October 1999

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The State of the Chesapeake Bay

A Report to the Citizens of the Bay Region

Chesapeake Bay Program

Chesapeake Bay Program

The Chesapeake Bay Program, formed in 1983 by the first *Chesapeake Bay Agreement*, is a unique regional partnership leading and directing restoration of the Chesapeake Bay. The Bay Program partners include the states of Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the US Environmental Protection Agency (EPA), which represents the federal government; and participating citizen advisory groups.

The second *Chesapeake Bay Agreement*, adopted in 1987 and amended in 1992, established an overall vision for the restoration and protection of the Bay. One of its main goals is to reduce the nutrients nitrogen and phosphorus entering the Bay by 40% by the year 2000. In the *Amendments*, partners agreed to maintain the 40% goal beyond the year 2000 and to attack nutrients at their source—upstream in the tributaries. The Chesapeake Executive Council, made up of the governors of Maryland, Pennsylvania and Virginia; the mayor of Washington, DC; the EPA administrator; and the chair of the Bay Commission, guided the restoration effort in 1993 with five directives addressing key areas of the restoration, including the tributaries, toxics, underwater Bay grasses, fish passages and agricultural nonpoint source pollution. In 1994, partners outlined initiatives for habitat restoration of aquatic, riparian and upland environments; nutrient reduction in the Bay's tributaries; and toxics reductions, with an emphasis on pollution prevention.

The 1995 *Local Government Partnership Initiative* engages the watershed's 1,650 local governments in the Bay restoration effort. The Executive Council followed this in 1996 by adopting the *Local Government Participation Action Plan* and the *Priorities for Action for Land, Growth and Stewardship in the Chesapeake Bay Region*, which address land use management, growth and development, stream corridor protection, and infrastructure improvements. A 1996 riparian forest buffers initiative furthers the Bay Program's commitment to improving water quality and enhancing habitat with the goal of increasing riparian buffers on 2,010 miles of stream and shoreline in the watershed by the year 2010. In 1997, the Bay Program renewed its commitment to meet the 40% nutrient reduction goal by the year 2000 and adopted initiatives that addressed the acceleration of current nutrient reduction efforts, expanded wetlands protection and support for community-based watershed restoration efforts.

Now, the Bay Program, advisory committees, all levels of government and other Bay stakeholders set their sights on *Chesapeake 2000*, a renewal of the *Chesapeake Bay Agreement* and one of the four directives signed at the 1998 Executive Council meeting. As always, the Bay Program's highest priority is the restoration of the Bay's living resources—its finfish, shellfish, Bay grasses, and other aquatic life and wildlife. *Chesapeake 2000* will assess the progress made since 1987 and, among other objectives, will identify new science and emerging challenges related to the Bay's health. Another directive—the Bay Program's Education Initiative—will bring information, data and the goals of the Bay region's restoration into classrooms. The other two 1998 directives address innovative technologies in Bay restoration and regional management of the use and transport of animal waste.

