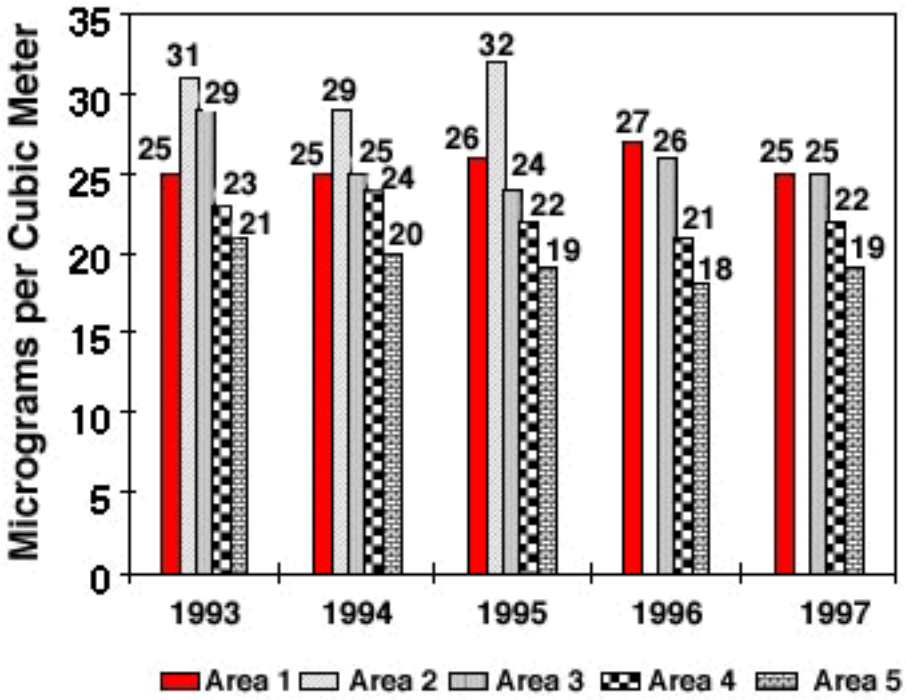
Lead
Annual Arithmetic Mean (ug/m^3)
National Ambient Air Quality Quarterly Standard = 1.5 ug/m^3



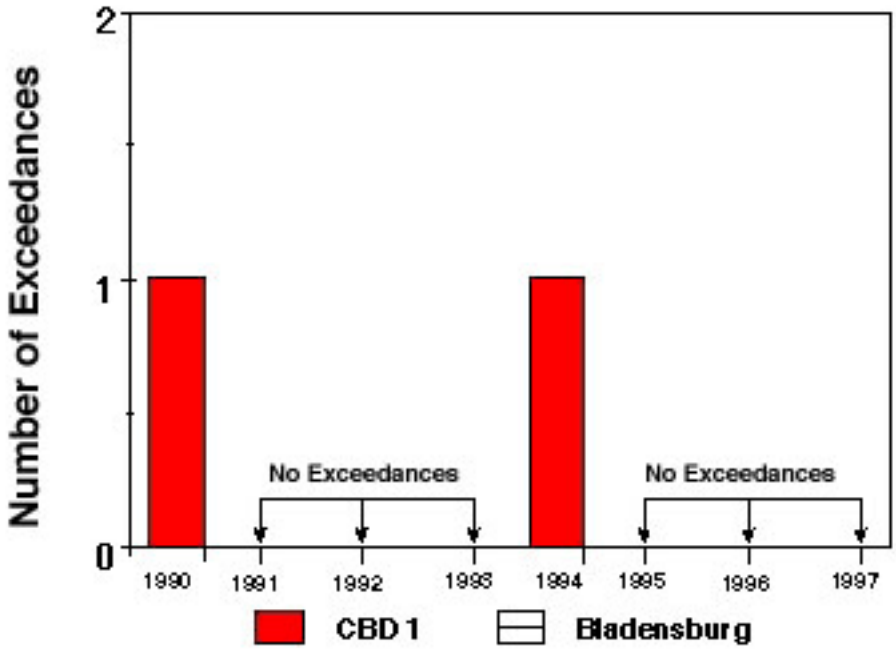
Nitrogen Dioxide
Annual Arithmetic Mean (ug/m^3)
National Ambient Air Quality Quarterly Standard = 100 ug/m^3



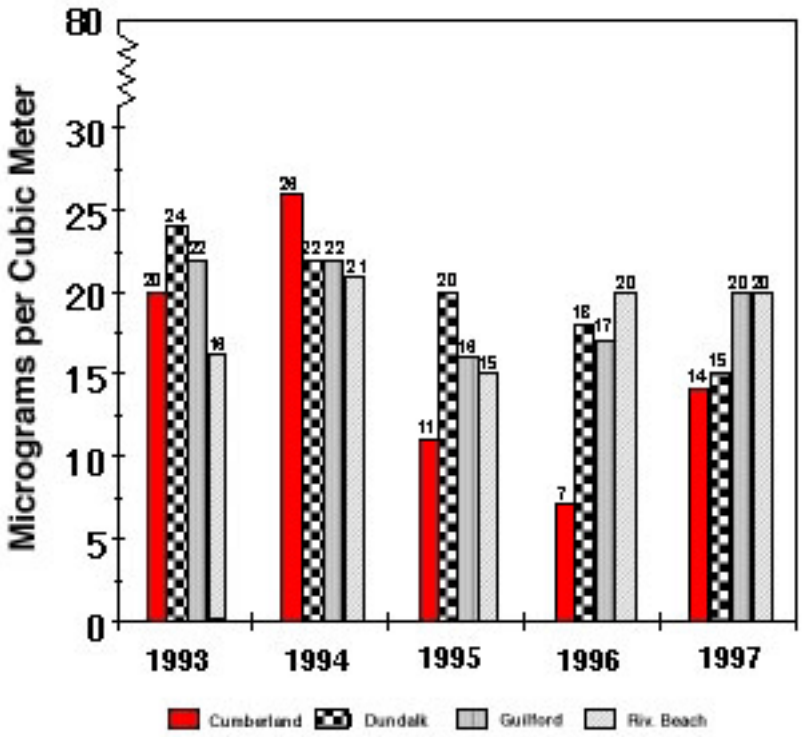
Inhalable Particulate -- PM-10
Annual Arithmetic Mean (ug/m^3)
National Ambient Air Quality Quarterly Standard = 50 ug/m^3



Carbon Monoxide
Number of Exceedances of 8-Hour Standard



Sulfur Dioxide
Annual Arithmetic Mean (ug/m^3)
National Ambient Air Quality Quarterly Standard = 80 ug/m^3



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NUMBER OF DAYS OZONE LEVELS WERE ABOVE THE 1-HOUR NATIONAL AMBIENT (OUTDOOR) AIR QUALITY STANDARD

Data/Graphs:
Maryland 1-Hour Ozone Exceedances by Year
Ratio of Days Ozone Levels Exceeded 1-Hour Ozone Standard to Days > 90 Degrees Fahrenheit in Maryland Nonattainment Areas

Goal:
Ensure the air is safe to breathe.

Indicators:
(1) Number of days ozone levels exceeded the federal 1-hour ozone standard.
(2) Ratio of days ozone levels exceeded the federal 1-hour ozone standard to days with temperatures above 90 degrees F.

Consequences:
The federal air quality standard for ozone is set at a level which protects public health. When ozone levels exceed the standard, adverse health effects occur. Ground-level ozone can cause lung damage, throat irritation, and congestion and is particularly threatening to people with respiratory diseases, such as asthma and emphysema.

Status:
Ozone-levels exceed the one hour standard 10 times in 1998. EPA changed the ozone standard from a 1-hour average level to an 8-hour average level because the 8-hour average level relates more directly to long-term exposure levels that have permanent adverse health effects. The revised 8-hour standard became effective in September 1997 while the existing 1-hour standard will remain in effect until EPA determines that an area has air quality meeting the 1-hour standard. All areas in Maryland must meet the 1-hour ozone standard.

Stressors/Sources:
Ground-level ozone is formed from the reaction of volatile organic compounds (VOC) and nitrogen oxides (NOx) in the presence of strong sunlight when temperatures are high. VOC emissions come from vehicle exhaust, paints and solvents, and industrial facilities. NOx is formed primarily as the result of combustion. Sources include power plants, industrial processes and vehicles.

Levels of ground-level ozone are heavily influenced by meteorological conditions with the highest levels generally occurring during hot, stagnant weather patterns. Long range transport of precursor pollutants also plays a major role.

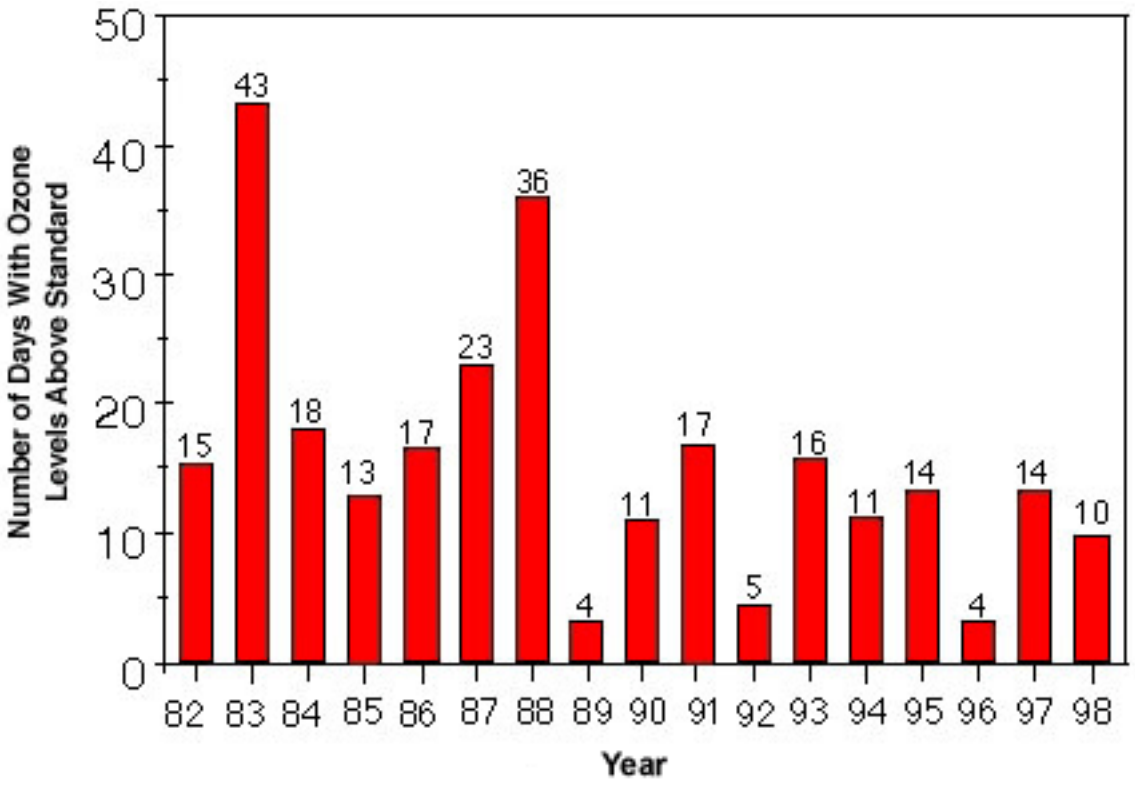
Management Objective:
Implement emissions control programs to reduce emissions of NOx and VOC from industries, utilities, small businesses, and mobile sources.

Benchmarks:
By 2005, each ozone monitor in Maryland will not exceed the 1-hour ozone standard more than three times in a three year period.

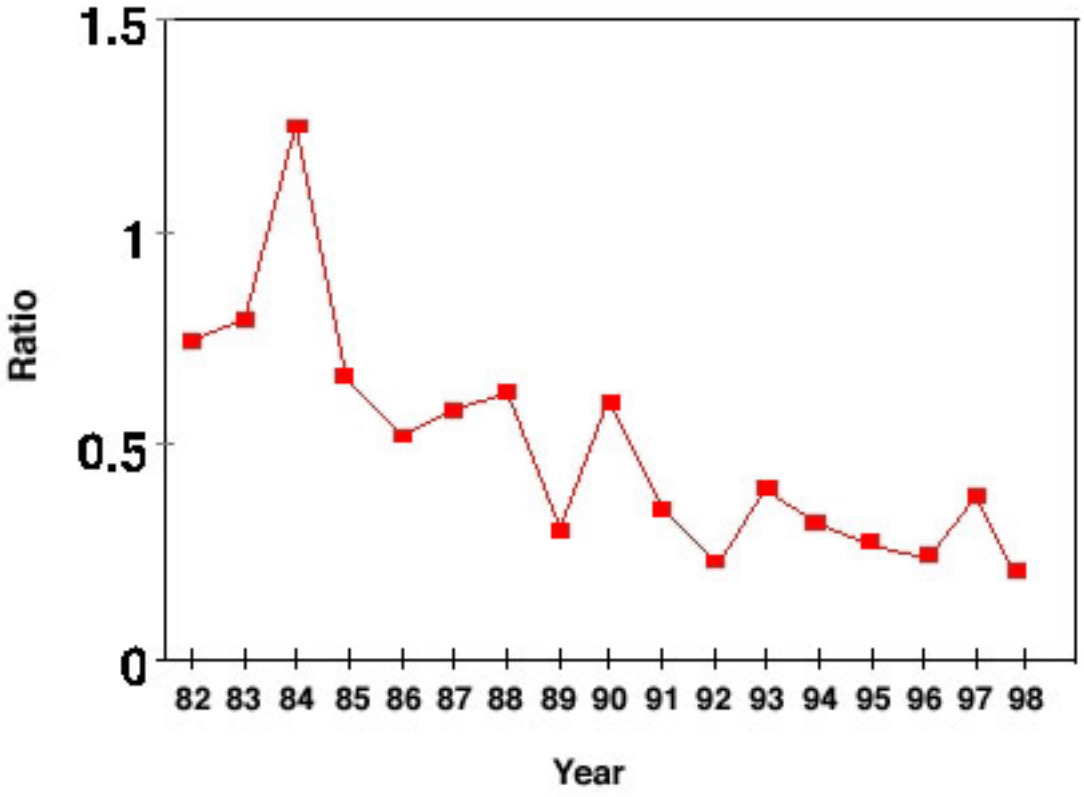
All Marylanders live in areas that meet the 1-hour ozone standard by 2005.

Indicator Development and Data Responsibility: *MDE's Air Quality Program, 410-537-3260.*

Maryland 1-Hour Exceedances by Year



Ratio of Days Ozone Levels Exceeded 1-Hour Ozone Standard to Days > 90°F in Maryland Nonattainment Areas



Maryland's Environmental Indicators
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NUMBER OF TIMES OZONE LEVELS EXCEED THE 8-HOUR OZONE NATIONAL AMBIENT (OUTDOOR) AIR QUALITY STANDARD

Data/Graphs:

Fourth Highest 8-Hour Ozone Level in Maryland (3 Year Average)
Number of 8-Hour Ozone Levels Above the 8-Hour Ozone Standard

Goal:

Ensure the air is safe to breathe.

Indicator:

Number of times ozone levels exceed the 8-hour ozone national ambient (outdoor) air quality standard.

Consequences:

Exposure to ozone levels in the ambient (outdoor) air above the national air quality standards for ozone has been linked to increased hospital admissions for respiratory ailments, such as asthma. Studies conducted in the northeastern United States and Canada show that ozone air pollution is associated with 10 to 20 percent of all the summertime respiratory-related hospital admissions. Repeated exposure to ozone can make people more susceptible to respiratory infection and lung inflammation, and can aggravate pre-existing respiratory diseases, such as asthma. Children run the greatest risk from exposure to ozone because they are active outside, playing and exercising during the summertime when ozone levels are at their highest.

Status:

Ozone levels exceeded the 8-hour ozone standard 54 times in 1996-1998. The revised 8-hour standard became effective on September 16, 1997 while the existing 1-hour standard will remain in effect until EPA determines that an area has air quality meeting the 1-hour standard. All areas in Maryland must meet the 1-hour ozone standard by 2005. EPA changed the ozone standard from a 1-hour average level to an 8-hour level because the 8-hour average level relates more directly to long-term exposure levels that have permanent adverse health effects.

Stressors/Sources:

Ground-level ozone is formed from the reaction of volatile organic compounds (VOC) and nitrogen oxides (NOx) in the presence of strong sunlight when temperatures are high. VOC emissions come from vehicle exhaust, paints and solvents, and industrial facilities. NOx is formed primarily as the result of combustion. Sources include power plants, industrial processes and vehicles.

Levels of ground-level ozone are heavily influenced by meteorological conditions with the highest levels generally occurring during hot, stagnant weather patterns. Long range transport of ozone forming pollutants both from neighboring states and other areas of the country contributes to elevated levels of ozone in Maryland.

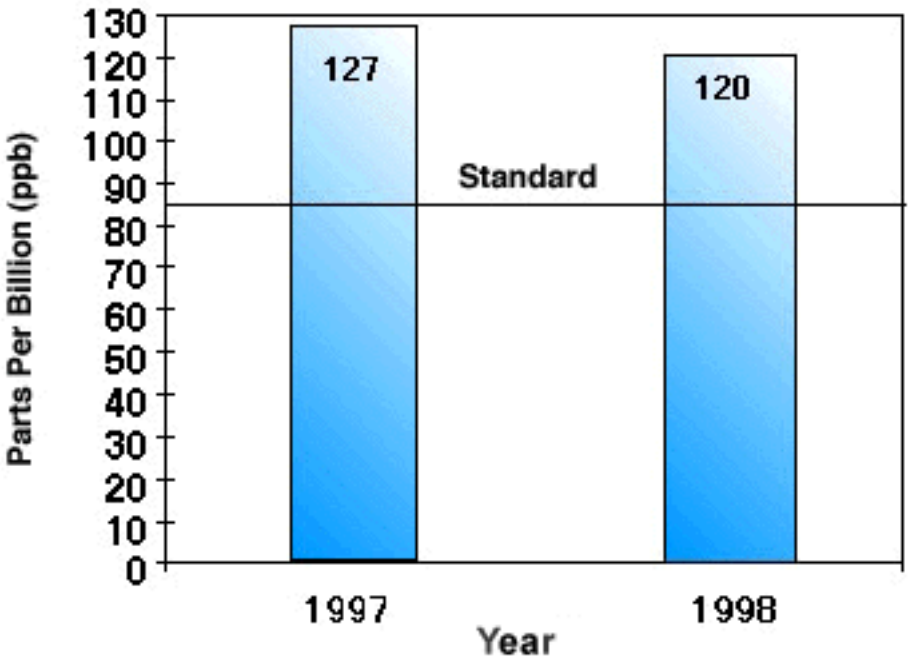
Management Objective:

Implement emissions control programs to reduce emissions of NOx and VOC from industries, utilities, small businesses and mobile sources. Develop statewide NOx emissions budget consistent with EPA's final rule to reduce transported pollution from 22 states to enable certain nonattainment states to meet the 8-hour ozone standard.

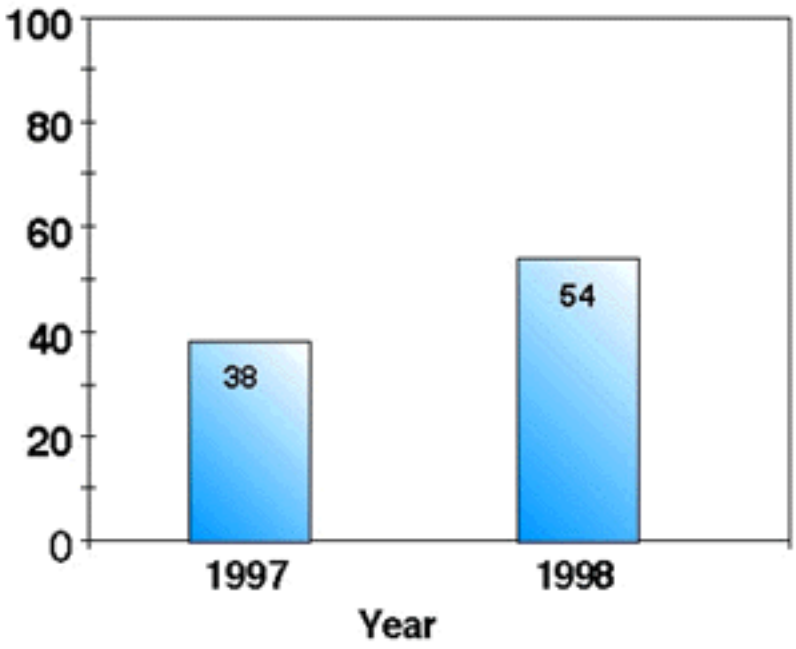
Benchmark: Recommend to EPA designations and classifications for counties in Maryland that appropriately reflect the county's air quality with respect to the 8-hour ozone standard and the county's influence on the air quality of other counties in Maryland and other states.

Indicator Development and Data Responsibility: *MDE's Air Quality Program, 410-537-3260.*

Fourth Highest 8-Hour Ozone Level
in Maryland
(3 Year Average)



Number of 8-Hour Ozone Levels
Above the 8-Hour Ozone Standard



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CHANGE IN EMISSIONS BY SOURCE CATEGORY FOR OZONE-FORMING COMPOUNDS (VOC AND NOx) AND OTHER COMMON AIR POLLUTANTS IN THE BALTIMORE NONATTAINMENT AREA

Data/Graphs:
VOC Emissions
NOx Emissions
CO Emissions
Lead Emissions
SOx & PM-10 Emissions

Goal: Ensure the air is safe to breathe.

Indicator: Change in emissions by source category for ozone-forming compounds (VOC and NOx) and other common pollutants in the Baltimore nonattainment area.

Consequences: The national ambient (outdoor) air quality standard is set at a level which protects public health. When pollutant levels exceed the federal standards, adverse health effects occur.

Status: The emissions inventory includes point source emissions for sulfur oxides and particulate matter. For lead, carbon monoxide, and the ozone-forming compounds (VOC and NOx), the inventory includes area, on-road mobile, and non-road mobile emissions as well as point source emissions. The emissions for VOCs and NOx are particularly important because they combine to form ozone. The 1996 inventory of VOC and NOx emissions were reduced by at least 15% by 1996. Lead emissions have dramatically decreased since 1980 due in large part to the elimination of the sale of leaded gasoline to the general public.

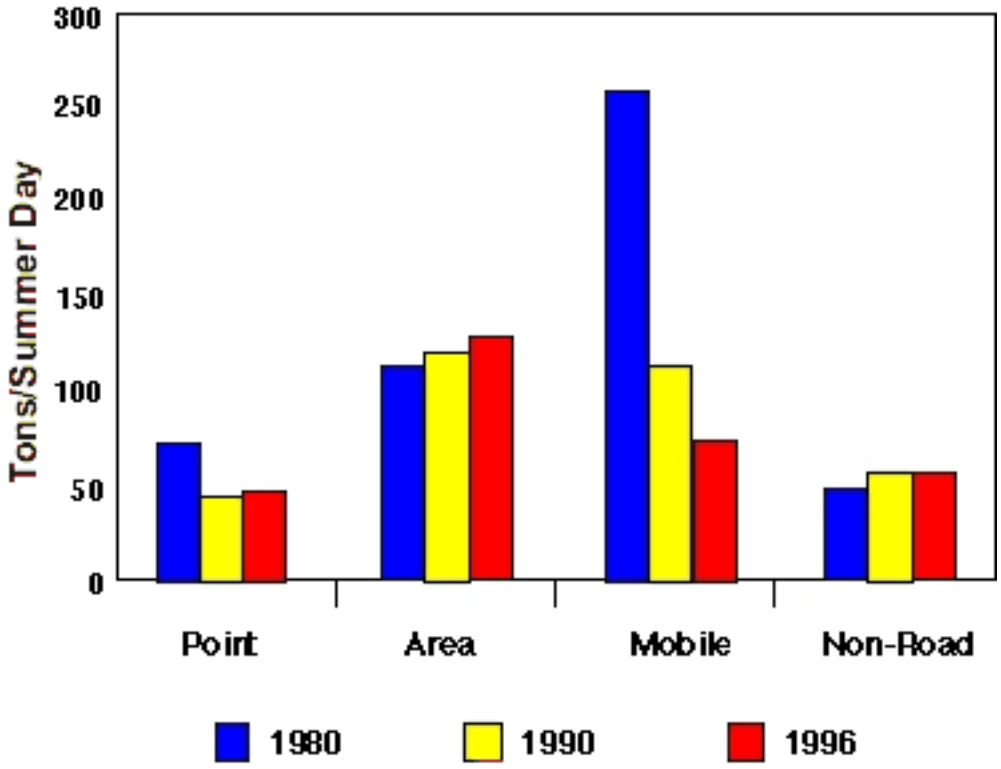
Stressors/Sources: Pollutant emission sources in Maryland and long range transport of pollutants from outside of Maryland affect Maryland's air quality. Emission reductions from sources in Maryland alone may not guarantee good air quality.

Management Objective: Implement emission control program for ozone-forming compounds to reduce emissions to levels that will allow all of Maryland to meet the national air quality standard for ozone. Implement existing control programs for the other pollutants to assure maintenance of the ambient (outdoor) air quality standards for those pollutants.

Benchmark: Achieve reductions in NOx and/or VOC emissions that are necessary to meet the health-based air quality standards for ozone.

Indicator Development and Data Responsibility: *MDE's Air Quality Program, 410-537-3260.*

VOC Emissions
Baltimore Nonattainment Area



Notes:

Point source emissions include emissions from major stationary sources.

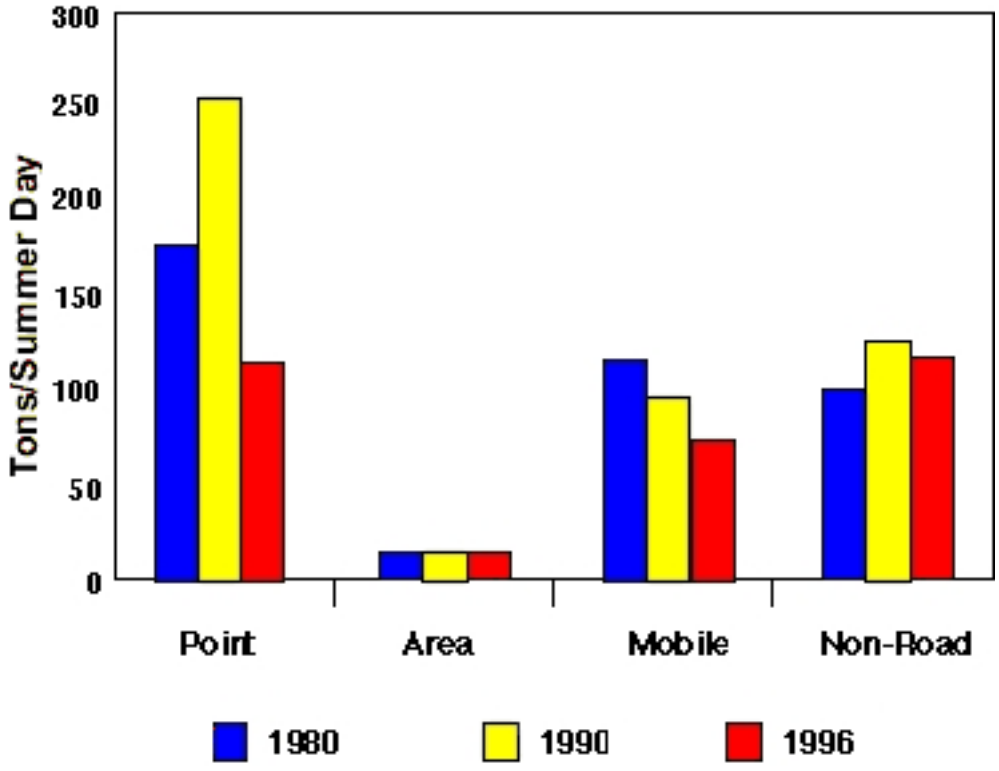
Area source emissions include emissions of stationary sources which are not major sources and which are too numerous to be counted individually.

Mobile source emissions include tailpipe and evaporative emissions from vehicles operating on public roadways.

Non-road emissions include emissions from vehicles and internal combustion engines not normally operated on public highways.

The VOC emissions values were adjusted to allow direct comparison of emission levels based on similar calculation methodologies for different years.

NOx Emissions
Baltimore Nonattainment Area



Notes:

Point source emissions include emissions from major stationary sources.

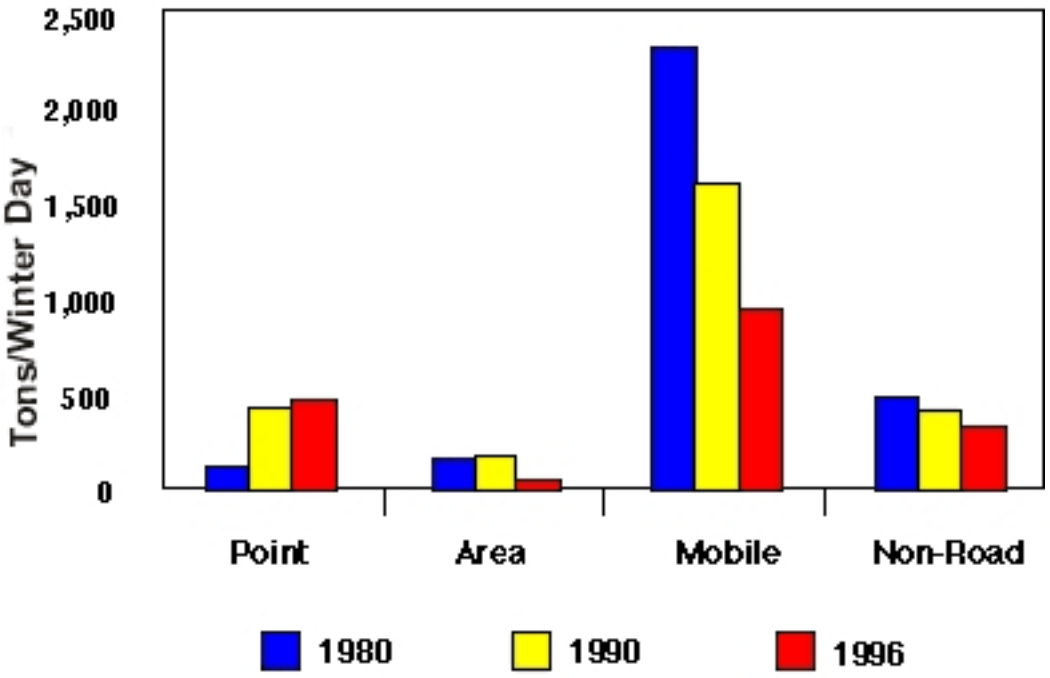
Area source emissions include emissions of stationary sources which are not major sources and which are too numerous to be counted individually.

Mobile source emissions include tailpipe and evaporative emissions from vehicles operating on public roadways.

Non-road emissions include emissions from vehicles and internal combustion engines not normally operated on public highways.

The NOx emissions values were adjusted to allow direct comparison of emission levels based on similar calculation methodologies for different years.

Carbon Monoxide Emissions
Baltimore Nonattainment Area



Notes:

Point source emissions include emissions from major stationary sources.

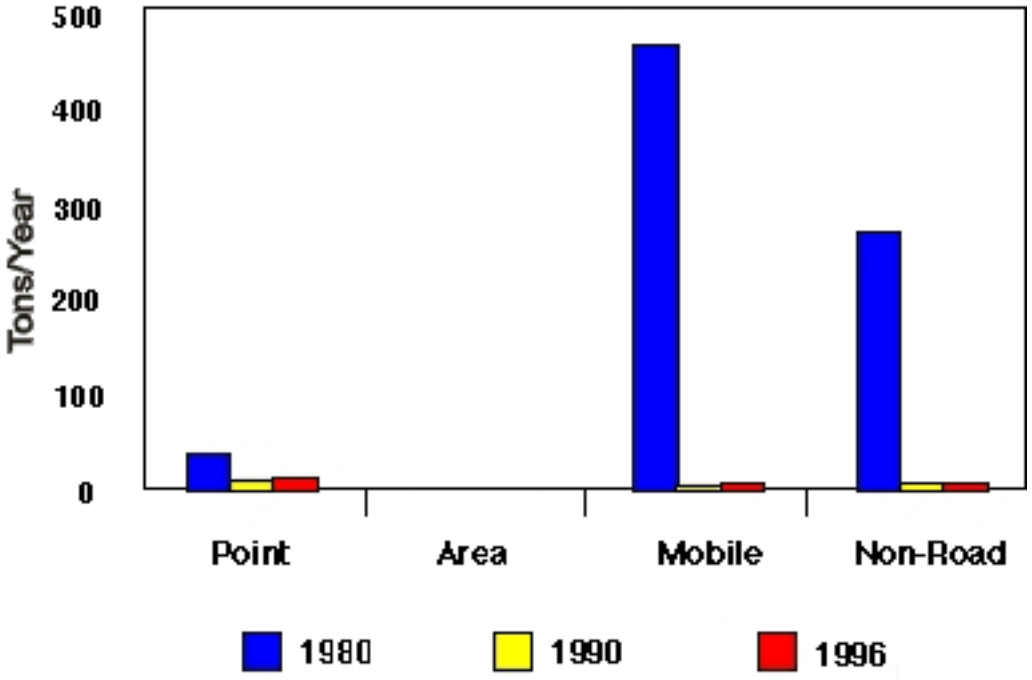
Area source emissions include emissions of stationary sources which are not major sources and which are too numerous to be counted individually.

Mobile source emissions include tailpipe and evaporative emissions from vehicles operating on public roadways.

Non-road emissions include emissions from vehicles and internal combustion engines not normally operated on public highways.

Baltimore achieved compliance with CO Standard in 1990.

Lead Emissions
Baltimore Nonattainment Area



Notes:

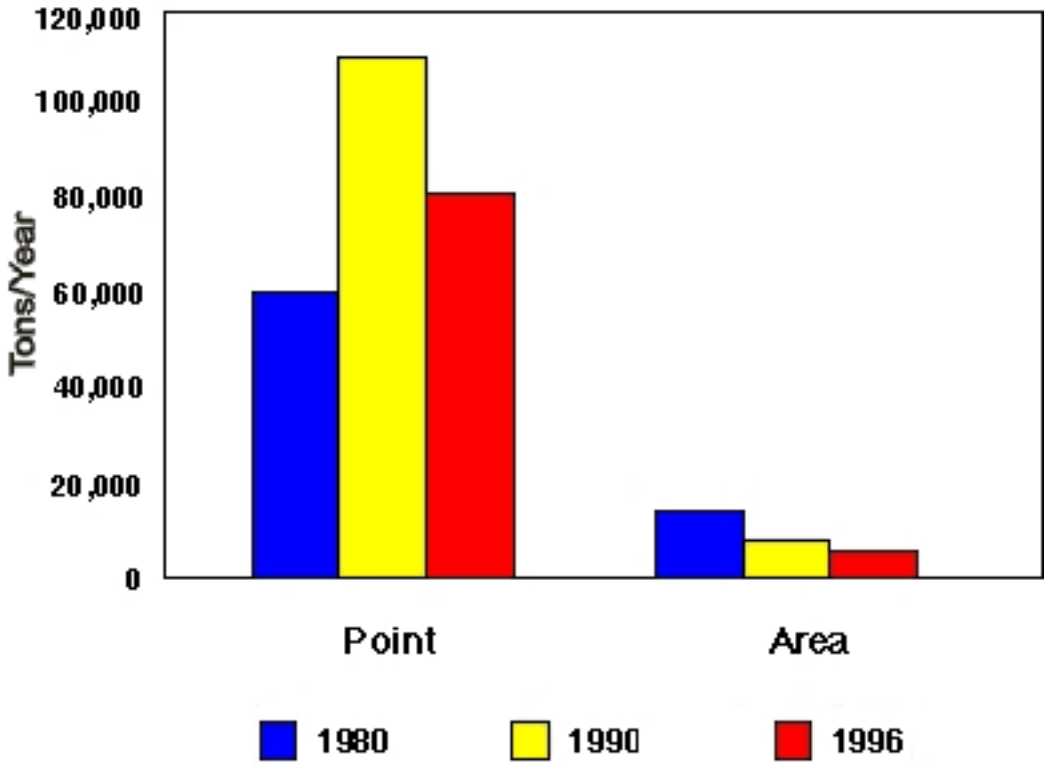
Point source emissions include emissions from major stationary sources.

Area source emissions include emissions of stationary sources which are not major sources and which are too numerous to be counted individually.

Mobile source emissions include tailpipe and evaporative emissions from vehicles operating on public roadways.

Non-road emissions include emissions from vehicles and internal combustion engines not normally operated on public highways.

SOx & PM-10 Emissions From Point Sources
Baltimore Nonattainment Area



Note: Point source emissions include emissions from major stationary sources.

Maryland's Environmental Indicators
Winter, 1999

SHELLFISH HARVESTING WATERS

Data/Graph: Acres of Conditionally Approved, Restricted, and Fully Approved Shellfish Harvesting Waters in Maryland

Goal: Ensure water is clean and safe for harvesting of fish and shellfish.

Indicator: Percentage of total shellfish harvesting acres that are approved (open), conditionally approved, restricted (closed).

Consequences: Shellfish strain water through their gills to trap microscopic plants and animals for food. If the water is contaminated with disease-causing bacteria or viruses, these can be consumed as food by shellfish. When eaten raw or partially cooked, these shellfish can make people sick. Assuring that oysters and clams are harvested only from areas that are safe and open to harvesting minimizes the risk of human illness.

In shellfish waters approved for harvesting, harvesting is permitted any time. In conditionally approved areas, harvesting is permitted except for the three days following rain events greater than 1" in 24 hours. Run-off from such a rainfall event can carry potentially harmful bacteria into surface waters from adjacent land. Shellfish harvesting is not permitted at any time from restricted areas.

Status: 1998: 1,067,057 acres approved (90.6%); 40,575 acres conditionally approved (3.4%) -- for a total of 94.0% approved; and 70,711 acres restricted (6.0%).

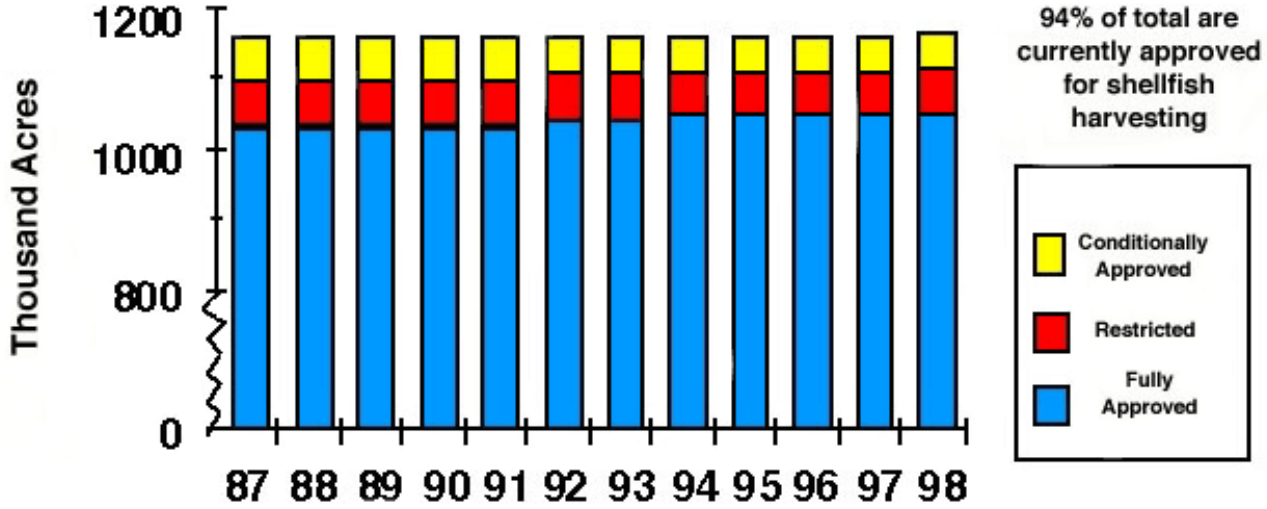
Stressors/Sources: The presence of humans in the watershed increases the potential for an adverse impact to shellfish water quality from sewage treatment facilities and bypasses from sewage pumping stations, failing septic systems, increased development, and farm animal operations. Where sewage outfalls already exist, closed safety zones surrounding these outfalls are mandated and necessary to protect human health.

Management Objective: Maximize availability of shellfish waters for commercial and recreational harvesting.

Benchmark: Maintain current level of 94.0% approval of total shellfish harvestable acres.

Indicator Development and Data Responsibility: *MDE's Environmental Risk Assessment Program, 410-537-3906.*

Acres of Conditionally Approved, Restricted, and Fully Approved Shellfish Harvesting Waters in Maryland



Maryland's Environmental Indicators
Winter, 1999

MARYLAND WATERS SAFE FOR HARVESTING FINFISH

Data/Graph:	Fish Consumption Advisories in Maryland Waters, 1996
Goal:	Ensure water is clean and safe for harvesting of fish and shellfish.
Indicator:	Percentage of Maryland waters covered by fish consumption advisories.
Consequences:	Certain fish in contaminated waters can accumulate high enough levels of toxic substances that, when consumed frequently over a lifetime, may increase the consumers' risk of adverse health effects. In waters covered by a fish consumption advisory, fishermen and consumers are advised to limit their consumption of certain fish species.
Status:	As of 1996, 0.8% of estuarine waters, 0.5% of lake waters, and none of Maryland's rivers and streams are covered by fish consumption advisories.
Stressors/Sources:	Past usage and inappropriate disposal of persistent organic substances have resulted in elevated levels of some hazardous substances in water bodies near major urban centers. Certain fish in these waters, due to their feeding habits, metabolic activity, age and fat content, may accumulate these substances to levels which may be harmful to people consuming them frequently throughout their lifetime. Current advisories are the result of contamination due to past use of Chlordane, which is now banned.
Management Objective:	Minimize public health risk associated with finfish contaminated with harmful levels of toxic substances.
Benchmark:	Maintain percentage of waters covered by fish advisories below 1% of estuarine, lake, and fresh free-flowing waters.

Indicator Development and Data Responsibility: *MDE's Environmental Risk Assessment Program, 410-537-3906.*

Fish Consumption Advisories in Maryland Waters, 1996

Waterbody	Affected Species	Area (sq. miles)	Percent of Total
Estuarine Waters			
Baltimore Harbor	Channel Catfish, American Eels	13.3	0.5%
Back River	Channel Catfish, American Eels	6.6	0.3%
	Total	19.9	0.8%
Lakes			
Lake Roland	Black Crappie, Carp	0.16	0.5%

MARYLANDERS SERVED BY PUBLIC WATER SYSTEMS IN COMPLIANCE

Data/Graphs:

Percent of Marylanders Served by Safe Water
Number of Public Water Supply Systems Exceeding Public Health Standards

Goal:

Ensure safe drinking water.

Indicator:

Percentage of all Marylanders who are currently served by public drinking water systems that receive water from systems that meet all applicable federal and state health standards (i.e., "in compliance").

Consequences:

Unsafe drinking water can have immediate consequences of widespread diseases, sickness, and even death to vulnerable members of our communities. Long term exposure to other contaminants at unsafe levels may increase the occurrence of cancer. High levels of lead in water can increase blood lead levels.

Status:

Maryland has experienced no disease outbreaks attributable to unsafe water in recent years. However, more stringent federal standards enacted largely in response to concern over both acute and chronic health effects of a range of contaminants, have created the current situation in which many individual public systems must upgrade their treatment process in order to be in full compliance with all applicable requirements.

In Maryland, as in other states, water is provided to the public by a multitude of small systems. These systems serve relatively few people in contrast to those systems in larger metropolitan areas that each serve 50,000 or more. The seven largest systems in the state serve 3.475 million, while the remaining 1,000 systems serve 860,000 customers. 74% of Maryland=s water systems serve fewer than 500 persons.

This explains why compliance rates are actually quite high C 99% for all standards except for lead and copper, which is currently at 96.2%. The Lead and Copper Rule was a new rule in 1995, and treatment improvements are in progress.

Beginning in 1999, all community water systems will prepare an annual report for consumers which provides detailed information on water sources, water quality, and potential health risks, if any.

Stressors/Sources:

Tighter federal standards, nutrients from human activities, watershed response to storms, aging infrastructure and need for competent operation all contribute to violations.

Management Objective:

Maximize compliance of public water supply systems with federal/state "maximum contaminant levels" (MCLs) and action levels established for lead, copper, and all other regulated contaminants, and with filtration requirements where applicable (i.e., for surface water sources).

Inform the public about their source of water, and water quality.

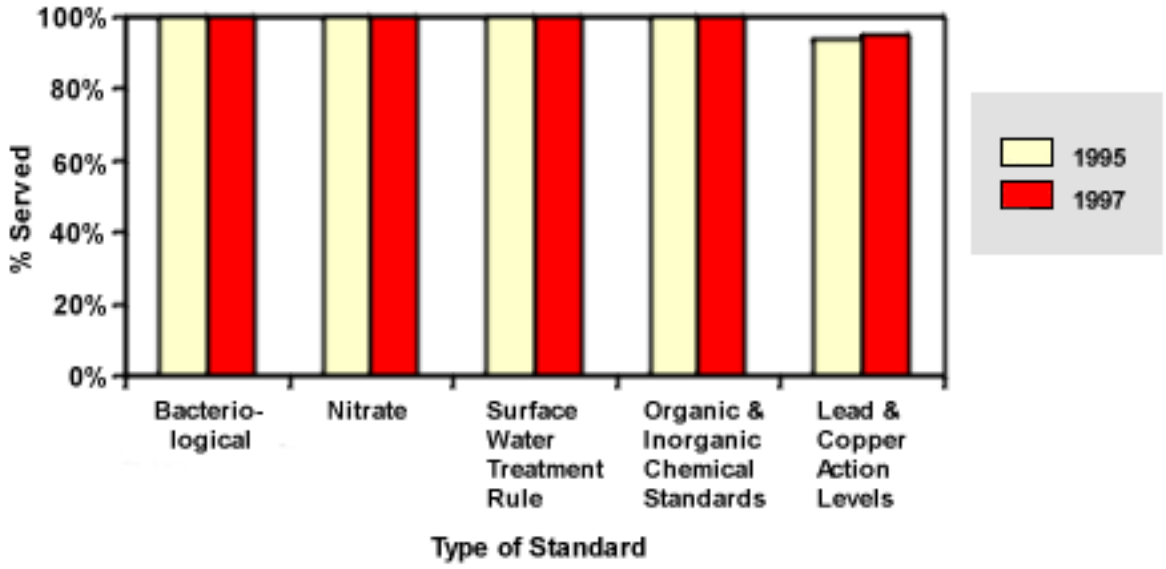
Benchmarks:

Maintain a 99% compliance rate for the population served by public water systems for all contaminants; achieve that level for lead and copper by year 2000.

Notify all consumers on public water systems, about their public water systems and water quality, on an annual basis.

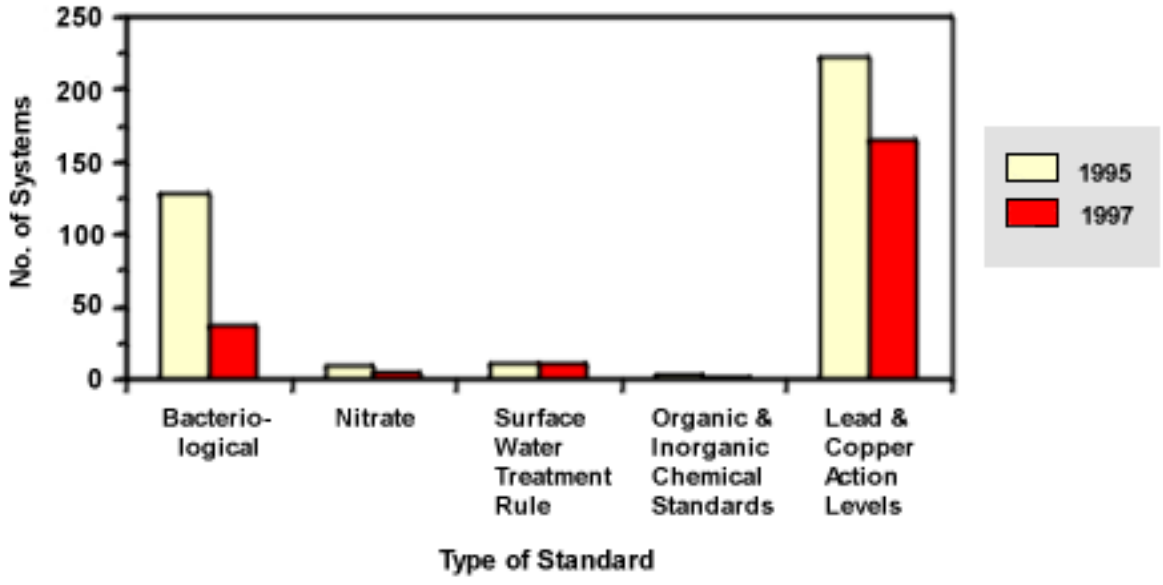
Indicator Development and Data Responsibility: *MDE's Water Supply Program, 410-537-3702.*

Percent of Marylanders Served by Safe Water



Note: The percentages above are time weighted for bacteriological standards and surface water treatment rules. If a system's violation lasted for a full year then the total population served is shown is out of compliance. If a system had a violation for one month then 1/12th of the population served shown is out of compliance while 11/12th shown is in compliance.

Number of Public Water Supply Systems Exceeding Public Health Standards



Maryland's Environmental Indicators
Winter, 1999

MARYLANDERS SERVED BY SURFACE SYSTEMS WITH SOURCE PROTECTION PROGRAMS IN PLACE

Data/Graph: Number of Marylanders Served by Surface Systems with Source Protection

Goal: Ensure safe drinking water.

Indicator: Percentage of all Marylanders who are currently served by public drinking water systems that receive water from vulnerable surface sources which have active source protection programs in place.

Consequences: Identifying those contaminants and significant contaminant sources which place water supplies in jeopardy is a necessary first step in developing watershed based protection programs. Creating interjurisdictional commitments to identify, prevent, and minimize such risks are needed for the program's success. Successful programs improve the safety and reliability of Maryland's water supplies.

Status: Formal programs are in place for three larger systems: the City of Baltimore, WSSC's Patuxent Supply, and the City of Cumberland. In depth risk assessments are underway in all three systems concurrent with development of improved watershed management practices. Significant local participation has been key to program successes. Coordination with other agencies and other states has begun for other water system watersheds.

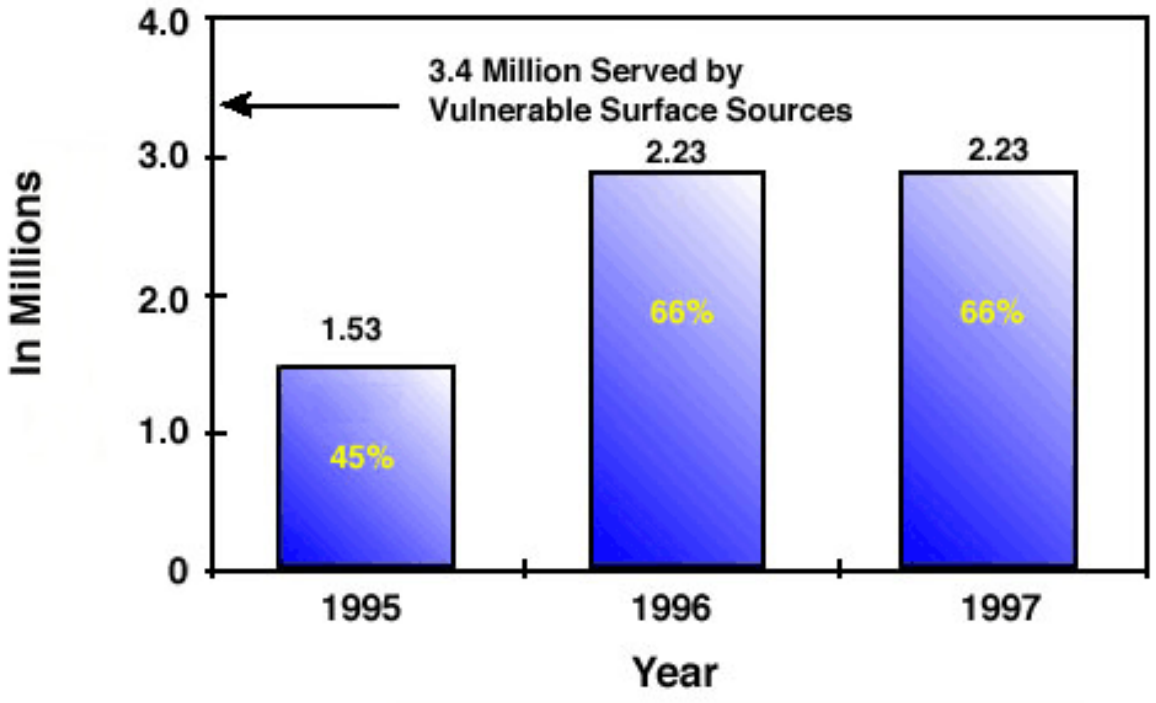
Stressors/Sources: Piped discharges and the affect of storm water runoff on agricultural activities, land development, and human activities result in the discharge of nutrients and contaminants to water bodies. Conversion of forested land into residential, commercial, or industrial use land negatively effects water quality. The extension of suburban areas into the Piedmont, and Valley and Ridge provinces places greater stresses on downstream water supplies.