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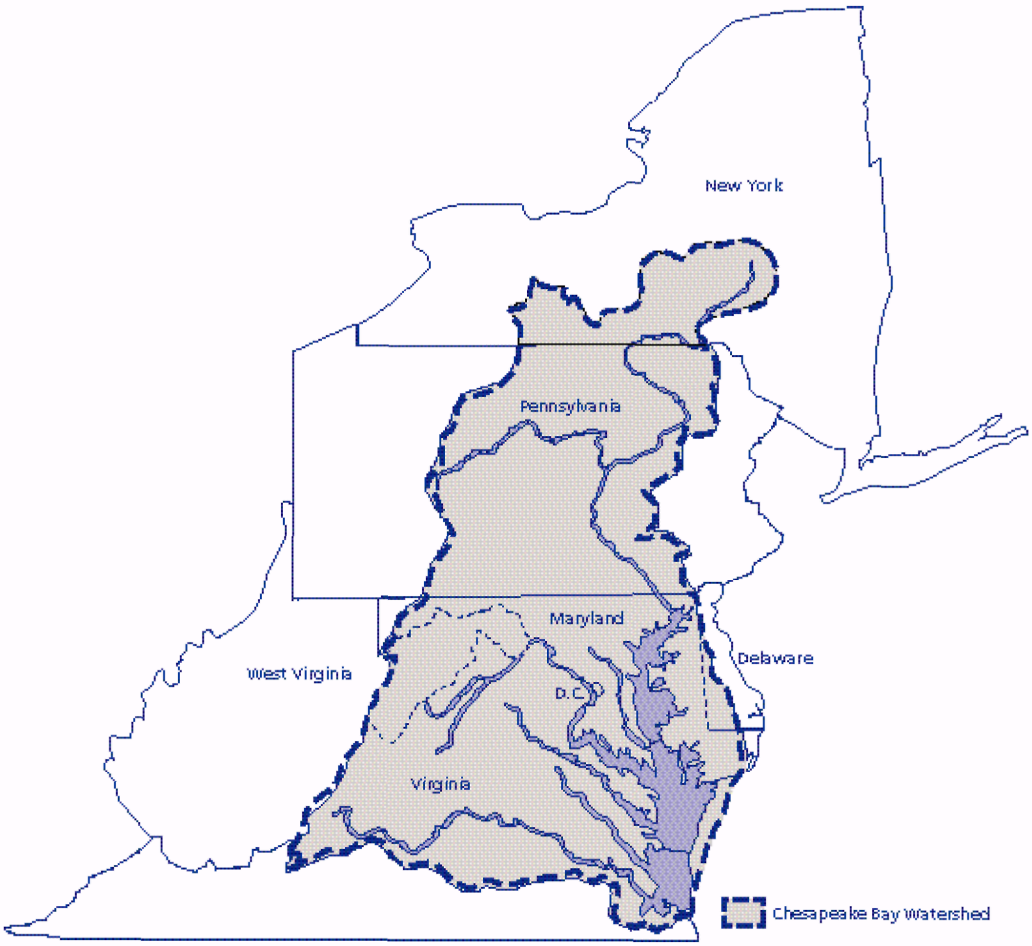

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INTRODUCTION

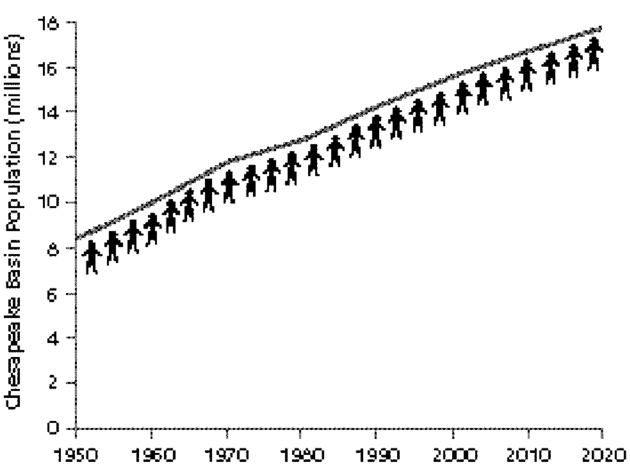
The State of the Chesapeake Bay

The Chesapeake Bay and its rivers are an incredibly complex and productive natural system. The 64,000-square-mile watershed teems with life. This region is home to more than 3,000 species of plants and animals and at least 15.1 million people. Every day, 300 more people call this region home. That pressure poses a great challenge to our natural resources and the pollution reductions we've achieved so far.

To many, the steady restoration of the Chesapeake system is a budding success story. As chief managers of the Bay's resources since 1983, the Chesapeake Bay Program partners have set clear goals for recovery through the reduction of nutrient and toxic pollution, plus habitat protection and restoration. More specifically, the Bay Program partners, guided by the Chesapeake Executive Council, put in place the management efforts that have led to the return of Bay grasses and cleaner water in most of our rivers. The Executive Council membership changes periodically, but its approach to the Bay restoration has always been the same—set clear, measurable goals, guide implementation and track the progress.

Measuring progress, however, is not an exact science. One word, such as good, fair or poor, doesn't quite tell the story. The bottom line is that the Bay Program partners believe the Bay and many of its living resources have come a long way since the 1970s. The Bay can be considered a patient that's just been released from intensive care and is recovering. Some of its vital signs are improving, but we need to keep a very close watch on all the signals.

POPULATION PROJECTION: CHESAPEAKE BAY WATERSHED



To understand progress to date, we offer this report. Treat it like a report to the shareholders. It is intended to explain the results of the investments you've made to protect and restore the Chesapeake system up to this point. This report also marks the Bay Program's continued commitment to be held accountable for our performance as managers of the Bay's precious resources.