Management Objective: Improve management of watersheds to prevent and mitigate contamination of potable surface water sources. Work with local governments to fully develop and implement source protection for all public drinking water systems that receive water from surface source.

Benchmark: Ensure that the 3.4 million Marylanders served by vulnerable surface water systems will have adequate source protection by year 2002.

Indicator Development and Data Responsibility: *MDE's Water Supply Program, 410-537-3702.*

Number of Marylanders Served
by Surface Systems with Source Protection



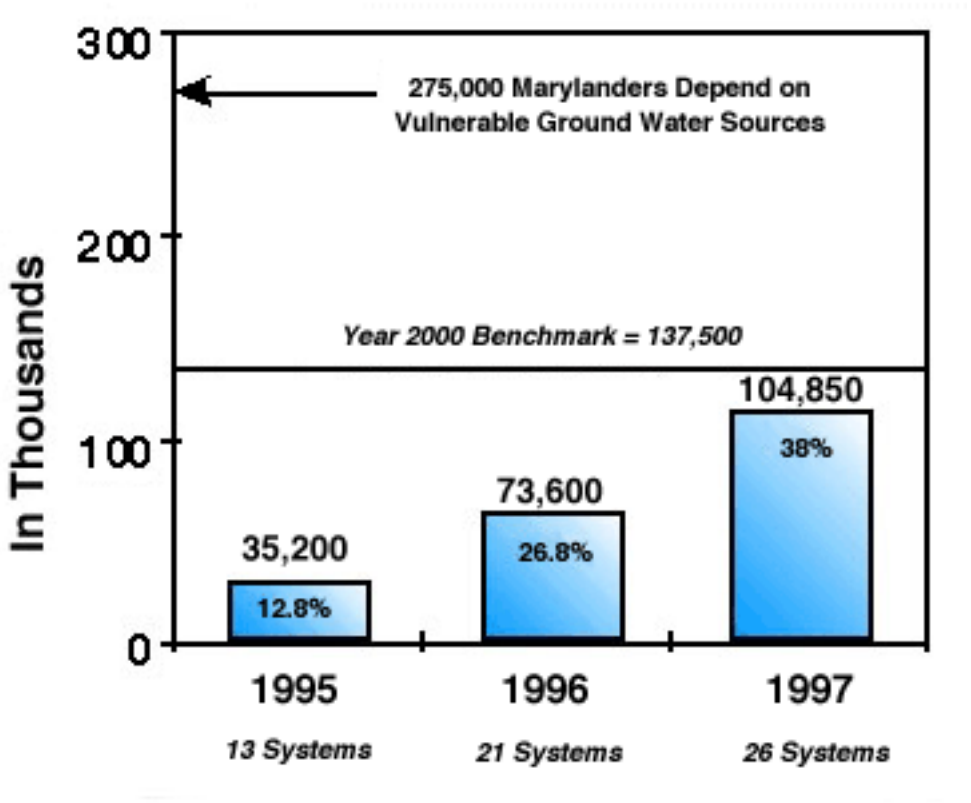
Maryland's Environmental Indicators
Winter, 1999

MARYLANDERS SERVED BY COMMUNITY GROUND WATER SYSTEMS WITH ACTIVE LOCAL WELLHEAD PROTECTION PROGRAMS

Data/Graph:	Number of Marylanders Served by Community Ground Water Systems with Active Local Wellhead Protection Programs
Goal:	Ensure safe drinking water.
Indicator:	Percentage of all Marylanders who are currently served by public drinking water systems that receive water from vulnerable groundwater sources which have active wellhead protection programs in place.
Consequences:	The long term viability of a community's water supply is enhanced by identifying risks to the source of supply and taking action to minimize those risks.
Status:	Communities have shown interest in voluntary partnerships. The adoption of local codes is a lengthy process. About 80 communities are working with the State to achieve protection programs. New grant funding under the Drinking Water State Revolving Loan Fund has enabled MDE to facilitate development of local programs.
Stressors/Sources:	Changes in land use, improper disposal of chemicals, nutrients from on-site disposal and fertilizer, spills and leaks from underground tanks all present risks to water supplies.
Management Objective:	Prevent contamination of potable groundwater aquifers by pollutants that may be conveyed to these aquifers through underground hydrological transport mechanisms. Develop locally based wellhead protection programs to ensure the long term viability of sources of supply.
Benchmark:	Establish active local programs that implement wellhead protection management practices for 137,500 Marylanders (or 50%) served by vulnerable sources, by the year 2000.

Indicator Development and Data Responsibility: *MDE's Water Supply Program, 410-537-3702.*

Number of Marylanders Served by Community Ground Water Systems with Active Local Wellhead Protection Programs

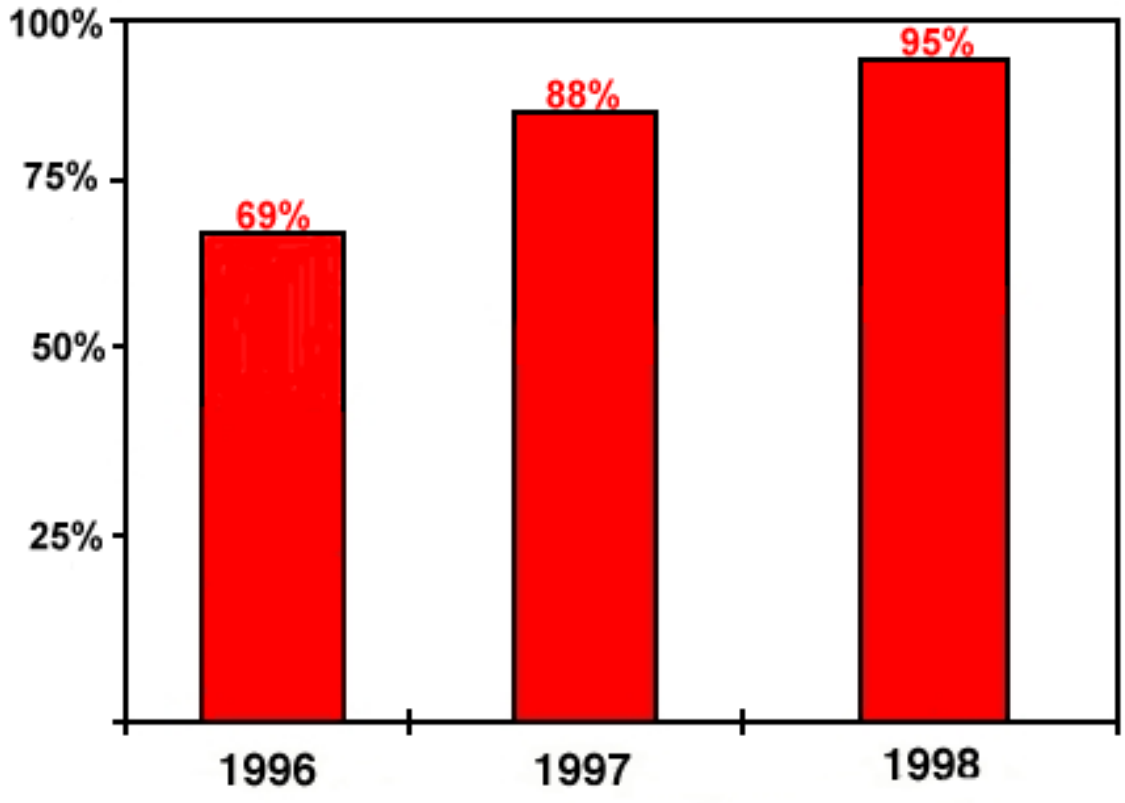


NUMBER OF MUNICIPAL WASTE LANDFILLS IN COMPLIANCE WITH GROUNDWATER STANDARDS

Data/Graph:	Percentage of Municipal Waste Landfills in Compliance
Goal:	Ensure safe drinking water.
Indicator:	Number of municipal waste landfills in compliance with groundwater standards**.**
Consequences:	Improper disposal of solid waste can pose direct threats to both the public health and the quality of Maryland's water resources.
Status:	In 1996, 18 of 26; in 1997 22 of 25; and in 1998, 21 of 22 operating municipal waste landfills were in compliance with groundwater standards.
Stressors/Sources:	Leachate migration containing contamination from chemicals at concentrations above the drinking water standards may cause groundwater contamination. Causes can include improper daily cover & capping; acceptance of unlawful or unpermitted types or quantities of waste; improper maintenance of liner; inadequate monitoring or corrective action; or migration of landfill gas.
Management Objective:	Prevent and reduce contamination of groundwater.
Benchmark:	Achieve 100% compliance with new EPA Subtitle D design standards for landfills by 1998.

Indicator Development and Data Responsibility: *MDE's Solid Waste Program, 410-537-3318.*

Percentage of Municipal Waste Landfills in Compliance



OIL CONTAMINATED SITES COMPLETED/INITIATED

Data/Graph: Percentage of Oil Contaminated Sites Cleaned Up

Goal: Ensure safe drinking water.

Indicator: Oil contaminated sites completed/initiated.

Consequences: Oil pollution resulting from unlawful spills, discharges or leaking underground storage tanks can cause potential groundwater contamination. Housing and economic development can decline in areas that become contaminated from oil due to reduced value of real estate and perceived or real contamination.

Status: 13,728 sites have been cleaned up or are implementing long-term clean-up activities as of October 1998.

6,141 oil contaminated sites cleaned up by November 1998.

45% of 13,728 oil contaminated sites cleaned up by November 1998.

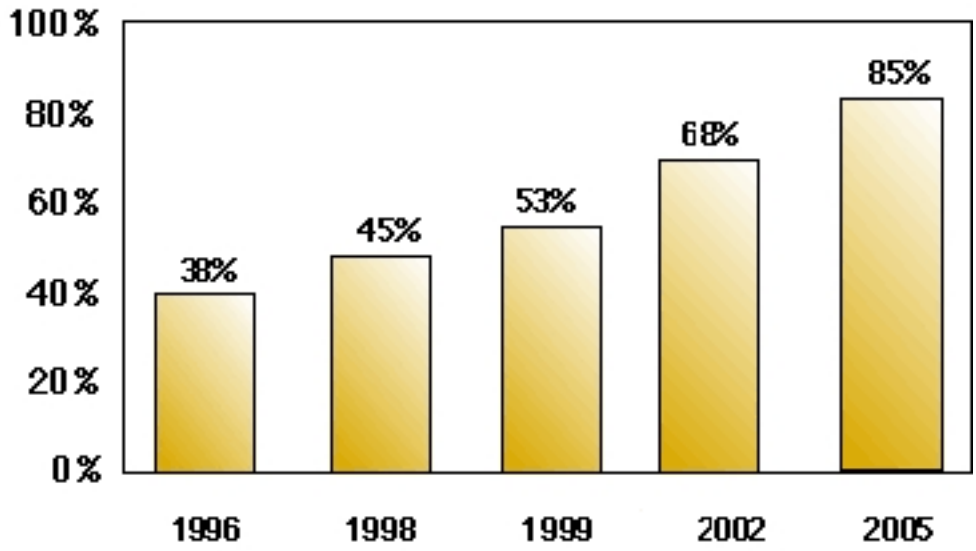
Stressors/Sources: Leaking underground storage tanks or spills create groundwater contamination; storage of oil in substandard storage systems leads to discharge of oil into the environment. As storage systems are upgraded oil discharges will decrease.

Management Objective: Expeditiously initiate and complete cleanups of sites impacted by discharge of oil.

Benchmark: Cleanup 85% of sites contaminated with oil by the Year 2005.

Indicator Development and Data Responsibility: *MDE's Oil Control Program, 410-537-3386.*

Percentage of Oil Contaminated Sites Cleaned Up



Maryland's Environmental Indicators
Winter, 1999

AMOUNT OF HAZARDOUS WASTE GENERATED PER YEAR

Over the past year, MDE staff and members of the Maryland Environment 2000 (ME 2000) Steering Committee and the Controlled Hazardous Substances Advisory Council met a number of times to discuss the concerns raised by the public and stakeholder groups on this Indicator in order to develop a more meaningful Hazardous Waste Indicator or perhaps to merge this Indicator with the Chesapeake Bay Program Toxics Reduction Indicator. In the end, the workgroup did not develop a replacement Indicator and agreed that until a better Indicator could be developed, MDE should continue to report on this Indicator, with a caveat about stakeholder concerns.

Initial discussions focused on what the Indicator should accomplish. The workgroup felt that the current Hazardous Waste Indicator which measures the total amount generated, does not take into account the actual disposition of the waste or the fact that increased production (economic activity) would result in an increase in the amount of waste generated. The workgroup members felt that hazardous waste, when properly managed, does not pose significant risk to public health or the environment. The workgroup felt that risk resulted from improper disposal of wastes or transportation incidents associated with waste handling.

Two purposes for the Indicator were discussed: one was primarily educational and the other, more difficult, was to try to demonstrate actual risk. Since the public is concerned with the hazardous waste which ends up in the wrong places, the workgroup felt there was some value in demonstrating what was actually done with the waste generated in the state and how businesses were complying with the regulations. However, the workgroup could not develop a way to actually measure those wastes that were disposed of illegally, which would pose the greatest risk. Therefore, the workgroup decided that the best place to look was where there were already sources of data which could be measured, such as that reported to the State or Federal environmental agencies.

The best indicator the workgroup could imagine was one in which the amount of waste was compared to the amount of a product, so that an increase in production, where the wastes were properly handled, would not penalize a company because of the associated increase in waste. While this indicator is easily calculated for an individual generator with its own specific product (and in fact is sometimes used internally to help a company measure its own environmental performance), the workgroup could not find a way to normalize this number across industries. For example, the quarts of waste oil would increase with the number of oil changes a garage did, the amount of waste from fossil or nuclear plants increases with the amount of electricity produced, the amount of waste in a chemical manufacturing plant increases with the number of pounds produced, depending on the chemistry, just as the amount of trash a family has will change depending on the number of children or babies in the house. While these measurements are reflective of how changes in activity can affect changes in waste, they can only be used to effectively compare similar businesses to each other. The workgroup could not find a way to compare pounds of waste / pounds of product or per kilowatt hour, or per item processed, etc., and thereby use this as a statewide indicator.

Additional possible indicators were discussed, as follows:

Incidents (transportation or otherwise) involving hazardous waste: This data was not thought to be useful for an indicator on it's own, but could be linked with the amount of hazardous waste managed by TRI facilities as evidence that a great deal of waste is being handled without incident. The state of Maryland does not have commercial facilities for managing hazardous wastes, so all wastes are transported out of state to be incinerated, landfilled or otherwise treated.

TRI (Toxics Release Inventory) pollution prevention data: The group decided that this information was substantially covered by the existing indicator on toxic releases to the air. TRI numbers include releases to the land, air, water or to treatment facilities (on-site or off-site).

Number of companies with pollution prevention plans, who participate in Businesses for the Bay, or who participated in the Reilly 33/50 program: The workgroup felt that there is not enough information to create a meaningful Indicator. There was a great deal of discussion about pollution prevention and representatives from the companies present said that many pollution prevention efforts have economic benefits and have been done for years, without being specifically labeled as such. If available, this information would also be industry specific and not be a good state-wide indicator.

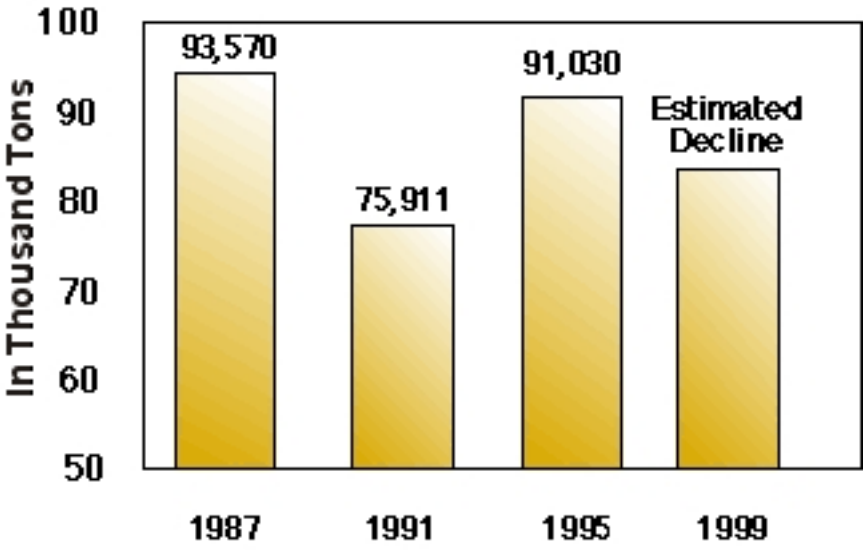
Amount of hazardous waste incinerated, landfilled or transferred off-site: An indicator of the Disposition of Hazardous Wastes was proposed to show how wastes were being managed by the generators. This would take the categories of wastes already reported biennially by generators and split them into their disposal methods. This idea was rejected by the workgroup as being more educational in nature than a way to track performance.

% Compliance with MDE regulations by generator ID# large/small: The workgroup discussed this proposal at length and decided that this measure would not be a useful indicator for the entire state. While the Department targets businesses with a history or suspicion (based on complaints) of non-compliance, this would not represent a total picture, and the generators inspected would not be consistent from year to year.

Data/Graph:	Hazardous Waste Generated Annually
Goal:	Reduce the threat to public health from the presence of hazardous waste and hazardous materials in the environment.
Indicator:	Amount of hazardous waste generated in Maryland annually.
Consequences:	Hazardous waste has the potential to cause or contribute to an increase in mortality or serious illness and to threaten the environment if mismanaged.
Status:	In 1995, 91,030 tons of hazardous waste were generated in the State. Maryland anticipates a decline in hazardous waste generation as the number of generators decreases and more pollution prevention technologies and systems are developed and implemented. Data for 1997 is currently being compiled by the U.S. EPA.
Stressors/Sources:	Hazardous waste is produced as a byproduct of many manufacturing operations and processes. Also, numerous commercial chemical products are regulated as hazardous waste once they are declared to be waste or intended to be discarded. Pollution prevention initiatives and hazardous waste recycling systems can involve substantial initial capital expenditures, particularly for small to medium size businesses (in proportion to revenues); increases in business and industrial activity can cause an increase in the generation of hazardous waste; wastes may become newly regulated as hazardous, causing a statistical increase in the amount of hazardous waste generated even though the total amount of waste generated does not increase.
Management Objective:	Reduce amounts of hazardous waste potentially subject to release into the environment.
Benchmark:	Achieve continual decrease in aggregate amount of hazardous waste generated per year.

Indicator Development and Data Responsibility: *MDE's Hazardous Waste Program, 410-537-3343.*

Hazardous Waste Generated Annually



Maryland's Environmental Indicators
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REPORTED EXCEEDANCES OF LEAD POISONING STANDARD

Data/Graph: Percentage of Children Screened Exceeding Lead Poisoning Standard

Goal: Reduce the threat to public health from the presence of hazardous waste and hazardous materials in the environment.

Indicator: Reported incidents of elevated blood lead levels as percentage of the total tested population.

Consequences: Ninety-five percent of the housing units in Maryland built before 1950 contain lead paint. Swallowing or breathing lead can poison children. Lead poisoning can slow a child's development and cause learning disabilities and behavior problems.

Status: In 1996, there were 1,830 reported incidents of elevated blood-lead levels statewide (3.1% of the children screened exceeded the lead poisoning standard). In 1997, 67,118 children 0-6 years of age were screened for lead poisoning (15.3% of all children aged 0-6 years in Maryland), and there were 1,233 reported incidents of elevated blood-level levels statewide (1.8% of the children screened exceeded the lead poisoning standard).

Stressors/Sources: Deteriorated lead paint in housing units; insufficient abatements; failure to notify tenant of danger or possible exposure; need for affordable housing.

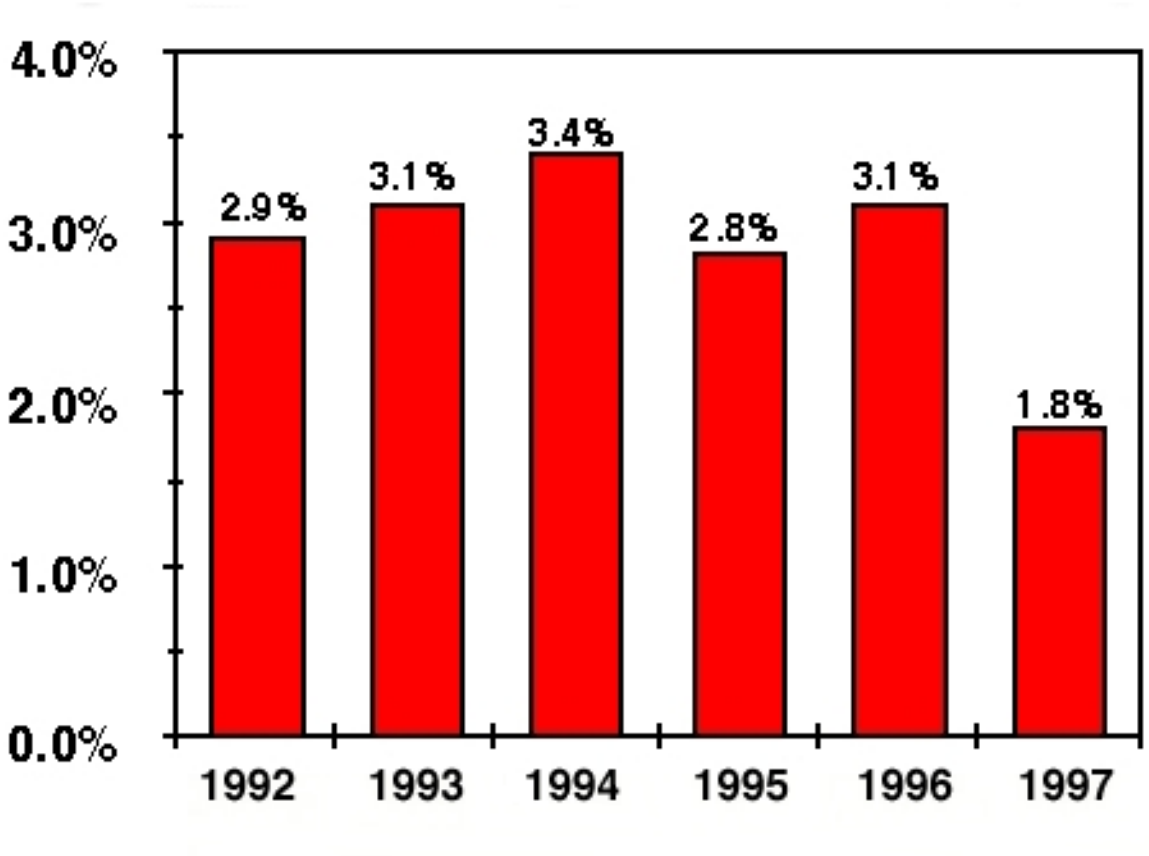
Management Objective: Reduce exposure of children to lead paint poisoning (using the percent of children screened with elevated blood levels as indicator of the program's success in reducing children's exposure to lead paint).

The lead paint hazard treatment program was fully implemented in February 1996. As more properties undergo lead hazard treatments, the number of detected cases is expected to diminish. Maryland seeks to ensure that 100% of properties that require lead paint hazard treatments are completed by the year 2006.

Benchmark: A reduction in the percentage of children screened exceeding lead poison standards to the lowest possible level.

Indicator Development and Data Responsibility: *MDE's Environmental Lead Program, 410-537-3441.*

Percentage of Children Screened
Exceeding Lead Poisoning Standards



Ecosystem Health Indicators

Maryland has substantial experience in evaluating the conditions of the State's biological resources. Through initiatives such as the multi-agency Chesapeake Bay Program and Maryland's Power Plant Research Program, state and federal agencies have accumulated a wealth of data for monitoring trends in resource conditions and developing corresponding management recommendations based on this abundance of scientifically credible data.

The ecosystem health information presented here was compiled and assembled according to conventional science and the best available data at the time of indicator development. The data are legitimate and meaningful. However, our understanding of ecosystem health is improving and as it does, the State needs to be prepared to develop the new information bases and tools that will enable us to accurately assess conditions.

Ecosystems are hierarchical in nature. They exist at many levels and can be described at many scales. To attempt to evaluate ecosystem health therefore requires a multidimensional approach that includes indicators of attributes from a hierarchy of levels -- from the health of the individual to populations to assemblages of species. Indicators which measure human impacts in ecosystems must also be recognized within such a hierarchy. A comprehensive approach to evaluating the health of ecosystems should consider indicators which depict conditions within as many of the levels of the hierarchies as possible.

An ecosystem approach to management is now being recognized as important at multiple levels of government and in the educational and private sectors. Approaches for evaluating trends in ecosystem health are being developed and tested at varying scales and locations throughout the United States, including Maryland. Issues of data availability and accessibility are also being confronted and resolved with the advent of new technologies and methodologies, such as remote sensing, geographic information systems and global positioning systems.

An ecosystem approach to management also requires a major commitment to a broad spectrum of scientific activities in inventory, assessment, and monitoring. A greater understanding of abiotic and biological processes is particularly important, including water cycle processes, sediment erosion-transport-deposition, geobiochemical processes (nitrate cycle, nutrient and toxics cycling), and human impacts on these processes.

In an effort to improve our indicators, Maryland is developing and evaluating new approaches to monitoring the health of the State's ecosystems. These new approaches share one or more of the following themes:

- Movement toward composite indicators
- Movement toward landscape indicators
- Movement toward indicators contributing to ecological risk assessments
- Movement toward accessible information on ecosystem health

The Environmental Partnership Agreement establishes a framework for the further development of these indicators. In the long term these indicators are at least as important, if not more important, than the indicators for which we have collected data in the past. It is imperative for ecosystem recovery and sustainability that we pursue their development.

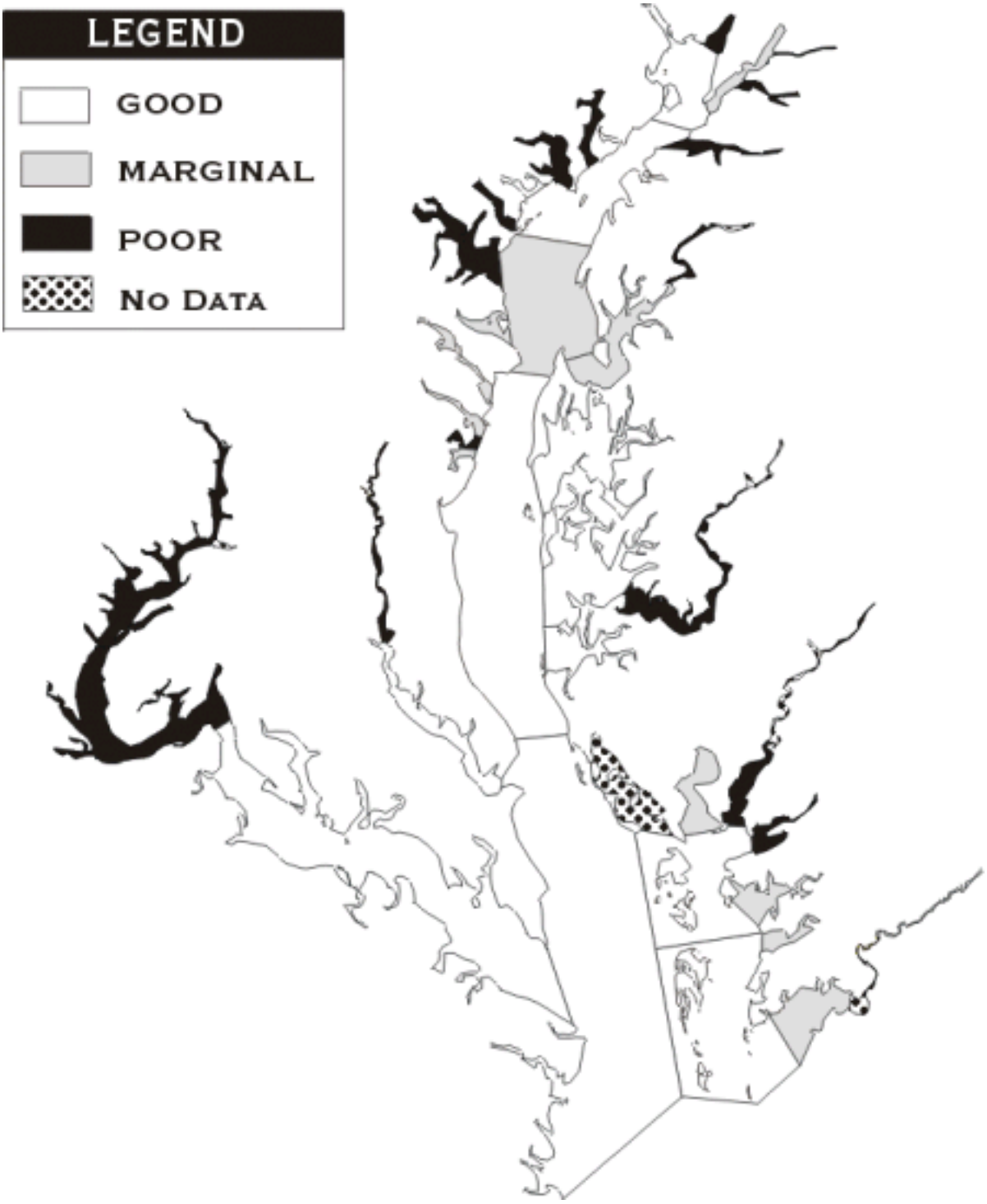
Maryland's Environmental Indicators
Winter, 1999

SUBMERGED AQUATIC VEGETATION HABITAT QUALITY

Data/Graph:	Submerged Aquatic Vegetation Habitat Quality (1995-1997)
Goal:	Improve and protect quality of surface waters.
Indicator:	Habitat quality rating based on the number of SAV habitat requirements achieved.
Consequences:	Chronically exceeding the value of one or more habitat parameter can potentially lead to loss of SAV in an area.
Status:	53% of Maryland Chesapeake Bay segments have at least marginal SAV habitat quality.
Stressors/Sources:	High nutrient levels in the water column resulting from point, nonpoint runoff, and atmospheric deposition cause algal blooms (cloudy water caused by excessive microscopic plant growth) and epiphytic growth (small plants that grow on the SAV) which harm SAV by reducing the amount of light reaching the plants. Increased suspended solids from runoff also harm SAV by reducing the amount of light reaching plants.
Management Objective:	Improve SAV habitat quality through nutrient and sediment reduction.
Benchmark:	Achieve adequate SAV habitat quality for all Maryland Chesapeake Bay tidal waters

Indicator Development and Data Responsibility: *DNR's Tidewater Ecosystem Assessment Division, 410-260-8630.*

SAV Habitat Quality



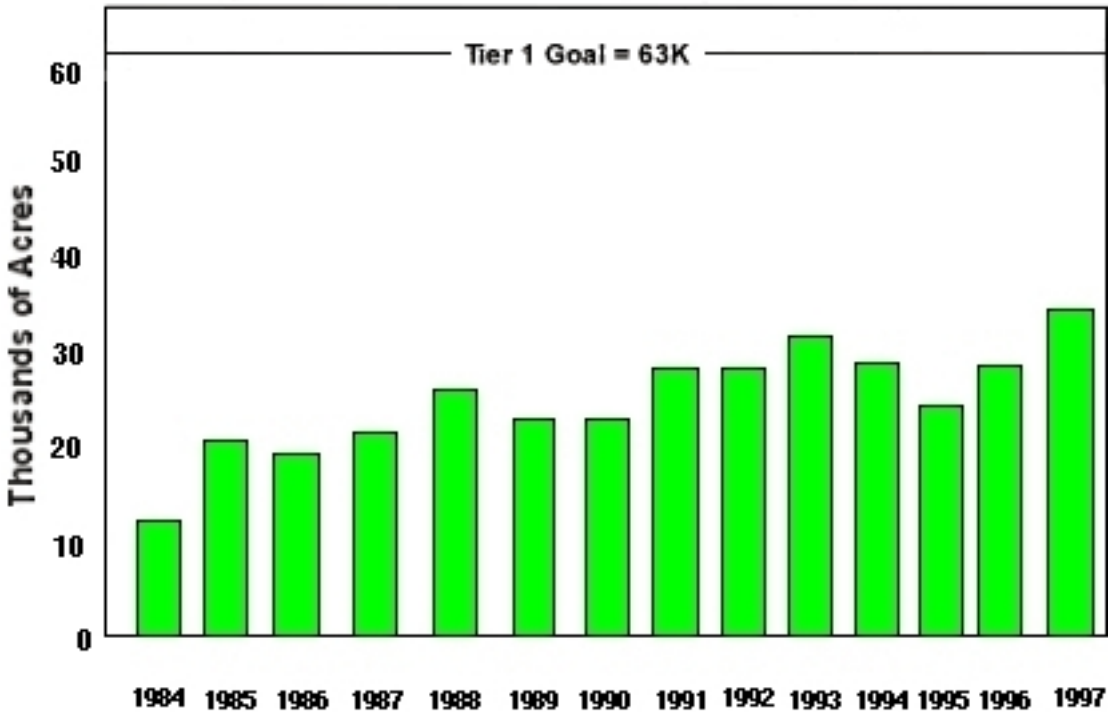
Maryland's Environmental Indicators
Winter, 1999

ACRES OF SUBMERGED AQUATIC VEGETATION

Data/Graph:	Acres of Submerged Aquatic Vegetation
Goal:	Conserve natural ecological communities and maintain viable populations of native SAV species.
Indicator:	Acres of submerged aquatic vegetation
Consequences:	Lack of SAV denies food and shelter for waterfowl, fish, and shellfish.
Status:	Approximately 57% of the Tier 1 goal.
Stressors/Sources:	High nutrient levels in the water column resulting from point source discharges, nonpoint runoff, and atmospheric deposition cause algal blooms (cloudy water caused by excessive microscopic plant growth)and epiphytic growth (small plants that grow on the SAV) which harm SAV by reducing the amount of light reaching the plants. Increased suspended solids from runoff also harm SAV by reducing the amount of light reaching plants.
Management Objective:	Re-establish SAV through reduction of nutrient loading to mainstem and tributaries. Implement SAV restoration activities.
Benchmark:	Increase submerged aquatic vegetation (SAV) coverage in Maryland to approximately 63,000 acres by 2005. This would restore areas inhabited by SAV from 1971 to 1990.

Indicator Development and Data Responsibility: *DNR's Tidewater Ecosystem Assessment Division, 410-260-8630.*

Acres of Submerged Aquatic Vegetation



Maryland's Environmental Indicators
Winter, 1999

BENTHIC COMMUNITIES IN THE CHESAPEAKE BAY

Data/Graph: Percentage of Total Area Meeting Benthic Community Restoration Goals

Goal: Conserve natural ecological communities and maintain viable populations of native species.

Indicator: Benthic Index of Biotic Integrity (B-IBI): Benthic communities from various places around the Bay are evaluated on measures of species diversity, species composition, productivity, and trophic composition. For each benthic community, a numeric rating is assigned for each attribute based on whether the community approximates (a score of 5), deviates slightly from (a score of 3) or deviates strongly from (a score of 1) a goal comprised of the characteristics of the attribute at reference sites. These are then averaged to determine the overall score used to classify the benthic community at a site. Scores for sites within each of the six regions are used to determine the percent area of each region that meets the Restoration Goals.

Consequences: Unhealthy benthic communities are an indication of poor habitat and/or water quality. Healthy benthic communities provide important food resources for higher trophic levels such as fish.

Status: Status is assessed for six regions of the Maryland portion of the Bay. In 1997, the results (as percent of total area which met Goals) were as follows:

- Upper Bay, 75%;
- Mainstem (except the deep trench), 56%;
- Potomac River, 26%;
- Patuxent River, 72%;
- Upper Western Tributaries, 52%; and
- Eastern Tributaries, 84%.

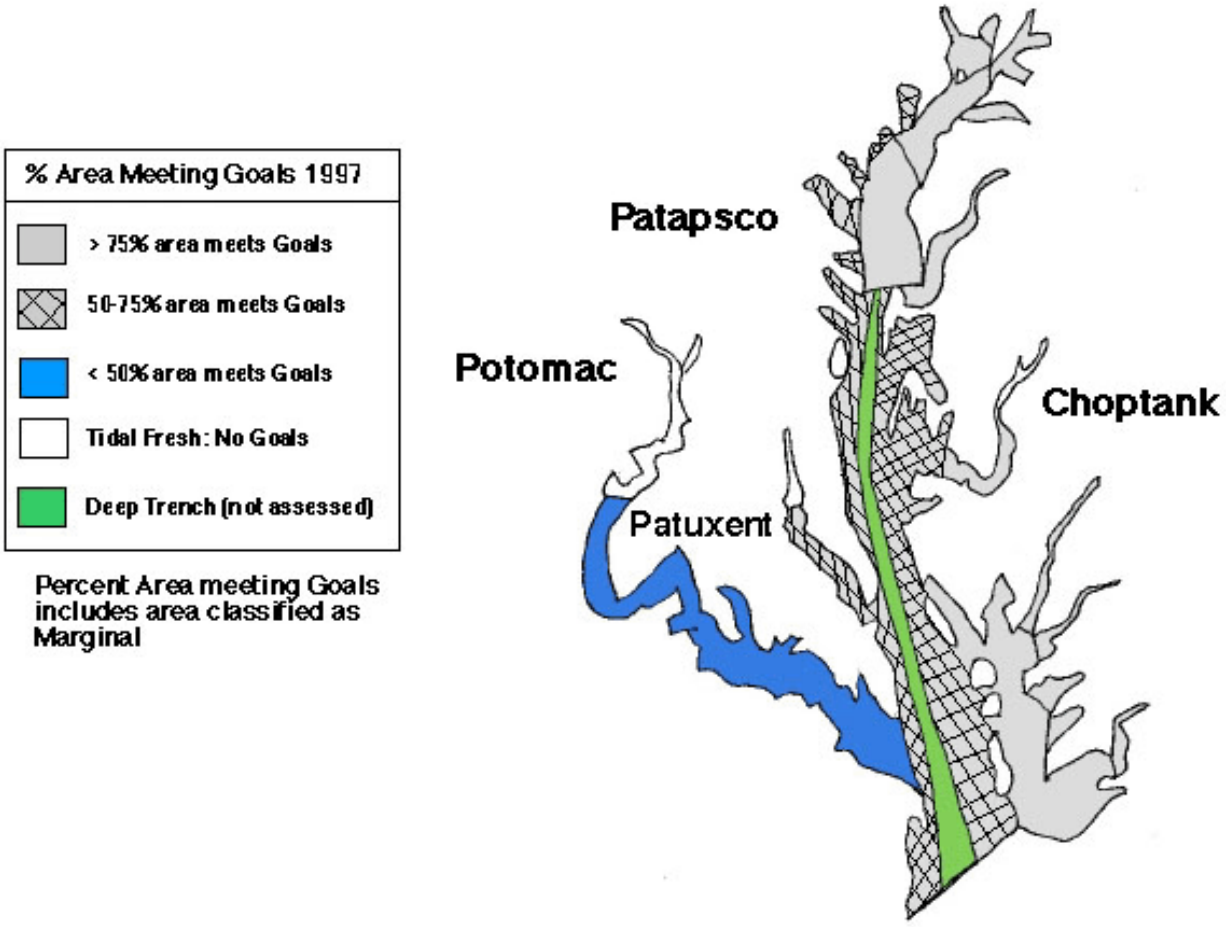
Stressors/Sources: Excess nutrients (eutrophication) and stratification of the water column in summer can contribute to low dissolved oxygen levels in the bottom waters, stressing and/or killing benthic communities. Toxic chemicals can accumulate in the sediments and adversely impact the benthic community.

Management Objective: To restore degraded benthic habitat through improvements in nutrient loadings, water quality and dissolved oxygen concentrations in bottom waters.

Benchmark: Meet benthic community restoration goals at 100% of area of Bay and tributaries.

Indicator Development and Data Responsibility: *DNR's Tidewater Ecosystem Assessment Division, 410-260-8630.*

Benthic Communities in the Chesapeake Bay



Maryland's Environmental Indicators
Winter, 1999

FISH INDEX OF BIOTIC INTEGRITY

Data/Graph: Estuarine Fish Community Index of Biotic Integrity

Goal: Conserve natural ecological communities.

Indicators: Indexes of Biotic Integrity for fishes (FIBI) have been developed for small (first to third order) coastal and non-coastal plain streams. A total of eight biological metrics are measured, scored and summed to calculate an FIBI. The coastal plain stream FIBI has seven metrics in common with the non-coastal plain stream FIBI. All metrics are noted below:

- number of native species
- number of benthic species
- % tolerant individuals
- % abundance of dominant species
- % generalists, omnivores and insectivores
- number of individuals/square meter
- biomass (grams/square meter) (Used for coastal plain streams only)
- % lithophilic spawners
- % insectivores. (Used for non-coastal plain streams only)

Consequences: A decline in fish IBI scores reflects a degradation in water quality and physical conditions.

Status: A report describing the results of fish IBI assessments based on 1995 Maryland Biological Stream Survey (MBSS) sampling in six river basins is available from DNR. A comprehensive DNR report covering the entire state, using three years of MBSS data (1995, 96, 97), is scheduled for completion in April, 1999.

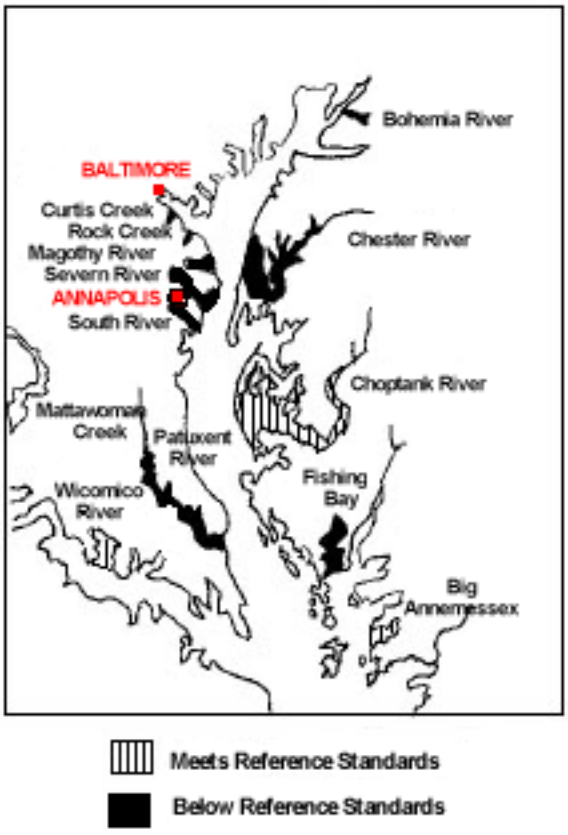
Stressors/Sources: Fish community indicators are influenced by point and nonpoint sources of water pollution. Water quality and physical habitat conditions in non-tidal streams and rivers are influenced by land use and land cover patterns in the watershed, such as the destruction of riparian forests and increasing the area of impervious land cover. Other major influences are channelization, encroachment by livestock, and blockages to upstream/downstream movements of fish.

Management Objectives: Implement watershed management strategies that will control and minimize point and non-point sources of water pollution, prevent the depletion of groundwater supplies, minimize the area of impervious land cover, restore riparian forests, keep livestock out of the stream channels, remove blockages to upstream/downstream movements of fish or construct fish passage structures if the blockages cannot be removed.

Benchmark: Achieve fish IBI scores of good, preferably, or at least fair in all sampled streams.

Indicator Development and Data Responsibility: *DNR's Monitoring and Non-Tidal Assessment, 410-260-8610.*

Estuarine Fish Community Index of Biotic Integrity



Fish community indicators for Chesapeake Bay tidal tributaries sampled between 1989 and 1997. IBI scores were averaged to get an overall rating for each tributary.

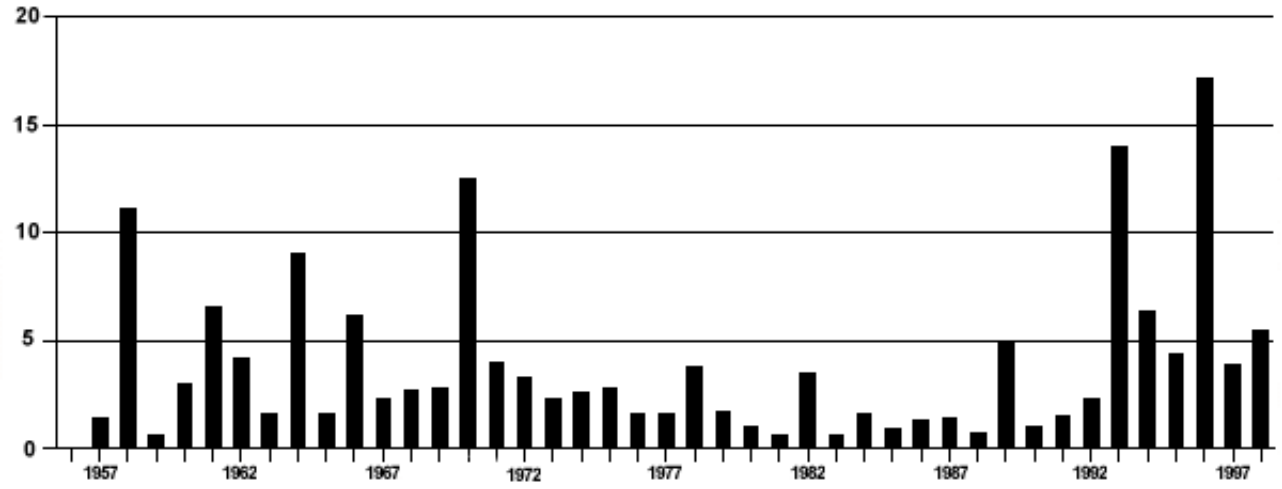
Maryland's Environmental Indicators
Winter, 1999

STRIPED BASS JUVENILE INDEX (JI)

Data/Graph:	Young-of-the-Year Striped Bass - Maryland (Geometric Mean)
Goal:	Maintain viable populations of native species.
Indicator:	The striped bass juvenile index is used as one of the parameters to estimate future population levels. Four river systems (Potomac, Choptank, Nanticoke, and Upper Bay), sampled once a month for three months (July to September), covering 22 sites. The juvenile index is the total number of juvenile (young-of-the-year) striped bass caught by seine hauls divided by the total number of haul seine.
Consequences:	Low spawning stock size will affect juvenile abundance. If the juvenile index is lower than 90% of all other values in the data set for three consecutive years, it will trigger additional management actions.
Status:	The 1998 JI was 5.50, above the average for the period.
Stressors/Sources:	Factors that influence the size of spawning stock include commercial and recreational harvest, habitat quality, and environmental parameters (especially temperature). Larval and juvenile mortality will also affect juvenile abundance. Mortality rates can be affected by water quality and biological parameters such as density of predators and food availability.
Management Objective:	Maintain juvenile abundance at or above historical levels and protect an adequate proportion of each year's young until they reach maturity.
Benchmark:	Maintain juvenile index at or above an average catch per haul of4.32, the Target Period Average (TPA), the average of indices from 1959-1972, a period of stable biomass and general stock health.

Indicator Development and Data Responsibility: *Maryland DNR's Fisheries Service, 410-260-8268.*

Young-of-the-Year Striped Bass - Maryland (Geometric Mean)



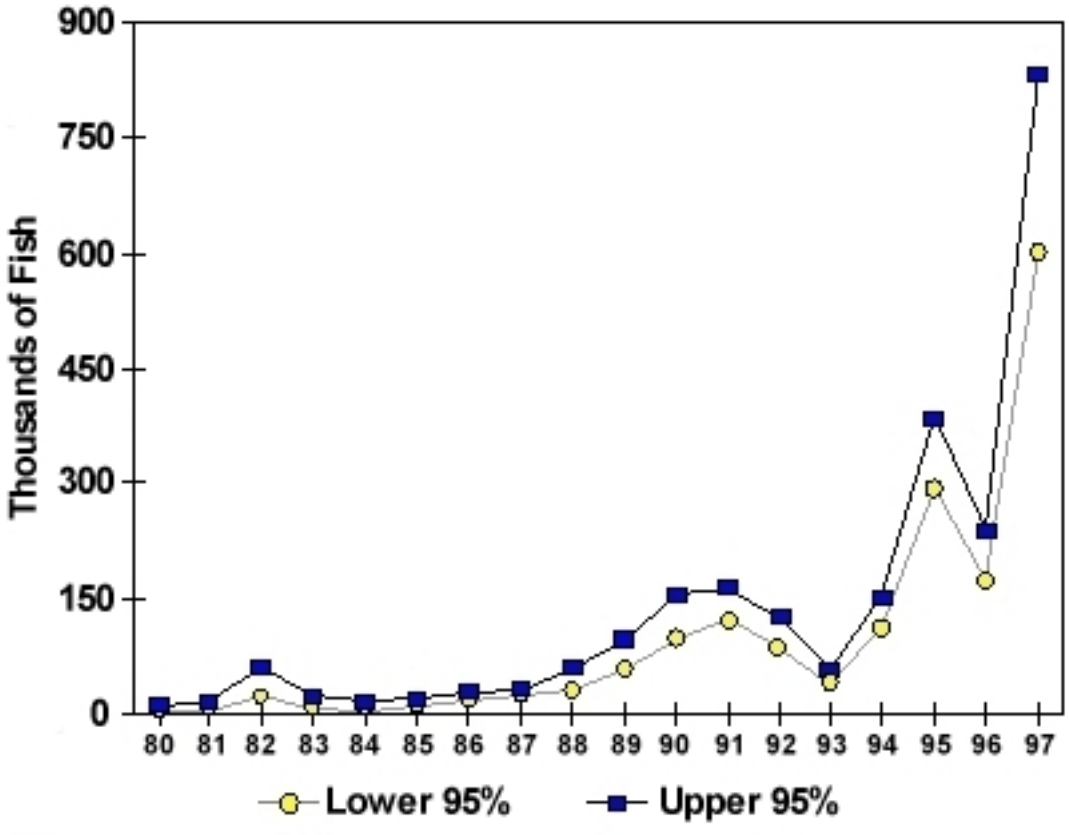
AMERICAN SHAD POPULATION

Data/Graph:	American Shad Population 95% Confidence Limits
Goal:	Maintain viable populations of native species.
Indicator:	Estimate of the adult American shad population in the Upper Bay. There is a 95% probability that the true number of Shad in the Upper Bay in a given year is between the lower and upper lines.
Consequences:	Low populations have led to a declining fishery.
Status:	1997 population estimate was about 709,000 adult shad. There is currently a moratorium on the harvest of American shad from the Chesapeake Bay.
Stressors/Sources:	Harvesting adults along the Atlantic coast; juveniles can be affected by water quality and water flow; habitat degradation; stream impediments blocking spawning and nursery grounds.
Management Objective:	Rebuild the American shad population in the Upper Bay.
Benchmark:	Restore the American Shad population to a level that would support a limited fishery.

Indicator Development and Data Responsibility: *DNR's Fisheries Service, 410-260-8268.*

American Shad Population

95% Confidence Limits

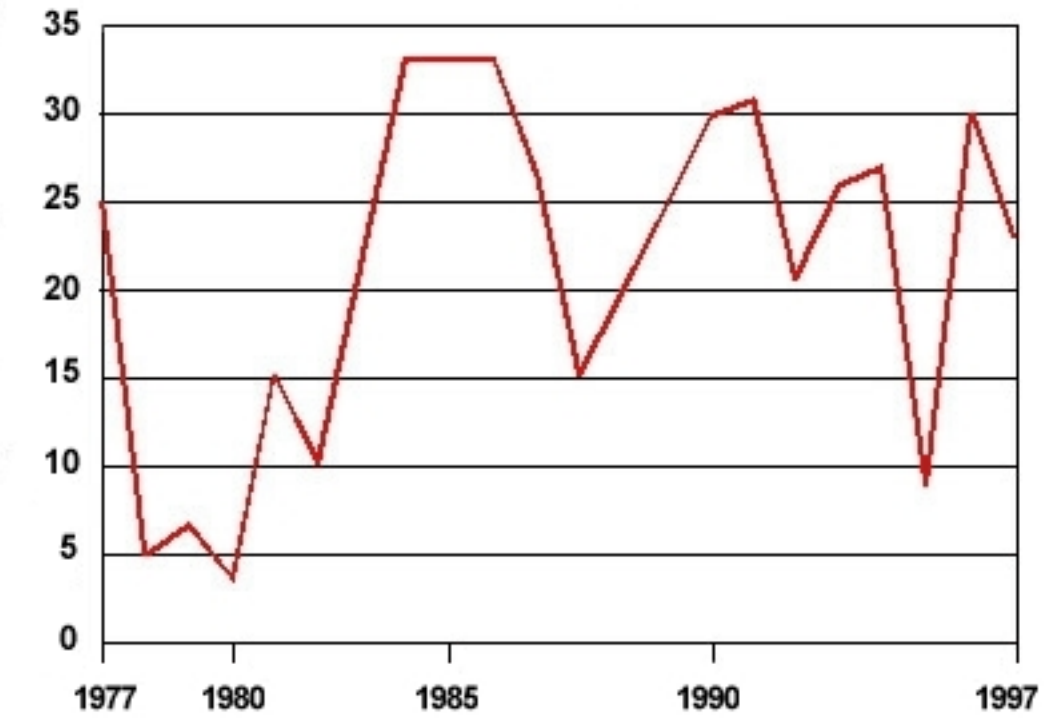


BLUE CRAB POPULATION

Data/Graph:	Overall Crabs Per Tow
Goal:	Maintain viable populations of native species.
Indicator:	Blue crab population.
Consequences:	Low population can lead to a reduced fishery and possibly below average levels of recruitment.
Status:	Currently blue crabs are fully exploited.
Stressors/Sources:	The blue crab stock can be affected by commercial and recreational exploitation, habitat alterations, and water quality.
Management Objective:	Protect the reproductive potential of the blue crab stock while optimizing recreational and commercial harvest.
Benchmark:	The Chesapeake Bay Blue Crab Target Setting Task Force will develop numerical targets that relate stock size to changes in exploitation.