This report highlights water quality conditions and the status of creatures that call the Bay home. The first question we answer is how are our most important species doing? We also explain the progress we're making to reduce the top four stressors on the Bay system: excess nutrients, toxic pollution, air pollution and landscape changes. Also highlighted are the most recent policy decisions and goals that are driving the overall cleanup effort, along with new findings, innovative technologies and some of the challenges we will face beyond 2000.

The Executive Council is preparing the road map for the future: *Chesapeake 2000*. That renewed agreement, to be written with the help of the citizens, will be a visionary document to guide the Bay Program into the next century. It also will lay out plans for dealing with the next generation of issues, such as the effects of a growing population on the landscape, our cap on nutrient loads, sediment pollution, the loss of forests and wetlands, and the decline of several species of valuable fish, shellfish and waterbirds.

More than anything, we hope this report will pique your interest in further exploring the Chesapeake Bay and its rivers and in making changes in your everyday life that will help the clean-up effort. To help you recognize areas where you can help, we include a special feature called "What You Can Do" throughout the report. If you are interested in more information about anything you read here, refer to our website at www.chesapeakebay.net or call us at 1-800-YOUR BAY. The Chesapeake is your Bay—yours to restore and to enjoy.

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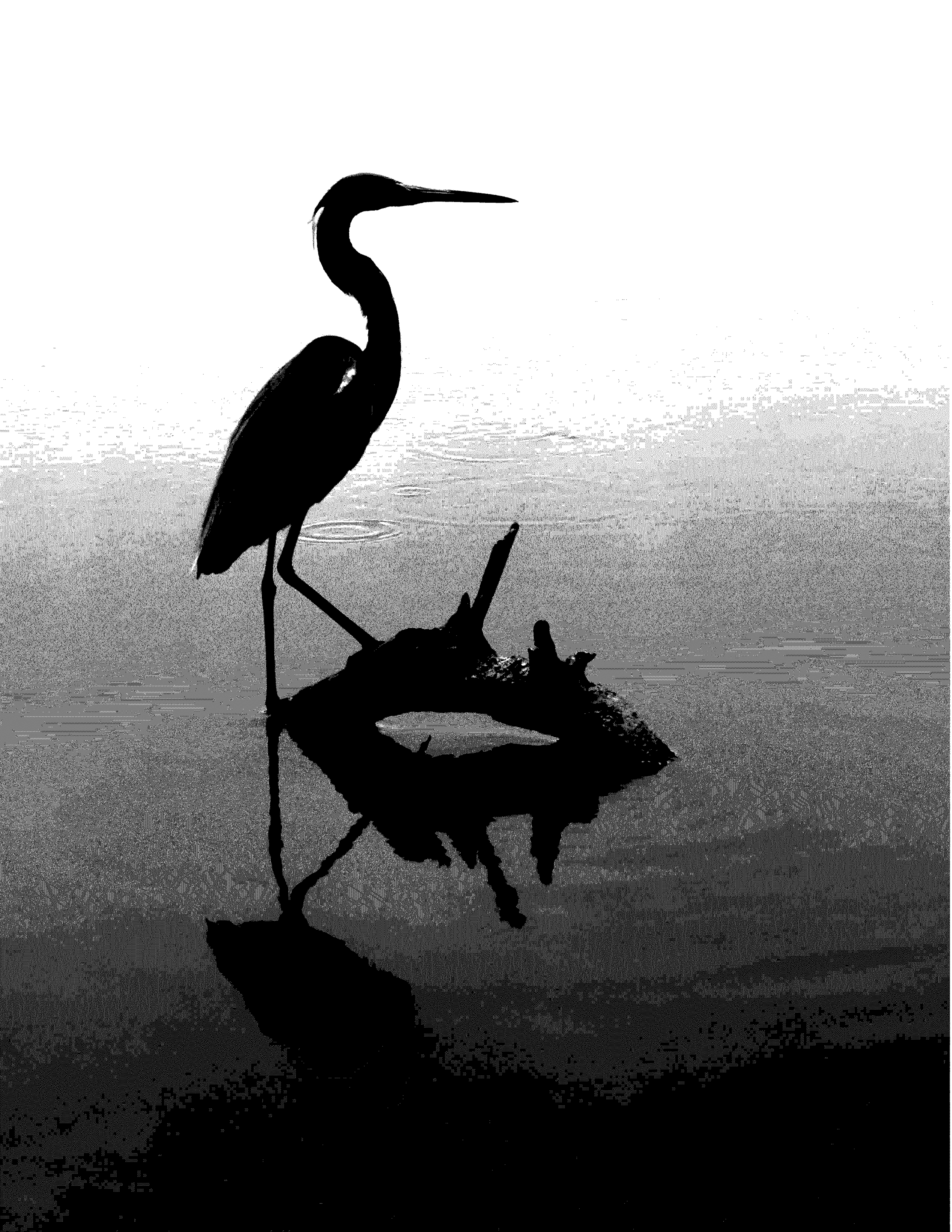