Indicator Development and Data Responsibility: *DNR's Fisheries Service, 410-260-8268.*

Overall Crabs Per Tow



SEED OYSTER PRODUCTION

Data/Graph:	Number of Seed Oysters Planted
Goal:	Maintain viable populations of native species.
Indicator:	Number of seed oysters planted from Maryland seed areas.
Consequences:	A significant portion of Maryland's oyster fishery depends on seed oyster production in areas of the Bay that receive good spat sets in most years. Seed-bearing shell from these seed areas are transplanted to productive growing areas which have not received adequate recruitment. Spat set is stimulated in seed areas by placing clean shells on suitable bottom each summer.
Status:	Seed oyster production since 1992 has been limited by salinity in the Bay and other factors. Bay-wide spat recruitment is limited by availability of suitable substrate.
Stressors/Sources:	Oysters are seriously impacted by parasite infestation (MSX and Dermo). In addition, high levels of freshwater discharge which lowers salinity can lead to higher oyster mortality in upper portions of the Bay and tributaries. In seed-producing areas, lower salinity generally results in lower spat set. Continued supply of oyster shell is critical to producing seed oysters. Greater quantities will be needed to achieve goal.
Management Objective:	Maximize success of oyster reproduction by providing optimum substrate in areas that are most suitable for spat set and then transplanting the seed oysters to the best grow-out areas.
Benchmark:	Provide enough shell to produce 500,000 bushels of seed-bearing shell per year.

Indicator Development and Data Responsibility: *DNR's Fisheries Service, 410-260-8259.*

Maryland's Environmental Indicators
Winter, 1999

NUTRIENT INPUTS TO MAINSTEM AND TRIBUTARY WATERS

Data/Graphs: Nitrogen Loads
Phosphorus Loads

Goal: Improve and protect quality of surface waters.

Indicator: Nitrogen and phosphorus load reductions as measured through Tributary Strategies implementation tracking, the 1997 (phase 4) Watershed model and the Integrated Watershed Analysis and Management System (IWAMS).

Consequences: Excessive nutrient loading causes rapid, uncontrolled growth of algae in surface water. These algal blooms cloud the water and block sunlight, which causes Bay grasses to die. When algae die and sink to the bottom water, decomposition of the resulting organic matter uses oxygen; if too much oxygen is used for decomposition, oxygen levels drop to the point that living resources are stressed.

Status: The amount of nutrients entering surface waters is amplified by human activities including sewage disposal, agricultural practices including misapplication of fertilizers, poor tillage practices, animal waste, urban storm runoff, and watershed modification such as forest buffer removal.

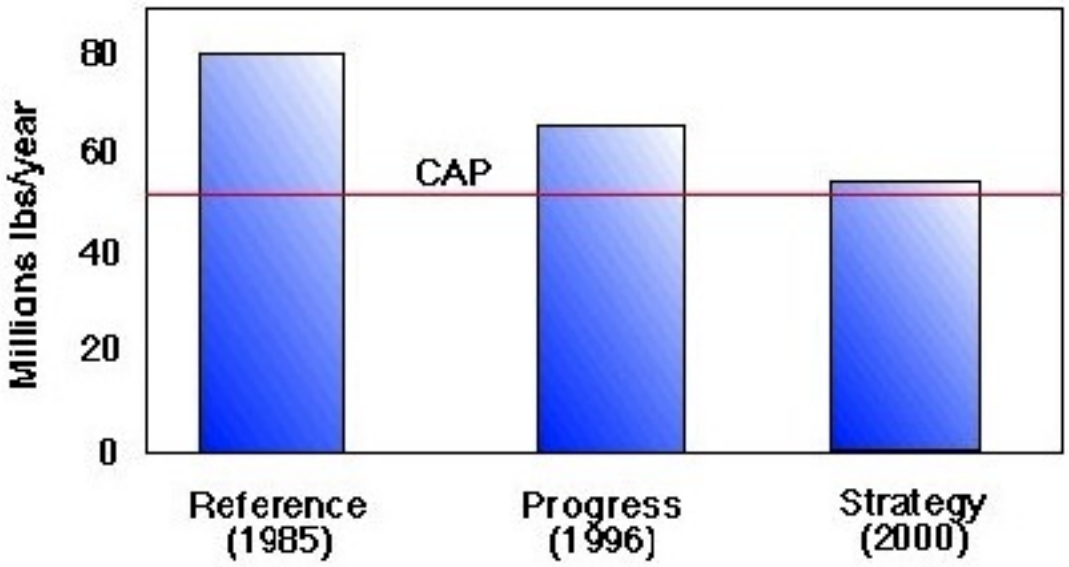
Stressors/Sources: A combination of voluntary and regulatory programs has reduced nitrogen by 17 million pounds and phosphorus by 1.9 million pounds from 1985 to 1996.

Management Objective: Reduce levels of nutrients entering the Chesapeake Bay from controllable sources in order to restore water quality and living resources conditions to accepted levels. The existing goal, or "cap," needs to be re-evaluated. As part of the '97 Directive, new maximum loading goals to the Bay may be established.

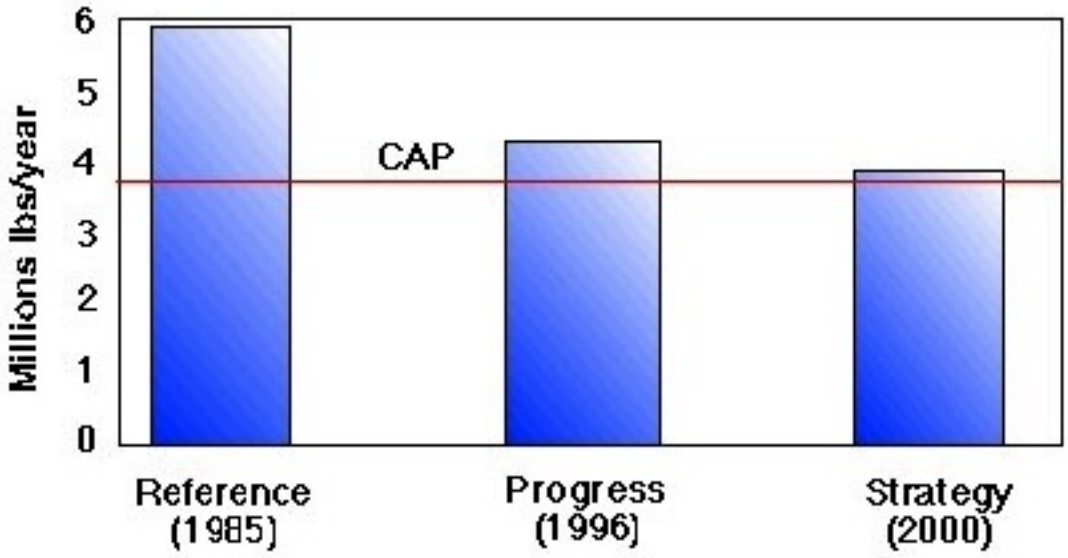
Benchmark: 40% nutrient reduction goal, from 1985 levels, achieved by the year 2000.

Indicator Development and Data Responsibility: *DNR's Watershed Management and Analysis Division, 410-260-8790.*

Nitrogen Loads



Phosphorus Loads



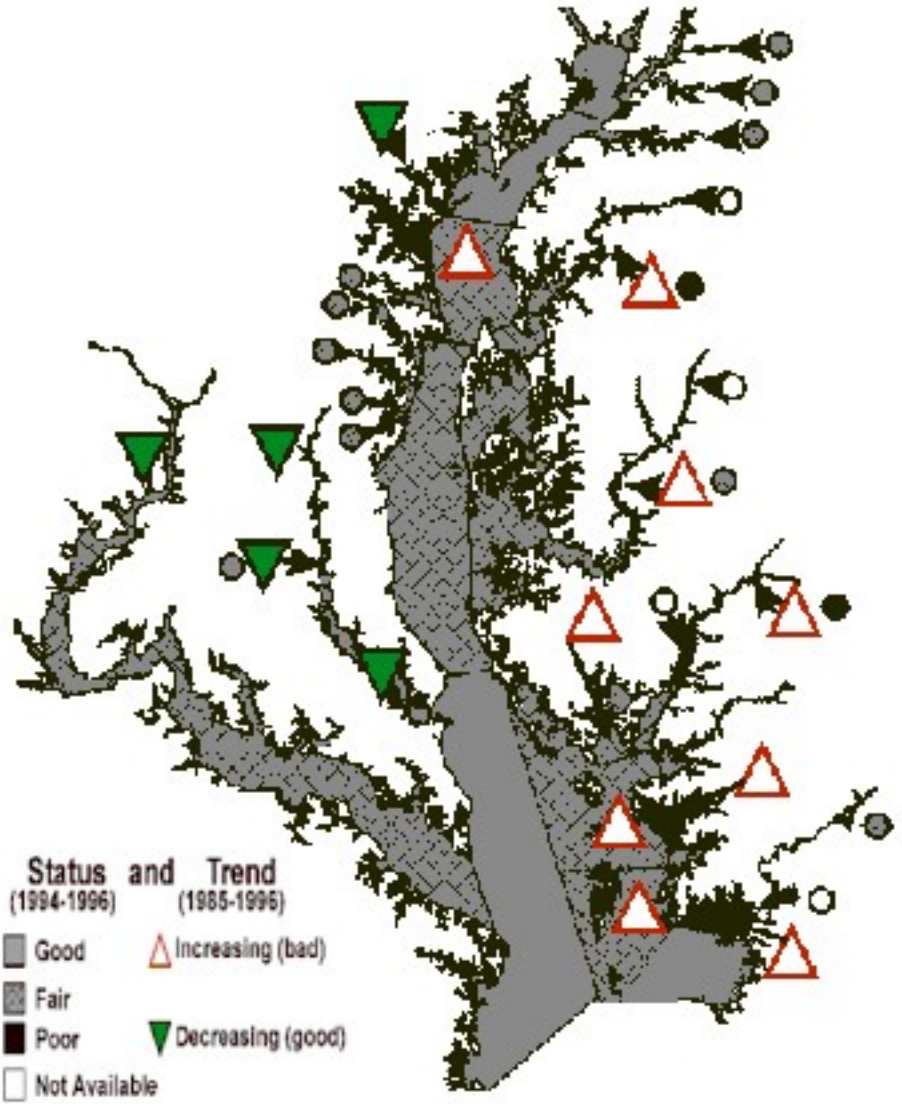
Maryland's Environmental Indicators
Winter, 1999

NITROGEN CONCENTRATION IN MARYLAND'S CHESAPEAKE BAY

Data/Graph:	Status and Trends of Nitrogen Concentration in the Maryland Portion of the Chesapeake Bay
Goal:	Improve and protect quality of surface waters.
Indicator:	Unfortunately, there are no scientifically established goals for "good" and "poor" levels of nitrogen to use for assessing the current conditions (status). Instead, a benchmark scale was developed using Bay-wide data from 1985-1996 for use as a relative scale for each salinity zone (tidal fresh, oligohaline and mesohaline). Each station is scored based on this relative scale and the score is used to categorize the water quality as"good" (lowest concentrations), "fair" (moderate concentrations), and "poor" (high concentrations).
Consequences:	High nitrogen levels can fuel algae blooms, which in turn can lead to decreased levels of dissolved oxygen in the bottom waters, impairing habitat for living resources. High nitrogen levels are also directly harmful to submerged aquatic vegetation (SAV) and indirectly harmful due to the increased levels of algae that can result.
Status:	Nitrogen concentrations (1994-1996) are fair to good in most parts of the Maryland Bay; exceptions are the Back, Patapsco,Chester, Nanticoke, Wicomico Rivers and Pocomoke Sound. Nitrogen concentrations (1985-1996) are improving in some Western Shore tributaries, but are degrading (increasing) in many areas of the Eastern Shore.
Stressors/Sources:	Excess nitrogen enters our waters from both point sources (for example, wastewater treatment plants) and non-point sources (for example, from agricultural fields, urban runoff, and air deposition).
Management Objective:	To reduce nitrogen inputs from both point and non-point sources and improve and restore tidal water habitats in conjunction with the United States Environmental Protection Agency (EPA) Chesapeake Bay Program.
Benchmark:	Reduce nitrogen concentration in Chesapeake Bay by 40% by the year 2000.

Indicator Development and Data Responsibility: *DNR's Tidewater Ecosystem Assessment Division, 410-260-8630.*

Status and Trends of Nitrogen Concentration in the Maryland Portion of the Chesapeake Bay



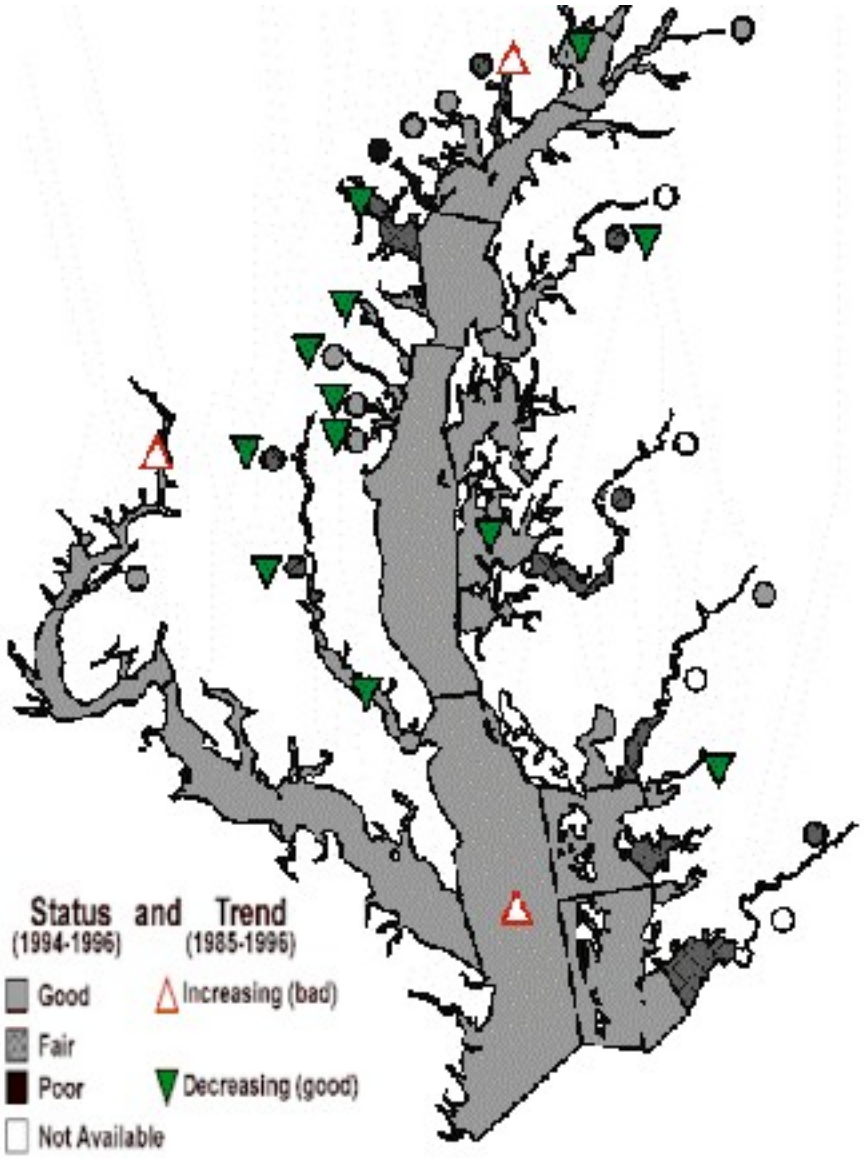
Maryland's Environmental Indicators
Winter, 1999

PHOSPHORUS CONCENTRATION IN MARYLAND'S CHESAPEAKE BAY

Data/Graph:	Status and Trends of Phosphorus Concentration in the Maryland Portion of the Chesapeake Bay
Goal:	Improve and protect quality of surface waters.
Indicator:	Unfortunately, there are no scientifically established goals for "good" and "poor" levels of phosphorus to use for assessing the current conditions (status). Instead, a benchmark scale was developed using Bay-wide data from 1985-1997 for use as a relative scale for each salinity zone (tidal fresh, oligohaline and mesohaline). Each station is scored based on this relative scale and the score is used to categorize the water quality as"good" (lowest concentrations), "fair" (moderate concentrations), and "poor" (high concentrations).
Consequences:	High phosphorus levels can fuel algae blooms, which in turn can lead to decreased levels of dissolved oxygen in the bottom waters, impairing habitat for living resources. High phosphorus levels are also directly harmful to submerged aquatic vegetation (SAV) and indirectly harmful due to the increased levels of algae that can result.
Status:	Phosphorus concentrations (1995-1997) are fair to good in most parts of the Maryland Bay with the exception of Back River. Phosphorus concentrations (1985-1997) are improving in many areas, but are still degrading in the Potomac, Bush, and lower Mainstem.
Stressors/Sources:	Excess phosphorus enters our waters from both point sources (for example, wastewater treatment plants) and non-point sources (for example, from agricultural fields and urban runoff).
Management Objective:	To reduce phosphorous inputs from both point and non-point sources and improve and restore tidal water habitats.
Benchmark:	Reduce concentrations of phosphorus in Chesapeake Bay and its tributaries by 40% by the year 2000.

Indicator Development and Data Responsibility: *DNR's Tidewater Ecosystem Assessment Division, 410-260-8630.*

Status and Trends of Phosphorus Concentration in the Maryland Portion of the Chesapeake Bay



Maryland's Environmental Indicators
Winter, 1999

CHESAPEAKE BAY PROGRAM TOXICS RELEASES -- MARYLAND

Over the past year, MDE staff and members of the Maryland Environment 2000 (ME 2000) Steering Committee and the Controlled Hazardous Substances Advisory Council met a number of times to discuss the concerns raised by the public and stakeholder groups on this Indicator in order to develop a more meaningful Chesapeake Bay Program Toxics Releases Indicator or even to merge this Indicator with the Hazardous Waste Indicator.

Initial discussions focused on what the Chesapeake Bay Program Toxics Releases Indicator should accomplish. The workgroup felt that the current Indicator, which measures the reported release of chemical contaminants, does not take into account releases that are not reported, changes in reporting requirements, or the fact that increased production (economic activity) would result in an increase in the amount of releases.

Like the discussion of the Hazardous Waste Indicator, numerous substitute Indicators were discussed, but the workgroup could not develop a replacement Indicator and agreed that until a better Indicator could be developed, MDE should continue to report on this Indicator with information about stakeholder concerns.

Data/Graph: Maryland Toxics Release Inventory, 1988-1996

Goal: Improve and protect Maryland's water quality.

Indicator: Toxics Release Inventory (TRI).

Consequences: Accumulation of too much of these contaminants can cause ecological and/or human health problems. Accumulation of chemical contaminants can adversely affect the ecology or human health of a region. Some contaminants can remain in the water column or sediment for long periods of time. Studies have shown that even relatively low concentrations of some toxic chemical contaminants can have a range of ecological impacts on the Chesapeake Bay. Chemical contaminants can compromise the immune system of Bay organisms, cause cancer in aquatic organisms, harm marine life, and affect the Bay's food web.

Status: Maryland has achieved a 53% percent reduction in reported air and water emissions as of 1994 (including transfers to publicly owned wastewater treatment plants). Since TRI reporting requirements have changed over the years, these data have been edited to include only those chemicals and industries for which reporting was required in 1988.

Stressors/Sources: Land releases and off-site transfers increased dramatically in 1991 due to a change in reporting requirements to include materials sent off-site for recycling and energy recovery. The additional increase in 1993-94 was due to one-time transfers from two large facilities in Baltimore. Transfers are expected to return to 1992 levels in 1995. The majority of the materials transferred are recycled and reused.

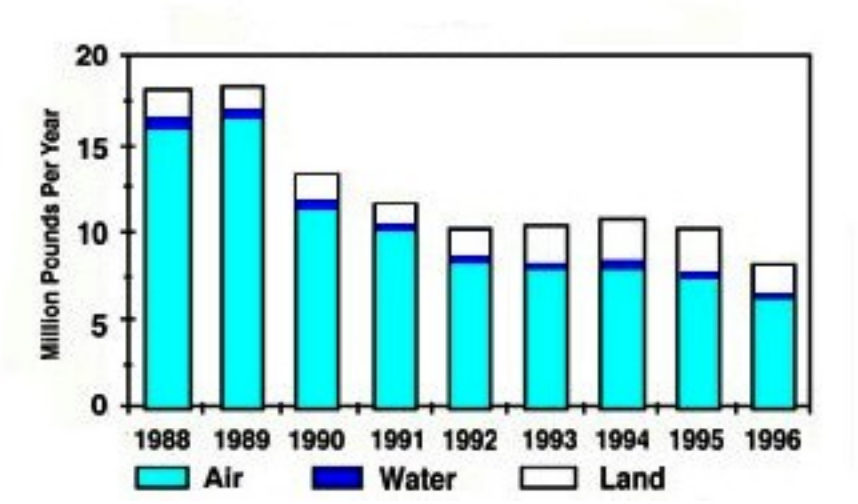
Stressors/Sources: Metals (e.g., copper, zinc, cadmium, mercury), pesticides, organic compounds [e.g., polynuclear aromatic compounds, polychlorinated biphenyls (PAHs and PCBs respectively)]. Chemical contaminants enter the Bay from point sources, nonpoint sources and the atmosphere.

Management Objective:	Through voluntary pollution prevention and regulatory limits, reduce emissions by 65% from a 1988 baseline by the year 2000.
Benchmark:	Maryland's Chesapeake Bay Program goal is to achieve by 2000, a 65% reduction of TRI chemicals into the environment from industries required to report in 1988.

Indicator Development and Data Responsibility: *MDE's Emergency Planning and Right-to-Know Program, 410-537-3800.*

Maryland Toxics Release Inventory, 1988-1996

Air, Water & Land Releases

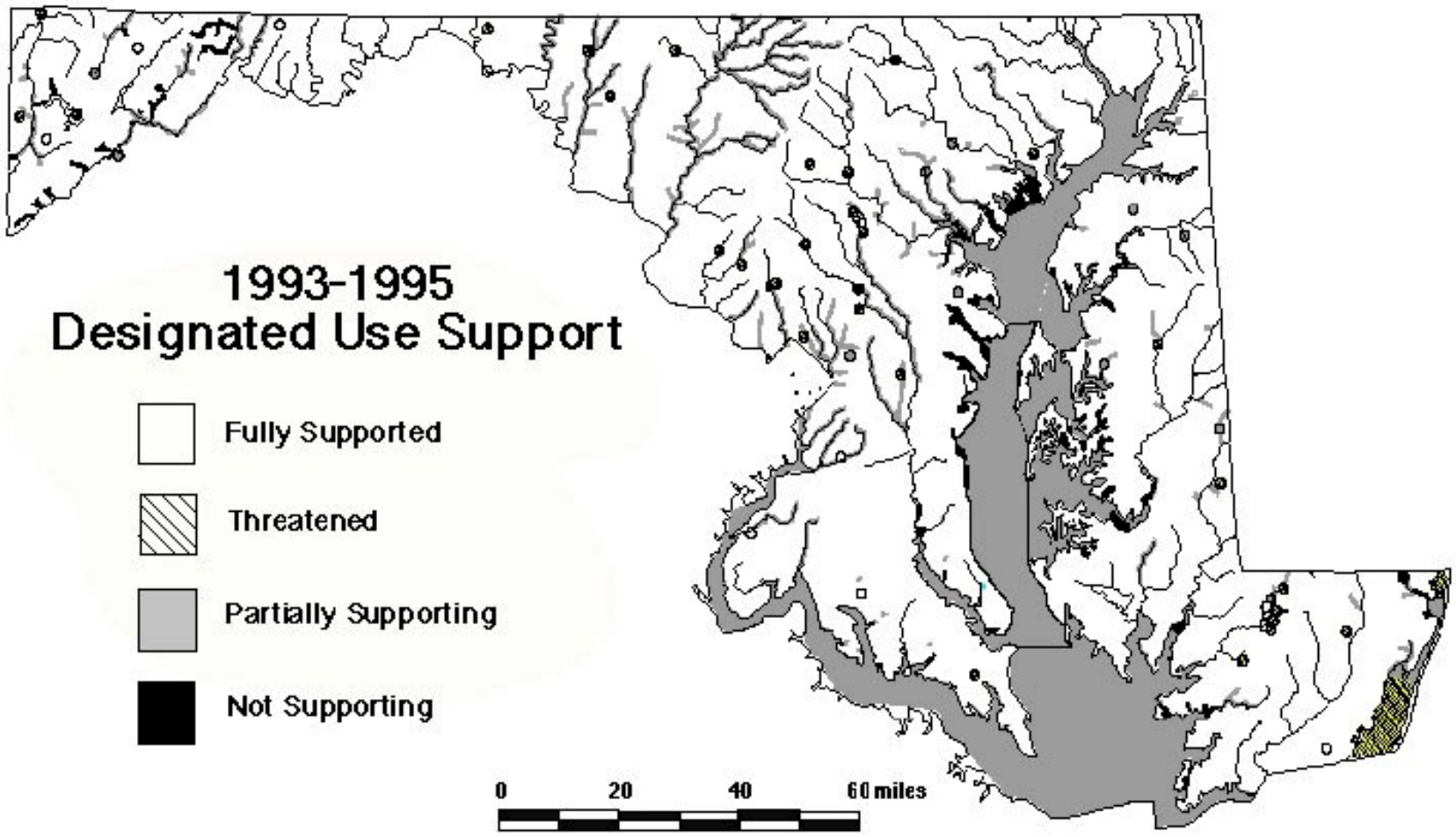


Maryland's Environmental Indicators
Winter, 1999

EXTENT TO WHICH DESIGNATED USES OF MARYLAND'S SURFACE WATERS ARE BEING MET

Data/Graph:	1993-1995 Designated Use Support
Goal:	Ensure that the "designated uses" of Maryland's surface waters are met and maintained for the benefit of Maryland's present and future generations.
Indicator:	Extent to which "designated uses" of Maryland surface waters are being met.
Consequences:	Waters that do not meet their designated uses represent a loss of a common resource that could result in economic and societal impacts and threaten human and ecosystem health. Maryland has determined that all surface waters in the state should be protected for basic water uses such as water contact recreation, fishing, support of balanced and diverse populations of aquatic plants, animals and wildlife, and use as an agricultural and industrial water supply. For some defined uses, like trout fishing, shellfish harvesting and public water supplies, water quality conditions must be even higher.
Status:	Of the 17,000 miles of mapped rivers and streams in Maryland, 89 percent fully support their designated uses; 11 percent of these waters do not fully support their uses. Of the 2,522 square miles of estuarine waters, only 3.5 percent fully support their designated uses; most of these waters only partly support their uses. Of the 21,010 acres of lakes that are tracked in Maryland, 82 percent fully support their designated uses; 18 percent partially support their use. Not all waters are directly monitored due to economic constraints; however, all waters are evaluated using available information.
Stressors/Sources:	Nutrients, sediment and bacteria from point and nonpoint source pollution may affect surface waters statewide. In some areas of the state, acidic waters from abandoned mines and atmospheric deposition, as well as toxic substances in urban stormwater and sediments may affect aquatic life and limit uses of these waters.
Management Objective:	Maximize percentage of surface waters meeting use designations.
Benchmark:	Continued increase in the percentage of the State's waters that fully support designated uses.

Indicator Development and Data Responsibility:



Source: MD Water Quality Inventory, 1993-1995

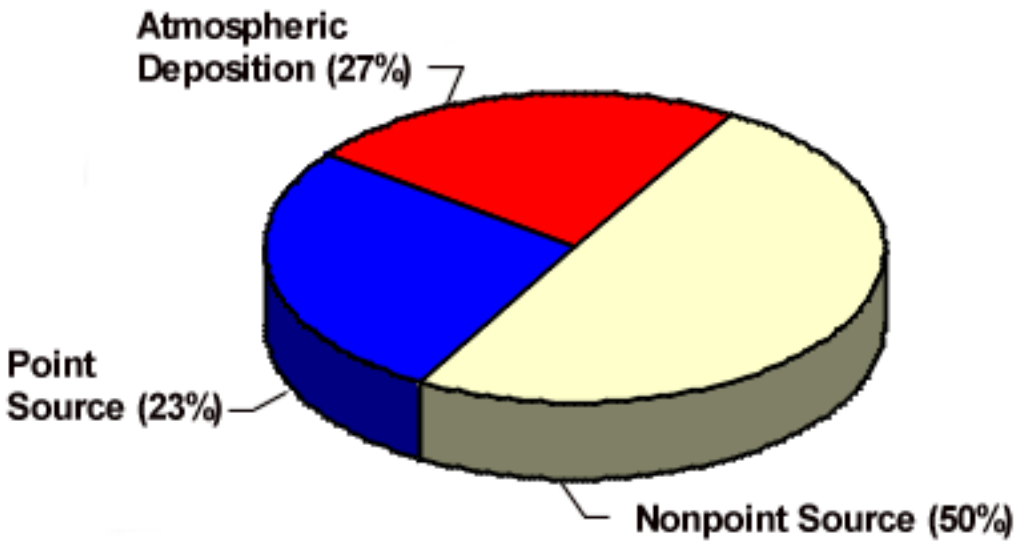
Maryland's Environmental Indicators
Winter, 1999

ATMOSPHERIC NITROGEN LOADING TO THE CHESAPEAKE BAY

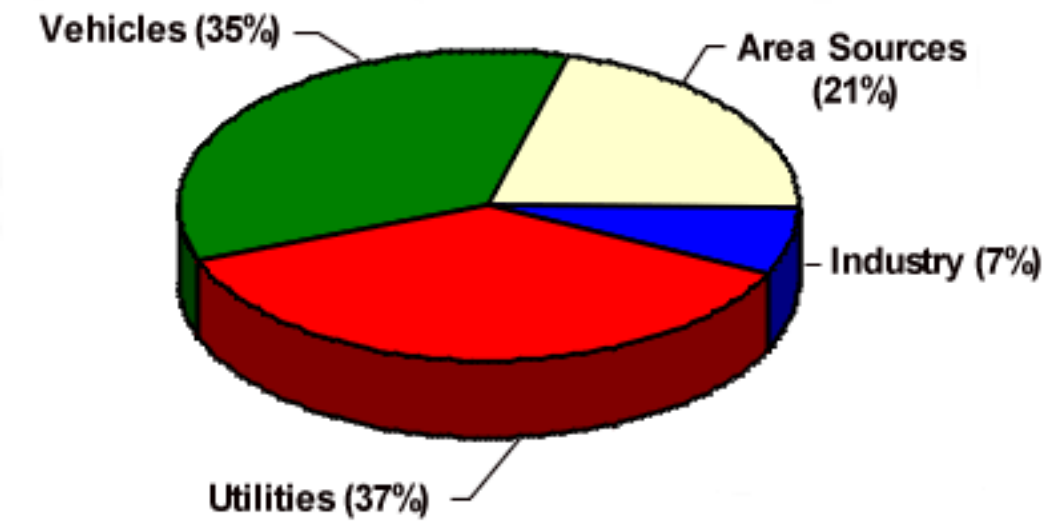
Data/Graphs:	Overall Nitrogen Sources to the Bay Atmospheric NOx Deposition to the Bay
Goal:	Improve and protect the water quality of the Chesapeake Bay.
Indicator:	Atmospheric nitrogen loading to the Chesapeake Bay.
Consequences:	Nitrogen from atmospheric emissions that are deposited in the Chesapeake Bay watershed and directly onto Bay waters contributes to the nutrient levels in the Bay. Through several mechanisms, high levels of nutrients lead to depletion of oxygen in Bay waters and deterioration of aquatic habitat.
Status:	Atmospheric nitrogen currently is responsible for approximately 27% of the nitrogen reaching the Chesapeake Bay.
Stressors/Sources:	Approximately 75% of the atmospheric nitrogen deposition reaching the Chesapeake Bay and its watershed originates from emission sources located within the designated Chesapeake Bay airshed. The EPA estimates that the remaining 25% originates from emission sources outside the airshed. Approximately 40% of the deposition originates from sources within Maryland, Pennsylvania, Virginia, and the District of Columbia. Nitrogen oxides are largely formed as a result of combustion processes. Emission sources include vehicles, utilities, industries, and area sources such as boats, and farm and lawn equipment.
Management Objective:	Implement nitrogen emission control strategies required under the Clean Air Act.
Benchmark:	No specific benchmarks have been established for atmospheric nitrogen reductions. Await results from Air Subcommittee of the Chesapeake Bay Program.

Indicator Development and Data Responsibility: *MDE's Air Quality Program, 410-537-3260.*

Overall Nitrogen Sources to the Bay



Atmospheric NOx Deposition to the Bay



Maryland's Environmental Indicators
Winter, 1999

CONTRIBUTION OF LOW DISSOLVED OXYGEN LEVELS TO WATER QUALITY IMPAIRMENT

Data/Graph: Percent of Designated Use-Impaired Surface Waters in Maryland Due to Low Dissolved Oxygen Levels

Goal: Ensure that designated uses of Maryland's surface waters are met.

Indicator: Extent to which dissolved oxygen levels below 5 MG/L (Maryland's water quality criteria) contribute to waters' not meeting designated uses.

Consequences: A sufficient level of dissolved oxygen in water is a necessary element in a healthy aquatic ecosystem. Maryland's criteria provide for a minimum level of dissolved oxygen for all aquatic plants and animals. Lower levels of dissolved oxygen reduce habitat needed for aquatic plants and animals to survive and reproduce. At very low oxygen levels, aquatic plants and animals are killed or excluded.

Status: Of the waters in Maryland that do not fully support designated uses, low dissolved oxygen levels contribute to the impaired water status in 48.6 percent of the state's impaired river miles, 66 percent of the state's impaired estuarine waters and 5.6 percent of the state's impaired lake waters.

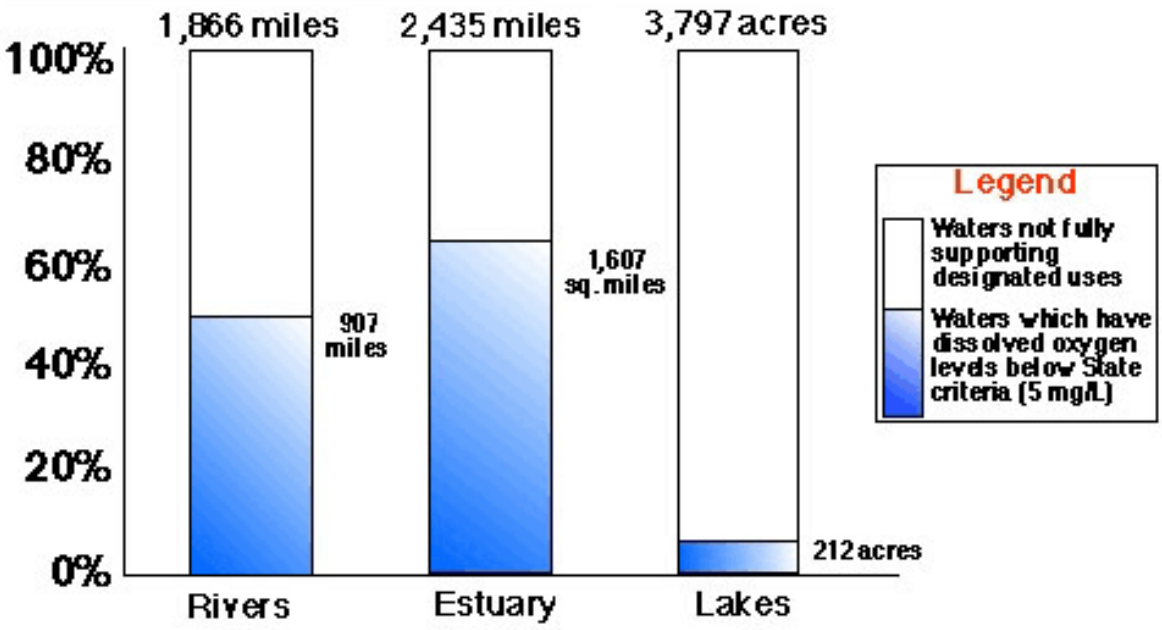
Stressors/Sources: Bacterial decomposition of organic material in the water column and sediments, and plant and animal respiration consume dissolved oxygen from the water. If too much organic material is present, or if phytoplankton populations are greatly increased by excess nutrients in the water, dissolved oxygen levels can be reduced to near zero. Cold waters can hold much more dissolved oxygen than warm waters. Low oxygen levels are seasonally evident during late spring to early fall.

Management Objective: Reduce conditions contributing to low dissolved oxygen in surface waters.

Benchmark: Continued reduction in the percentage of the State’s surface waters impaired by low dissolved oxygen.

Indicator Development and Data Responsibility:

Percentage of Designated Use-Impaired Surface Waters in Maryland Due to Low Dissolved Oxygen Levels



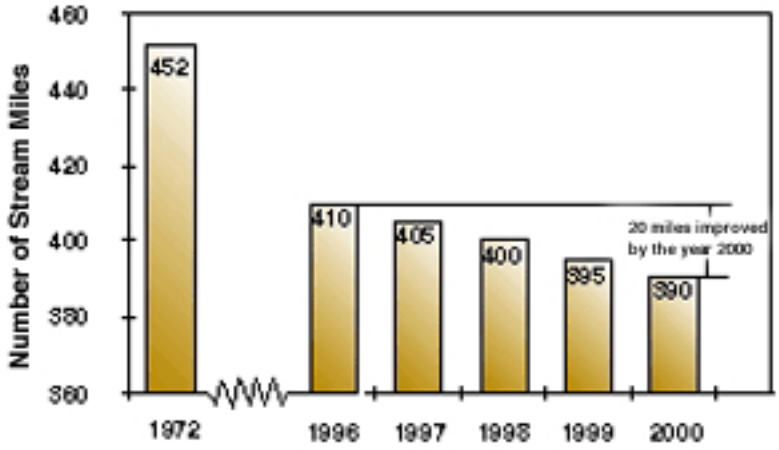
Maryland's Environmental Indicators
Winter, 1999

MILES OF STREAMS DEGRADED BY ABANDONED MINE DRAINAGE

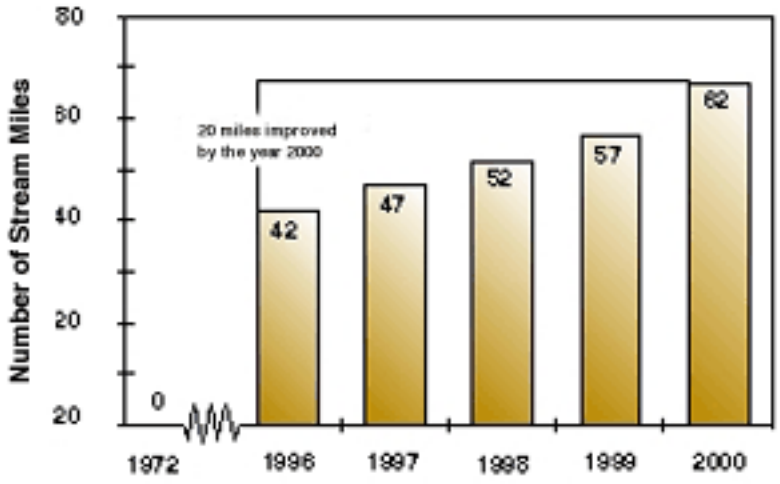
Data/Graphs:	Stream Miles Degraded Stream Miles Improved
Goal:	Improve and protect Maryland's water quality.
Indicator:	Extent to which aquatic ecosystems disrupted prior to the enactment of stricter controls over mining have been restored.
Consequences:	Abandoned mines can be a source of stream pollutants. Aquatic communities are damaged or eliminated as a result.
Status:	An estimated 410 miles of streams are currently degraded by abandoned mine drainage. About 42 miles of impacted stream have been improved since 1972.
Stressors/Sources:	A significant environmental stressor, abandoned mine drainage contributes suspended solids/sediments from coal and noncoal mines, and acid and metals from coal mines.
Management Objective:	The mitigation and/or abatement of stressors/sources at abandoned mine sites, mitigation of damage in streams adversely impacted by abandoned mine drainage, and the restoration of water quality.
Benchmark:	The improvement of 20 miles of downstream aquatic habitat by the year 2000.

Indicator Development and Data Responsibility: *MDE's Mining Program, 410-537-8055.*

Stream Miles Degraded



Stream Miles Improved



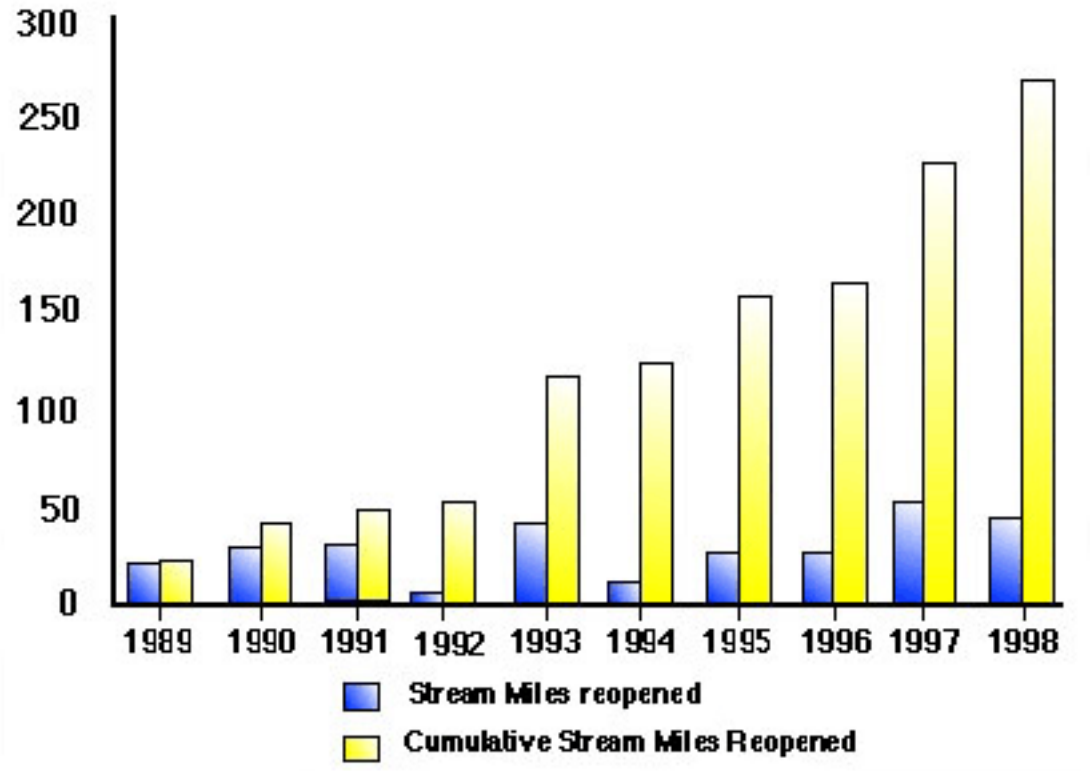
Maryland's Environmental Indicators
Winter, 1999

STREAM MILES OPEN TO MIGRATORY FISH

Data/Graph:	Actual and Cumulative Stream Miles Reopened to Migratory Fish, 1989-1998
Goal:	Maintain natural ecological and evolutionary processes.
Indicator:	Stream miles open to migratory fish
Consequences:	Blockages of migration lead to dramatic declines in anadromous fish populations.
Status:	The construction of fish passages, through the completion of 50 projects between 1985 and 1998, has resulted in the reopening of 276.9 miles of streams in Chesapeake Bay watersheds and four miles of streams draining to the Coastal Bays.
Stressors/Sources:	Over a thousand miles of fish spawning habitat on Chesapeake Bay are currently blocked by dams, culverts and other obstructions. Anadromous fish, such as shad and river herring, rely on access to freshwater streams with suitable bottom and current for spawning.
Management Objective:	Restore access to historical spawning grounds for migratory fish.
Benchmark:	By 2003, remove blockages and reopen 413 miles of the Chesapeake Bay's tributaries in Maryland.

Indicator Development and Data Responsibility: *DNR's Fisheries Service, 410-260-8341.*

Actual and Cumulative Stream Miles Reopened to Migratory Fish, 1989-1998



Maryland's Environmental Indicators
Winter, 1999

PHYSICAL HABITAT INDEX

Data/Graph: Statewide Estimate of Percent of Stream Miles Within Habitat Assessment Classes

Goal: Conserve ecological communities

Indicator: A physical habitat indicator (PHI) has been developed for small (first to third order) coastal and non-coastal plain streams. A total of seven physical habitat metrics are measured, scored and summed to calculate an PHI. The coastal plain stream PHI has four metrics in common with the non-coastal plain stream PHI. All metrics are noted below:

- instream habitat
- velocity -depth diversity
- pool - glide - eddy quality
- embeddedness
- maximum depth
- number of root wads
- aesthetic rating

Consequences: A decline in the physical habitat index score indicates alteration of the stream habitat relative to a reference site and may represent less than suitable habitat for stream communities.

Status: A comprehensive DNR report covering the entire state, using three years of MBSS data (1995, 96, 97), is scheduled for completion in April, 1999.

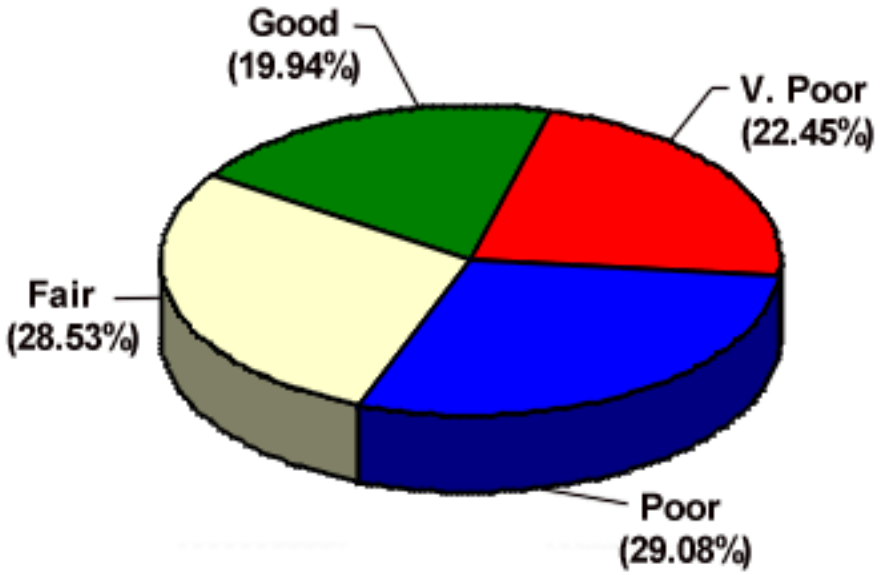
Stressors/Sources: Fish community indicators are influenced by point and nonpoint sources of water pollution. Water quality and physical habitat conditions in non-tidal streams and rivers are influenced by land use and land cover patterns in the watershed, such as the destruction of riparian forests and increasing the area of impervious land cover. Other major influences are channelization, encroachment by livestock, and blockages to upstream/downstream movements of fish.

Management Objective: Implement watershed management strategies that will control and minimize point and non-point sources of water pollution, prevent the depletion of groundwater supplies, minimize the area of impervious land cover, restore riparian forests, keep livestock out of the stream channels, remove blockages to upstream/downstream movements of fish or construct fish passage structures if the blockages cannot be removed.

Benchmark: Achieve physical habitat index scores of *Good*, preferably, or at least *Fair* in all sampled streams.

Indicator Development and Data Responsibility: *DNR's Monitoring and Non-Tidal Assessment Division, 410-260-8620.*

Statewide Estimate of Percent of Stream Miles*
Within Habitat Assessment Classes



***1st, 2nd, and 3rd order streams only.**
Data Source: 1995, 1996, & 1997 MBSS

Maryland's Environmental Indicators
Winter, 1999

FISH INDEX OF BIOTIC INTEGRITY

Data/Graph: Statewide Estimate of Percent of Stream Miles Within Fish IBI Classes

Goal: Conserve natural ecological communities.

Indicator: Indexes of Biotic Integrity for fishes (FIBI) has been developed for small (first to third order) coastal and non-coastal plain streams. A total of eight biological metrics are measured, scored and summed to calculate an FIBI. The coastal plain stream FIBI has seven metrics in common with the non-coastal plain stream FIBI. All metrics are noted below:

- number of native species
- number of benthic species
- % tolerant individuals
- % abundance of dominant species
- % generalists, omnivores and insectivores
- number of individuals/square meter
- biomass (grams/square meter) (Used for coastal plain streams only)
- % lithophilic spawners
- % insectivores. (Used for non-coastal plain streams only)

Consequences: A decline in fish IBI scores reflects a degradation in water quality and physical conditions.

Status: A report describing the results of fish IBI assessments based on 1995 MBSS sampling in six river basins is available from DNR. A comprehensive DNR report covering the entire state, using three years of MBSS data (1995, 96, 97), is scheduled for completion in April, 1999.

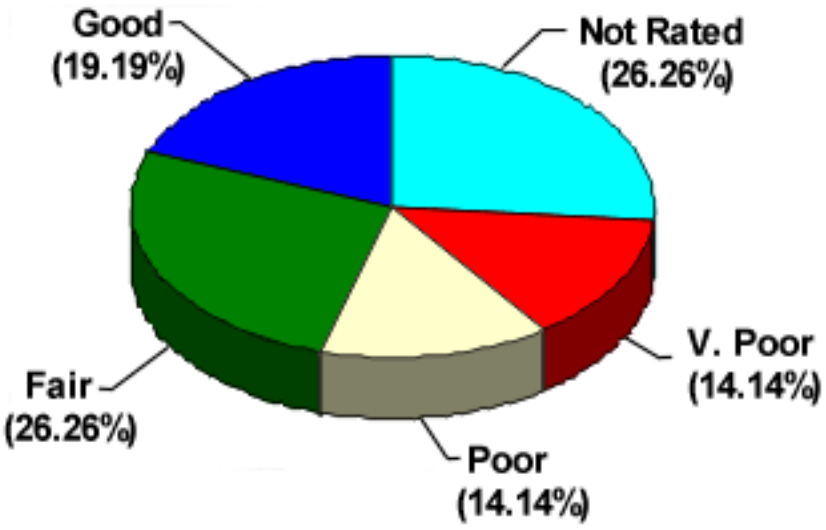
Stressors/Sources: Fish community indicators are influenced by point and nonpoint sources of water pollution. Water quality and physical habitat conditions in non-tidal streams and rivers are influenced by land use and land cover patterns in the watershed, such as the destruction of riparian forests and increasing the area of impervious land cover. Other major influences are channelization, encroachment by livestock, and blockages to upstream/downstream movements of fish.

Management Objective: Implement watershed management strategies that will control and minimize point and non-point sources of water pollution, prevent the depletion of groundwater supplies, minimize the area of impervious land cover, restore riparian forests, keep livestock out of the stream channels, remove blockages to upstream/downstream movements of fish or construct fish passage structures if the blockages cannot be removed.

Benchmark: Achieve fish IBI scores of good, preferably, or at least fair in all sampled streams.

Indicator Development and Data Responsibility: *DNR's Monitoring and Non-Tidal Assessment Division, 410-260-8610.*

Statewide Estimate of Percent of Stream Miles*
Within Fish IBI Classes



***1st, 2nd, and 3rd order streams only.**
Data Source: 1995, 1996 & 1997 MBSS

Maryland's Environmental Indicators
Winter, 1999

BENTHIC MACROINVERTEBRATE COMMUNITIES (NON-TIDAL)

Data/Graph: Statewide Estimate of Percent of Stream Miles Within Macroinvertebrate IBI Classes

Goal: Conserve natural ecological communities.

Indicators: Benthic Indexes of Biological Integrity (BIBI) have been developed for the smaller (first to third order) coastal plain and non-coastal plain Maryland streams. Coastal plain streams use seven biological metrics, and non-coastal plain streams use eight biological metrics to assess the status of benthic macroinvertebrate communities in Maryland's non-tidal streams. These metrics are as follows:

- taxa number
- EPT taxa number
- % Ephemoptera
- Ephemoptera taxa number (non-coastal plain only)
- Diptera taxa number (non-coastal plain only)
- % Tanytarsini (Diptera) (non-coastal plain only)
- % pollution intolerant taxa (non-coastal plain only)
- % collectors (non-coastal plain only)
- % of Chironomidae that are Tanytarsini (coastal plain only)
- % clinger taxa (coastal plain only)
- % scrapers (coastal plain only)
- Florida Index (coastal plain only)

Consequences: A decrease in the BIBI indicates a degradation in water quality and physical habitat condition.

Status: The Benthic Index of Biological Integrity for use in Maryland streams has only recently been developed. A comprehensive DNR report covering the entire state, using three years of MBSS data (1995, 96, 97), is scheduled for completion in April, 1999. BIBI scores generally worsened across the state from west to east.

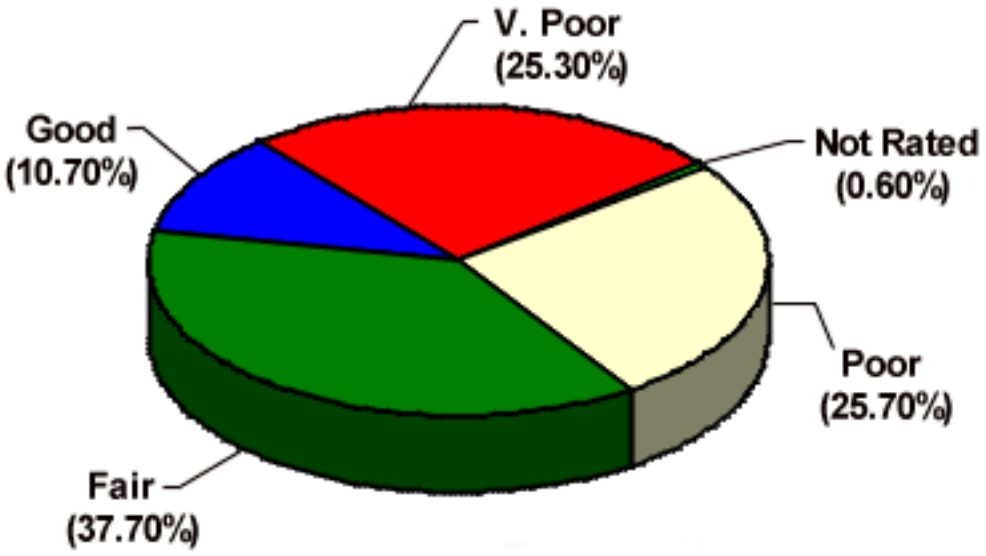
Stressors/Sources: Benthic community indicators are influenced by point and nonpoint sources of water pollution. Water quality and physical habitat conditions in non-tidal streams and rivers are influenced by land use and land cover patterns in the watershed, such as the destruction of riparian forests and increasing the area of impervious land cover. Other major influences are channelization and encroachment by livestock.

Management Objective: Implement watershed management strategies that will control and minimize point and non-point sources of water pollution, prevent the depletion of groundwater supplies, minimize the area of impervious land cover, restore riparian forests and keep livestock out of the stream channels.

Benchmark: Attain good BIBI scores for benthic macroinvertebrate community condition at 75% of the stream miles in all major watersheds.

Indicator Development and Data Responsibility: *DNR's Monitoring and Non-Tidal Assessment Division, 410-260-8610.*

Statewide Estimate of Percent of Stream Miles*
Within Macroinvertebrate IBI Classes



***1st, 2nd, and 3rd order streams only.**
Data Source: 1995, 1996 & 1997 MBSS

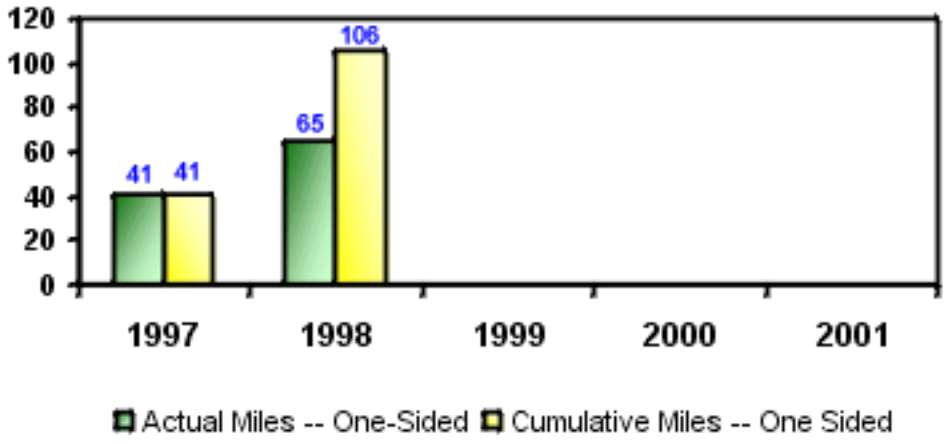
Maryland's Environmental Indicators
Winter, 1999

RIPARIAN FOREST BUFFERS

Data/Graph:	Riparian Forest Buffers Reestablished
Goal:	Maintain natural evolutionary and ecological processes.
Indicator:	Miles of riparian forest buffers re-established.
Consequences:	Loss of riparian forests results in a lack of buffering of surface water from impacts of land use activities, promoting the addition of sediments and nutrients. It can also lead to elevation of water temperature, degradation of the aquatic food chain, and loss of habitat for terrestrial and aquatic species.
Status:	Maryland has approximately 17,000 miles of streams depicted on USGS 7.5' quadrangle on maps, plus an unmeasured number of miles of intermittent streams. A 1996 study carried out by Penn State University and submitted to the Chesapeake Bay Program Office found that nearly half of Maryland's streams lacked 100-foot buffers on both sides of the stream. Since then, 106 miles of forest buffer have been re-established.
Stressors/Sources:	Land clearing for agricultural, residential or other purposes.
Management Objective:	Increase the extent of riparian forest buffers.
Benchmark:	Establish 600 miles of forest buffers by 2010, or 43 miles per year for 14 years.

Indicator Development and Data Responsibility: *DNR's Forest Service, 410-260-8531.*

Riparian Forest Buffers Reestablished



Maryland's Environmental Indicators
Winter, 1999

MARYLAND WETLAND TRENDS

Data/Graphs: Maryland Non Tidal and Tidal Wetland Trends, 1991-1997

Goal: Ensure adequate protection and restoration of Maryland's wetland resources.

Indicator: Acres of Maryland's total wetland resource base (both tidal and nontidal) that is being gained/lost through regulatory programs.

Consequences: Wetlands provide a variety of environmental benefits including enhancement of water quality. An increase in wetlands, and/or wetland quality, in select areas will provide nutrient assimilation, sedimentation reduction, and shoreline protection, thereby improving water quality and habitat for a variety of plants and animals.

Status: The total number of wetland acres in Maryland is current estimated as 598,422 acres, including unvegetated flats, bars and shorelines; rocky shores; and open water areas. Tidal wetlands account for 252,280 acres, and nontidal wetlands account for 346,142 acres, including riverine and lacustrine wetlands. At present, an average increase of 9 acres of tidal wetlands and 20 acres of nontidal wetlands are being realized annually through regulatory programs. An average annual increase of 85 acres of nontidal wetlands is attributed to non-regulatory programs. When combined, regulatory plus non-regulatory results yield an increase in the total wetland resource base of about 0.02% which is equivalent to maintaining, but not restoring the base.

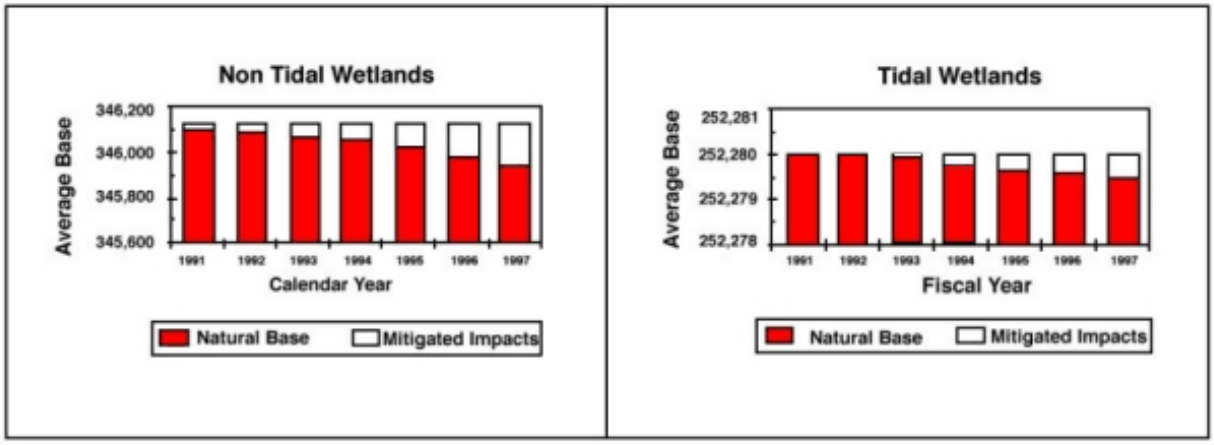
Stressors/Sources: Wetland losses are resulting from sea level rise, shoreline erosion, and land development activities. Over the course of Maryland's post-colonial history, it is estimated that some 300,000 acres of wetlands have been lost.

Management Objective: Achieve and, to the extent feasible, exceed Maryland's current statutory goal of "no net loss" of Maryland's wetland resources.

Benchmark: Develop a state wetland conservation plan that will incorporate a long-range goal of 10% for wetlands protection in Maryland.

Indicator Development and Data Responsibility: *MDE's Wetlands and Waterways Program, 410-537-8091.*

Maryland Non-Tidal and Tidal Wetland Trends, 1991-1997



Maryland's Environmental Indicators
Winter, 1999

MARYLAND WETLANDS RESTORATION INITIATIVE

Data/Graph: Wetland Creation and Restoration Progress Toward the 60,000 Acre Goal

Goal: Ensure adequate protection and restoration of Maryland's wetlands resources.

Indicator: Acres of wetlands restored or created other than those required for mitigation under regulatory programs.

Consequences: Wetlands provide a variety of environmental benefits including enhancement of water quality. An increase in wetlands, and/or wetland quality, in select areas will provide nutrient assimilation, sedimentation reduction, and shoreline protection, thereby improving water quality and habitat for a variety of plants and animals.

Status: The current estimated total number of wetland acres is 598,422 acres, including unvegetated flats, bars and shorelines; rocky shores; and open water areas. Tidal wetlands account for 252,280 acres and nontidal wetland account for 346,142 acres, including riverine and lacustrine wetlands. A Wetlands Restoration Steering Committee has been appointed and is in process of developing a strategy for the accomplishment of the management objective. The Maryland restoration program is being coordinated with the Chesapeake Bay Program wetland restoration initiative.

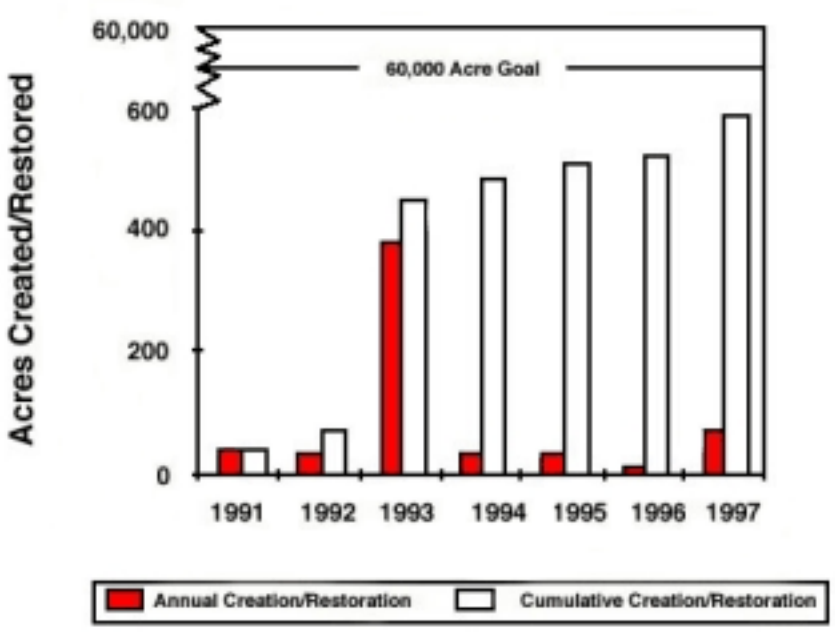
Stressors/Sources: Wetland losses are resulting from sea level rise, shoreline erosion, and land development activities. Over the course of Maryland's post-colonial history, it is estimated that some 300,000 acres of wetlands have been lost. Approximately 60,000 were lost during the period of explosive growth and intensive land use since the 1940's.

Management Objective: Achieve a net gain in wetlands through a statewide, voluntary program of wetlands restoration and creation that will include participation by individuals, community groups, conservation organizations, businesses, corporations, and government agencies.

Benchmark: Restore and create 60,000 acres of tidal and nontidal wetlands on a voluntary basis.

Indicator Development and Data Responsibility: *MDE's Wetlands and Waterways Program 410-537-8091 and the Wetlands Restoration Steering Committee 410-537-8059.*

Wetland Creation and Restoration
Progress Toward the 60,000 Acre Goal



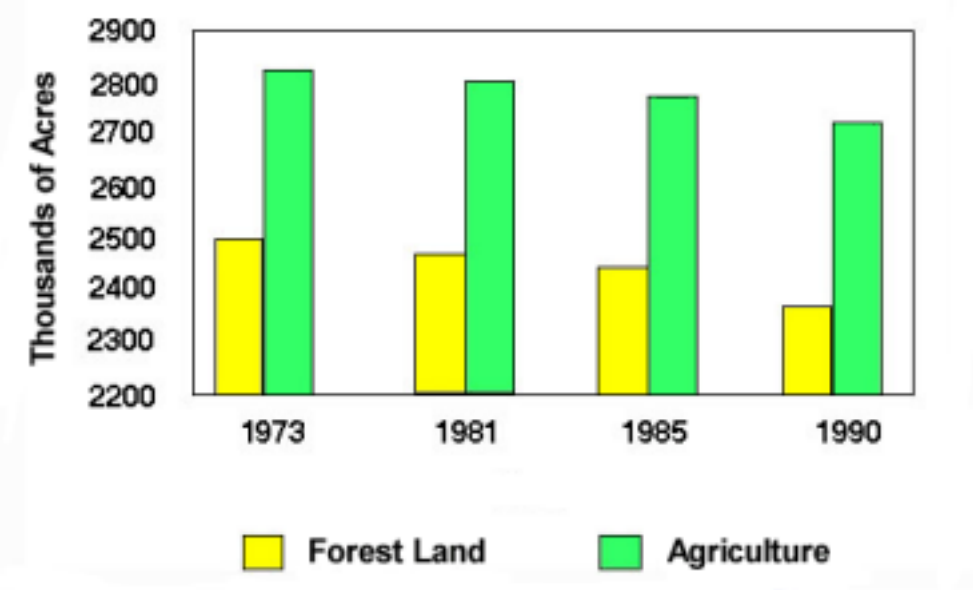
Maryland's Environmental Indicators
Winter, 1999

LOSS OF AGRICULTURAL AND FOREST LAND

Data/Graph:	Loss of Agricultural and Forest Land
Goal:	Maintain Maryland's natural resource land base and encourage smart growth.
Indicator:	Loss of agricultural and forest land
Consequences:	Habitat is directly lost as lands are urbanized, and remaining natural areas are fragmented into patches which are less and less viable as habitat. The economic viability of both agriculture and forestry depends on the availability not just of suitable land but of uninterrupted tracts.
Status:	Continued trends toward large lot development and patterns of sprawl. Significant losses of agricultural and forest land in Central and Southern Maryland.
Stressors/Sources:	Population growth and the resultant conversion of natural areas to residential, commercial, and industrial uses provide the greatest stress to both agricultural and forest areas, particularly the sprawl pattern of the last few decades. Both the development of the residential/commercial/industrial uses and the construction of the infrastructure to serve them act as stressors to natural and agricultural values.
Management Objective:	Minimize or avoid the isolation, fragmentation, and conversion of forest and agricultural land to non-resource based uses. Encourage "smart growth" in efficient development patterns and conservation of existing neighborhoods.
Benchmark:	Reduced rate of agricultural and forest land conversions.

Indicator Development and Data Responsibility: *Maryland Office of Planning, 410-767-4570.*

Loss of Agricultural and Forest Land



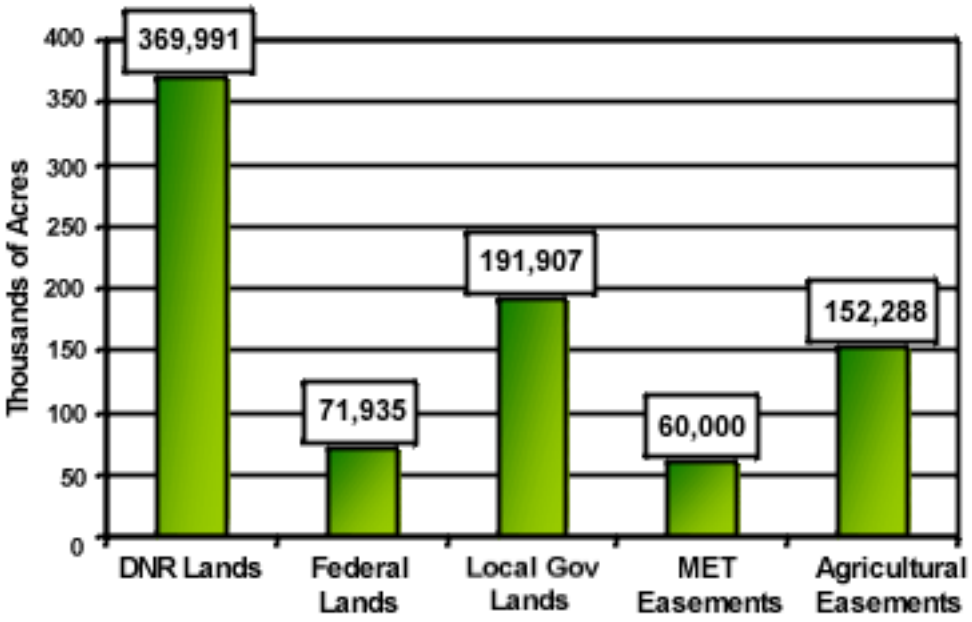
Maryland's Environmental Indicators
Winter, 1999

PROTECTED LANDS

Data/Graph:	Lands in Maryland Protected Under Public Ownership or Easements
Goal:	Maintain Maryland's natural resource land base.
Indicator:	Lands in public ownership or under conservation or agricultural easement.
Consequences:	Failure to protect substantial amounts of land from intensive development increases the potential threat to maintaining biological diversity and the resource base needed to support the State's natural resource based industries, including recreation. Increasing demands placed on existing public land resources for recreation can be detrimental to the maintenance of ecological functions at sites already acquired.
Status:	Land protected via public ownership or public easement programs currently totals over 846,100 acres, or over 13% of the total land base of the State. However, protected lands are not distributed evenly across the Maryland, or in proportion to the State's population, nor do they necessarily protect the areas with the greatest natural resource value. Natural lands accessible to the public are not being acquired at a rate proportional to population growth.
Stressors/Sources:	Development continues to threaten the land base available for recreation, agriculture, and forest industries, as well as for maintaining ecological processes and conserving biological diversity. Increased real estate values translate to less open space protected for each dollar spent.
Management Objective:	Protect sufficient open space for use by citizens of Maryland and to protect a core network of natural areas representative of Maryland's biological diversity.
Benchmark:	Protect open space at a level equal to or greater than the rate land is converted to non-open space uses.

Indicator Development and Data Responsibility: *DNR's Chesapeake and Coastal Watershed Service, 410-260-8790.*

Lands in Maryland Protected Under Public Ownership or Easements



Sources: DNR Lands--Acreage Report, 1998; Federal and Local Lands--Office of Planning Open Space Acreage by Classification for Maryland, Dec. 1992; MET Easements--Maryland Environmental Trust, Dec 1998; Agricultural Easements --Maryland Agricultural Land Preservation Foundation, Summer 1998.

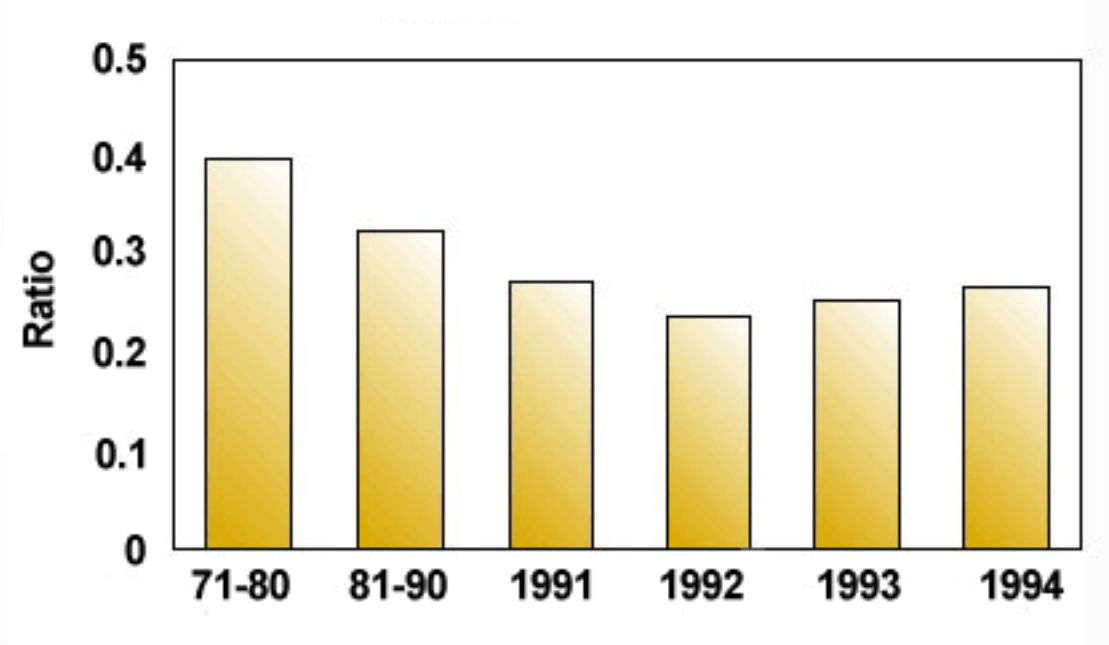
Maryland's Environmental Indicators
Winter, 1999

SEPTIC SYSTEM PERMITS/LOW DENSITY RESIDENTIAL DEVELOPMENT

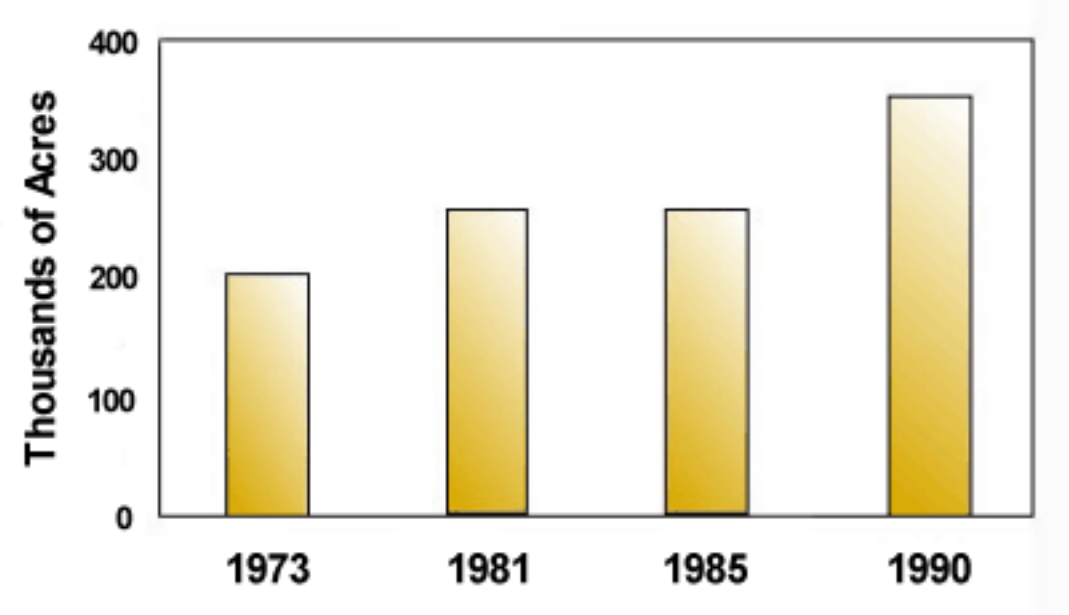
Data/Graphs:	Ratio of Septic Permits to Total Building Permits Low Density Residential Land
Goal:	Reduce sprawl development.
Indicators:	(1) Ratio of septic permits to total building permits (2) Acres of low density residential development
Consequences:	Low density development is a major contributor of nutrients to local waterways. Research has revealed that low density development (1 unit per 5 acres) contributes nearly 17 times more phosphorus and 24 times more nitrogen per dwelling unit than high density development. Septic systems are the predominant form of sewage treatment in low density areas. Newer system designs which allow for nutrient removal are expensive and rarely utilized. Low density development also increases the use of automobiles which consume gasoline and contribute nitrogen to the air that is subsequently deposited into waterways.
Status:	Large-lot development and concomitant use of septic tanks are both increasing.
Stressors/Sources:	Sprawl is a major stressor, driven by population growth, decreasing household sizes, trends toward larger lot sizes, and out-migration from existing community centers.
Management Objective:	Encouraging "smart growth" in efficient development patterns and conservation of existing neighborhoods. This may be accomplished using existing infrastructure and thereby decrease the total annual acreage developed on septic systems.
Benchmark:	Create a downward trend in the ratio of septic permits to total building permits issued consistent with the State's overall effort to encourage "Smart Growth".

Indicator Development and Data Responsibility: *Maryland Office of Planning*

Ratio of Septic Permits to Total Building Permits



Low Density Residential Land



Maryland's Environmental Indicators
Winter, 1999

ACRES OF ABANDONED MINE LANDS

Data/Graphs: Abandoned Mine Lands
Improved Mine Lands

Goal: Improve and protect Maryland's water quality

Indicator: Extent to which terrestrial ecosystems disrupted prior to the enactment of stricter controls over mining have been restored to safe, productive use.

Consequences: Abandoned mine lands are sources of safety hazards and environmentally degraded habitats.

Status: An estimated 8,040 acres of abandoned mine lands currently exist in Maryland's two coal producing counties, i.e., Allegany and Garrett. About 1,460 acres have been reclaimed since 1972.

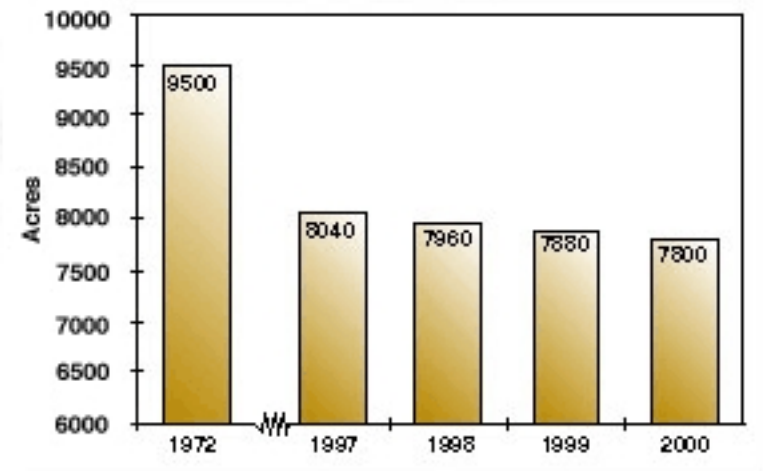
Stressors/Sources: Abandoned mine lands constitute safety hazards for humans and environmental stressors through disturbance or destruction of terrestrial habitat for plant and animal species.

Management Objective: Reclaim the land by removing safety hazards; restore the quality of terrestrial habitats by establishing adequate revegetation through reforestation and wildlife enhancement practices where practical; and return land to productive use. Encourage remining of abandoned mine lands by providing incentives for mining companies.

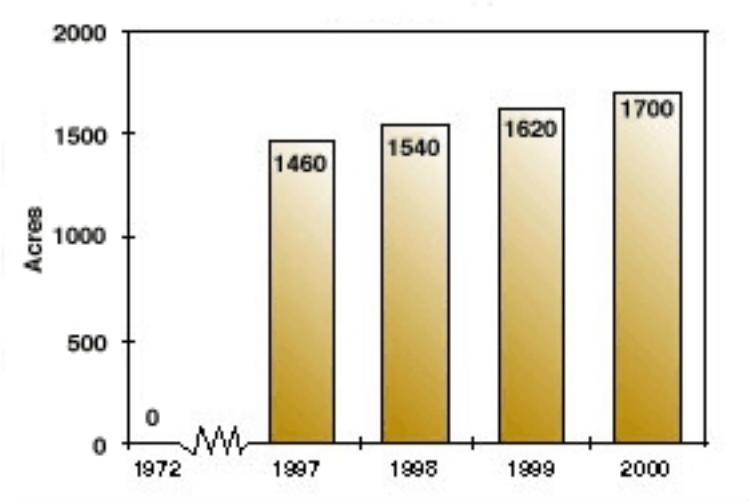
Benchmark: The reclamation of 240 acres of abandoned mine sites, making the sites safe for humans and environmentally productive by the year 2000.

Indicator Development and Data Responsibility: *MDE's Mining Program, 410-537-8055.*

Abandoned Mine Lands



Improved Mine Lands



Maryland's Environmental Indicators
Winter, 1999

ACRES OF BROWNFIELDS/FEDERAL FACILITIES APPROVED FOR DEVELOPMENT

Data/Graphs: Total Cumulative Acres of Brownfield Sites Where Hazardous Waste Contamination Has Been Addressed
Total Cumulative Acres of Federal Facilities Slated for Closure Where Hazardous Waste Contamination Has Been Addressed

Goal: Protect and maintain Maryland's natural resource land base and encourage smart growth and community revitalization.

Indicator: Acres of brownfields/federal facilities where hazardous waste contamination has been addressed.

Consequences: Commercial or industrial sites and federal facilities slated for closure in Maryland that are potential candidates for reuse (known as brownfields) are sometimes left idle because of potential liability associated with potentially contaminated property. Failure to re-use abandoned sites contributes to sprawl development and consumption of open space, agricultural, and forest land. Redevelopment necessitates environmental cleanups at properties that otherwise may lie idle, and may provide economic development benefits including new jobs and increased tax revenues, promoting wise growth management by using existing infrastructure and avoiding unnecessary development in undeveloped "greenfields."

Status: Six federal facility approvals completed, 57 brownfield assessments completed, and 11 voluntary cleanup program sites completed.

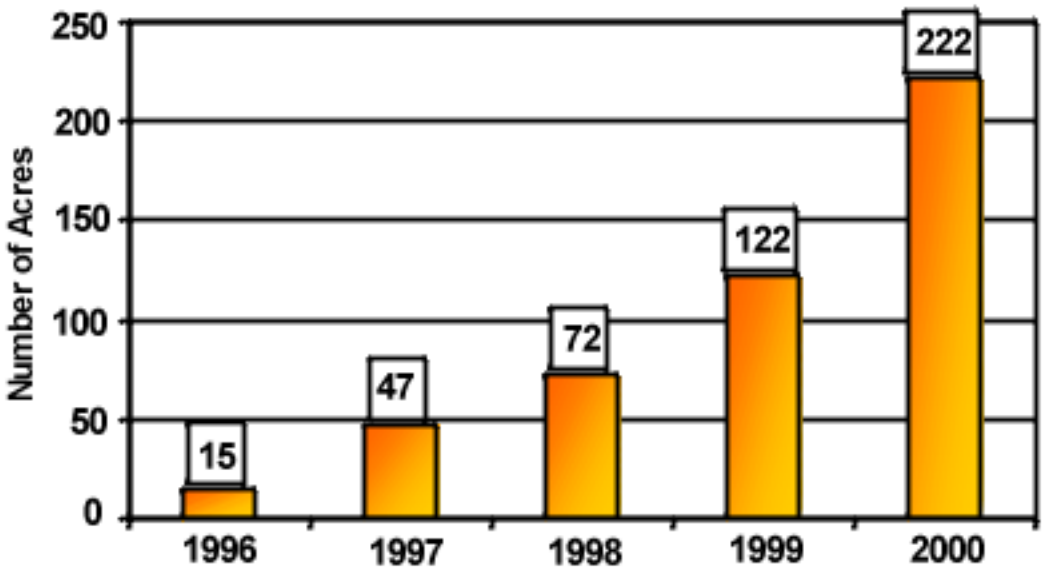
Stressors/Sources: Remediation to acceptable levels at brownfield sites and federal facilities slated for closure can be costly ; lenders may be hesitant to invest in potentially contaminated property.

Management Objective: Reduce use of undeveloped land through cleanup and reuse of vacated former commercial or industrial sites and federal facilities.

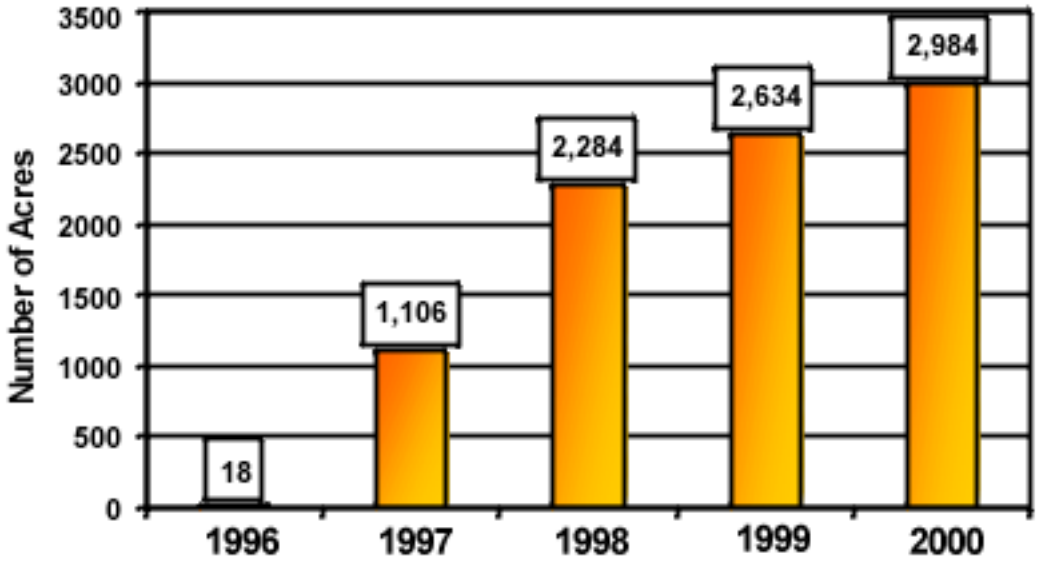
Benchmark: By the year 2000, remediate 222 acres of brownfields sites; one hundred percent of potential federal facilities slated for closure cleaned up and approved for reuse by the year 2001.

Indicator Development and Data Responsibility: *MDE's Environmental Restoration and Redevelopment Program, 410-537-3427.*

Total Cumulative Acres of Brownfield Sites Where Hazardous Waste Contamination Has Been Addressed



Total Cumulative Acres
of Federal Facilities Slated for Closure
Where Hazardous Waste Contamination
Has Been Addressed



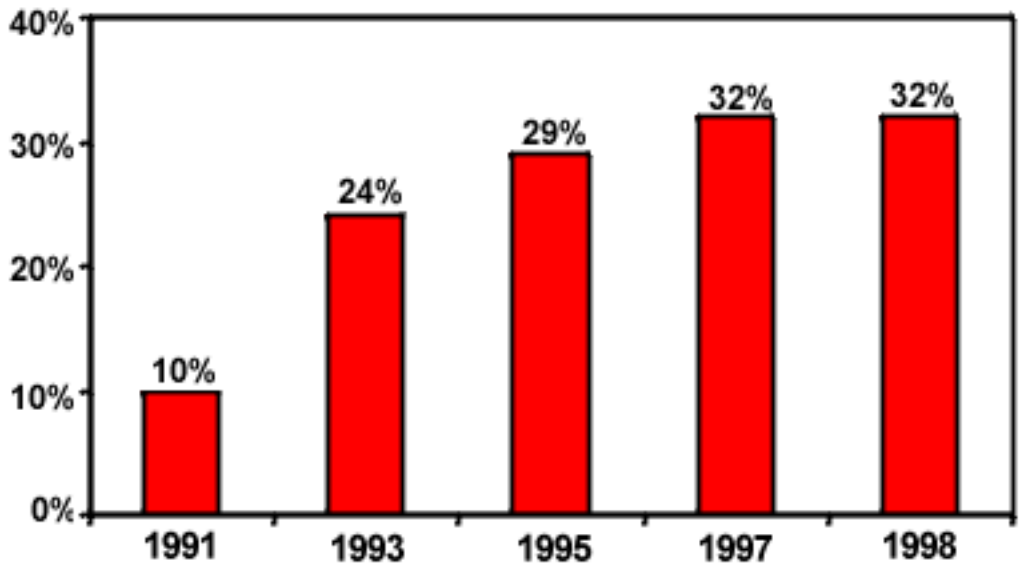
Maryland's Environmental Indicators
Winter, 1999

REDUCTION IN REQUIRED LANDFILL CAPACITY

Data/Graph:	Statewide Recycling Rate
Goal:	Protect and maintain Maryland's natural resource land base and encourage smart growth and community revitalization.
Indicator:	Increasing rates of recycling which fosters reductions in required landfill capacity.
Consequences:	A significant amount of waste can be diverted from landfills and other solid waste acceptance facilities through recycling programs.
Status:	Current Statewide recycling rate is 32%.
Stressors/Sources:	Current county practices do not result in households paying for the true and full cost of solid waste disposal; use of inexpensive out-of-state mega-landfills has decreased the cost of disposal, reduced revenues to the county facilities but extended their useful life; recycling programs can be more inconvenient than disposal; markets may not support profitable recycling.
Management Objective:	Increase the volume of waste recycled and markets for products made from recycled materials.
Benchmark:	Maintain at least a 29% statewide recycling rate.

Indicator Development and Data Responsibility: *MDE's Recycling Services Program, 410-537-3315.*

Statewide Recycling Rate



Maryland's Environmental Indicators
Winter, 1999

FOREST INTERIOR BREEDING BIRD POPULATIONS

Data/Graphs: Breeding Bird Survey, 1966-1996
Breeding Bird Survey, 1980-1996

Goal: Conserve natural ecological communities and maintain viable populations of native species.

Indicator: Number of forest interior breeding bird species with stable or increasing population trends.

Consequences: Declining populations of these species indicate that large, contiguous forested areas are being lost, degraded, or fragmented into smaller blocks of woodlands incapable of sustaining complete forest ecosystem functions.

Status: Eighteen of 21 species had stable or increasing long-term population trends during the period 1966-1996 and 18 of 21 species had stable or increasing recent, short-term population trends during 1980-1996.

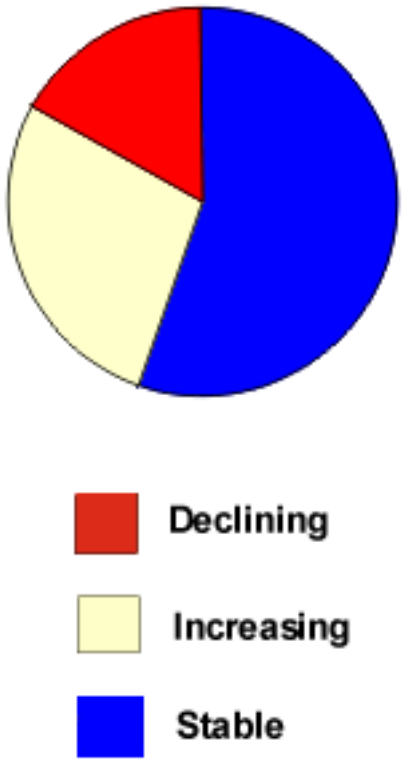
Stressors/Sources: As area-sensitive nesting species, forest interior breeding birds are affected by forest loss and fragmentation. Forest loss eliminates the required habitat for nesting, while forest fragmentation results in reduced or no reproductive success due to increased predation and parasitism rates to nests and nesting birds. These same forest alterations can adversely impact other living resources that have evolved in intact forested landscapes, including many species of plants and animals.

Management Objective: Conserve large, contiguous forested areas capable of supporting populations of forest interior breeding birds and other forest interior species, both plant and animal.

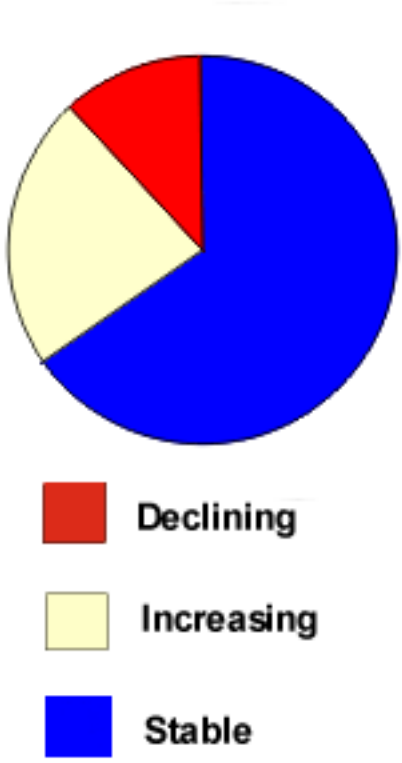
Benchmark: Populations of all species of forest interior breeding birds remain stable or increase.

Indicator Development and Data Responsibility: *DNR's Wildlife and Heritage Division, 410-260-8540.*

Breeding Bird Survey, 1966-1996



Breeding Bird Survey, 1980-1996



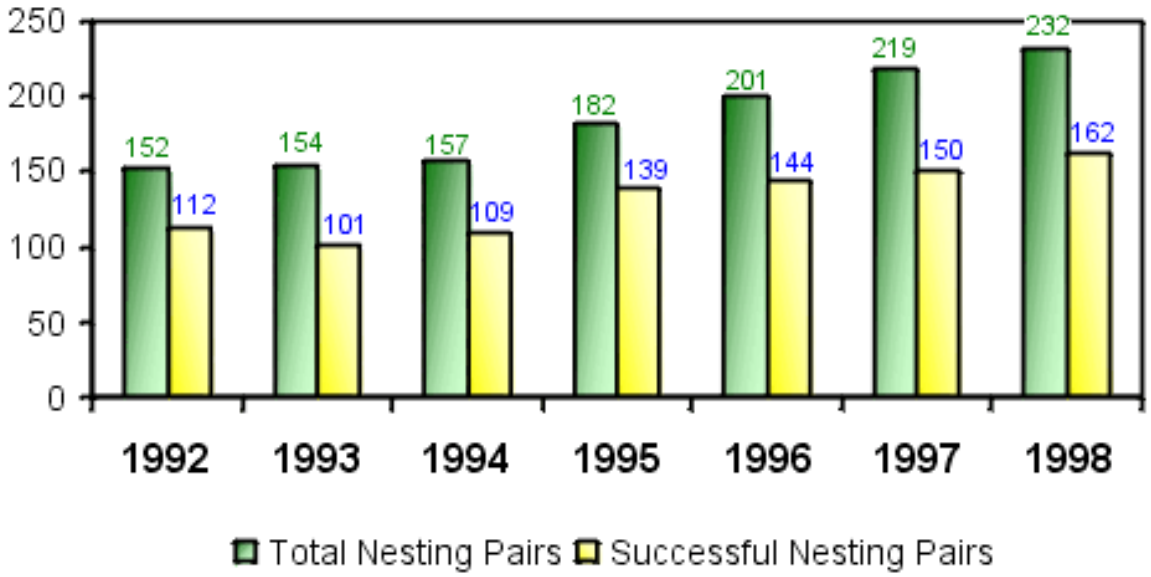
Maryland's Environmental Indicators
Winter, 1999

BALD EAGLE POPULATION

Data/Graph:	Bald Eagle Nest Success
Goal:	Maintain natural ecological and evolutionary processes.
Indicator:	Number of successful bald eagle nesting pairs. Nesting bald eagles require a stable and healthy prey base, suitable woodlands near tidal water, and an area relatively free from human activity in order to reproduce successfully. The lack of such conditions indicates that natural ecological processes have been compromised and the stability of the estuarine ecosystem may be in jeopardy.
Consequences:	Poor nesting success would lead to a decline in this highly symbolic species and in overall biological diversity.
Status:	There were 232 nesting pairs in 1998, of which 162 nested successfully.
Stressors/Sources:	Contamination of the fish prey base by organochlorine pesticides led to the demise of the bald eagle population in the 1960's and 1970's. As a top predator, bald eagles can be affected by contaminants getting into the estuarine ecosystem and being passed through other living organisms. Eagle populations are also dependent on a sufficient amount of fish and other aquatic prey to subsist. Wooded shorelines and other wooded areas in close proximity to tidal waters are necessary to support large numbers of nesting bald eagles. These same forested areas serve to buffer the adjacent water from runoff. Increased development of wooded shorelines and increased human activities within . these areas can render the habitat unsuitable for nesting bald eagles.
Management Objective:	Conserve habitats and ecological processes required to support top predators in the food chain.
Benchmark:	The number of nesting pairs of bald eagles successfully fledging an average of one juvenile per nest remains at or above 200 annually.

Indicator Development and Data Responsibility: *DNR's Wildlife and Heritage Division, 410-260-8540.*

Bald Eagle Nest Success



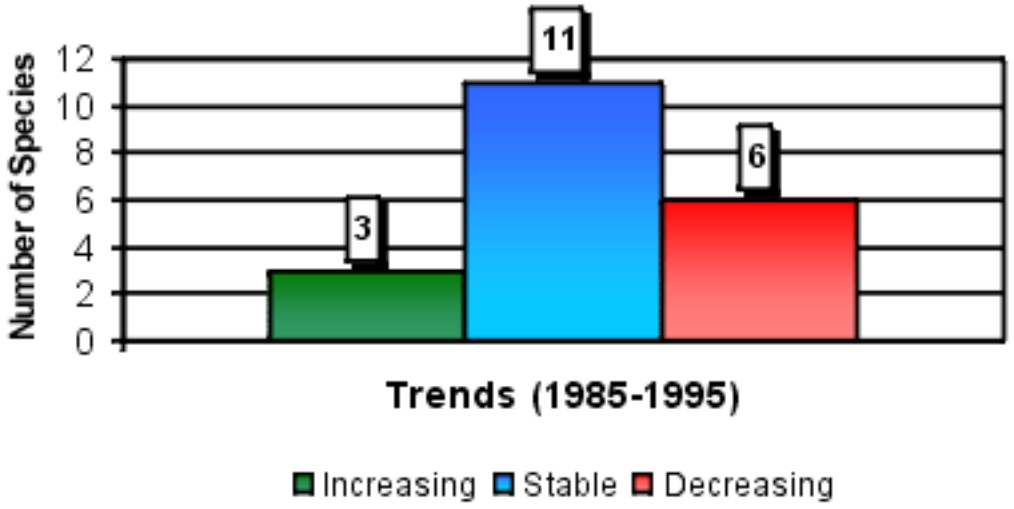
Maryland's Environmental Indicators
Winter, 1999

COLONIAL WATERBIRD POPULATION TRENDS

Data/Graph:	Colonial Waterbird Population Trends
Goal:	Maintain natural ecological and evolutionary processes.
Indicator:	Population trends of colonial waterbird species.
Consequences:	Declining populations of these species indicate that natural ecological processes have been compromised and the stability of the estuarine ecosystem may be in jeopardy.
Status:	Full surveys are conducted every five years, mpst recently in 1995. Eleven of 20 species had stable populations between 1985-1995; three species' populations increased during 1985-1995; six populations decreased.
Stressors/Sources:	Colonial nesting waterbirds concentrate all their reproductive energies at a few locations on the landscape. The integrity and availability of these sites are crucial to the population stability of these birds. Increased development of wooded shorelines and increased human activities within these areas can render habitat unsuitable for colony sites. As top predators, these birds also depend upon a stable and healthy prey base of fish and other aquatic animals.
Management Objective:	Conserve habitats and ecological processes required to support top predators in the food chain.
Benchmark:	Populations of all species of colonial waterbirds remain stable or increase.

Indicator Development and Data Responsibility: *DNR, Wildlife and Heritage Division, 410-260-8540.*

Colonial Waterbird Population Trends



Maryland's Environmental Indicators
Winter, 1999

GLOBALLY RARE SPECIES

Data/Graph: Number of Reported Globally Rare Species, By Maryland County

Goal: Maintain viable populations of all native species in their natural habitats.

Indicator: Number of Globally Rare Species Retained in Landscape

Consequences: Globally rare species are the most precarious components of the full array of native ecosystems, natural communities and species that comprise the biological Integrity of Maryland. In a very broad sense, the continued occurrence of these species in our State is reflective of the ecological functional integrity of the landscape. Continued erosion of this resource base signals that natural ecological processes have been compromised and the stability of the ecosystem may be in jeopardy.

Status: Maryland harbors 149 species (or subspecies) potentially or currently considered globally rare. Of these, 122 (82%) have been reported within the last 50 years as occurring in the State.

The decline of natural diversity is a trend that is discernible and statistically significant only at rather lengthy scales of time. Biases, such as intensiveness of inventory effort, must be considered. Increases in the number of globally rare species may mean that additional species have been brought to the brink, have been rediscovered or have expanded their range. Decreases may mean that a species has become extinct or that it has recovered. For these reasons it is not particularly illustrative to graphically portray annual fluctuations. Nonetheless, changes to status over time are significant, should be tracked, and should be evaluated and described based upon the case specific factors.

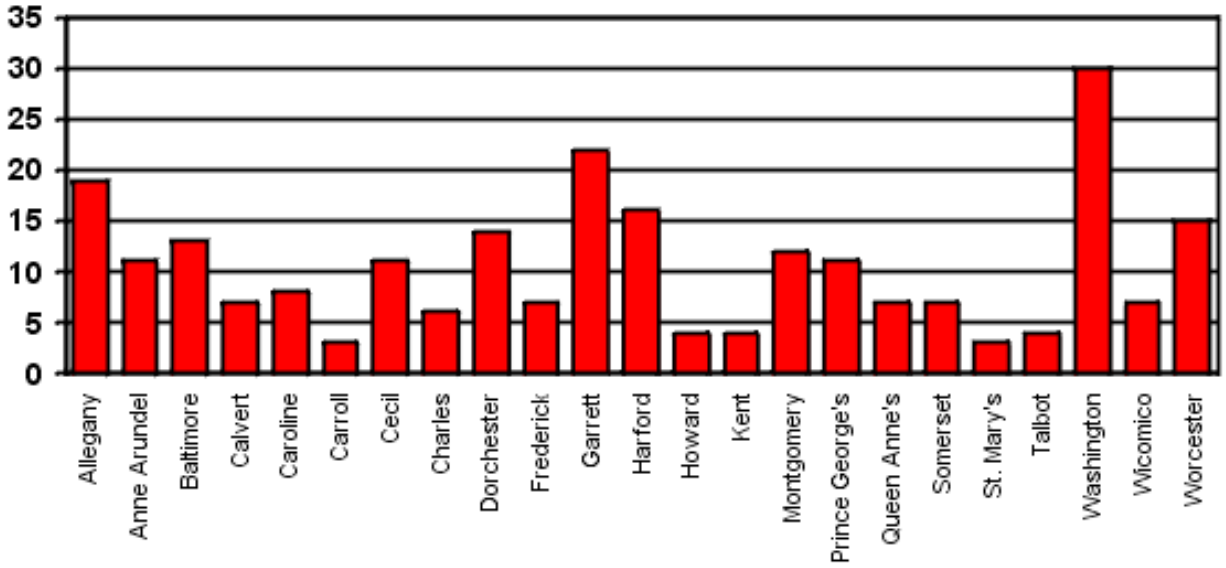
Stressors/Sources: Population growth and rapid development and landscape change are at the heart of the loss of species from the land. These phenomena frequently lead to habitat loss and fragmentation, habitat alteration and degradation, introduction of pollutants into natural systems, and a host of other stressors.

Management Objective: Minimize or avoid the loss and isolation of native terrestrial habitats.

Benchmark: Maryland population of globally rare species is considered secure and the lands on which they occur are managed to ensure long-term viability.

Indicator Development and Data Responsibility: *DNR's Wildlife and Heritage Division, 410-260-8540.*

Number of Reported Globally Rare Species
By Maryland County



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