EXECUTIVE SUMMARY

The State of the Chesapeake Bay

Since 1983, the Chesapeake Bay Program has been working in cooperation with federal, state and local governments; industry; farmers; environmentalists; conservation associations; citizen groups; and others to restore the Bay's water quality by reducing pollution. To help guide these efforts, the Bay Program set a series of challenging goals to achieve its top priority—the restoration of living resources including finfish, shellfish, underwater Bay grasses and other aquatic life and wildlife.

As we approach 2000, striped bass are back in record numbers, underwater grasses have rebounded since the 1980s, and sewage treatment plant upgrades have helped in the ongoing clean-up of rivers. We have made impressive progress toward the ambitious nutrient reduction goal set in 1987. Scientists recognized early on that excess nutrients were the Bay's number one pollution problem; that's why clean-up efforts are focused so heavily on reducing them. The implementation of nutrient reduction strategies in the major tributary rivers has been a key to this progress, along with strong citizen support. It's fair to say that the Bay and rivers would be in much worse shape today if no action had been taken.

There's more good news: in some places, living resources are beginning to respond, especially in areas where management actions have been concentrated. However, that good news is tempered by the lack of water quality improvements in some areas and the effect of *Pfiesteria* and *Pfiesteria*-like organisms on fish and humans in 1997. There also is a disturbing trend showing significant losses of Bay grasses in the Tangier Sound area—one of the most productive areas of the Bay for blue crabs. The challenges we face in restoring living resources and reducing nutrients remind us that we need to do more if we want to achieve our living resource and habitat restoration goals and, ultimately, a healthier, more productive, more resilient Bay system.

OVERVIEW

- **Nutrient Reduction** — The Bay Program's most important goal is the 40% reduction of the controllable loads of nitrogen and phosphorus entering the Bay by 2000. In 1997, following extensive reevaluation, the Bay Program concluded that the phosphorus goal will be met, but the nitrogen goal wouldn't unless current reduction efforts were accelerated. Since then, a number of actions have been taken to close the gap on nitrogen.
- **Toxics Reduction** — We're learning more about the sources of toxic chemicals to the major river basins in the region. New data will enable the Bay Program to target and tailor toxics reduction and pollution prevention efforts. Between 1988 and 1997, industries have reduced toxic releases into the Bay by 67%.
- **Air pollution** — Scientists estimate that approximately 21% of all the nitrogen in the Bay region comes from the air. Air quality monitoring has become more sophisticated, and there is growing evidence that nitrogen emissions, particularly nitrogen oxides, contribute significantly to the excess nutrient problem in the Chesapeake system.
- **Landscape changes** — Put simply, changes to the landscape throughout the Chesapeake region threaten to undo more than 25 years of environmental improvements in just a short time.

While the Bay Program partners grapple with controlling or eliminating the top stressors on the Bay system, there is good news on the local level. More local governments and watershed organizations are spearheading decision-making and hands-on work to reduce nutrients and toxics and to restore habitat. More citizens throughout the region also monitor water quality in their neighborhood for nutrients, oxygen, clarity and the presence of Bay grasses. Schools across the region also are kicking in with habitat restoration projects and clean-up efforts. Overall, the effort to restore the Chesapeake system is stronger than ever with more partners on all levels.

How the Bay Works

The State of the Chesapeake Bay

Before we report on the status of some of the Chesapeake Bay's most important living resources, it is helpful to explain a little about the overall Bay system. Scientists call the Bay an ecosystem—a complex set of relationships among the living resources, habitats and residents of the Bay.

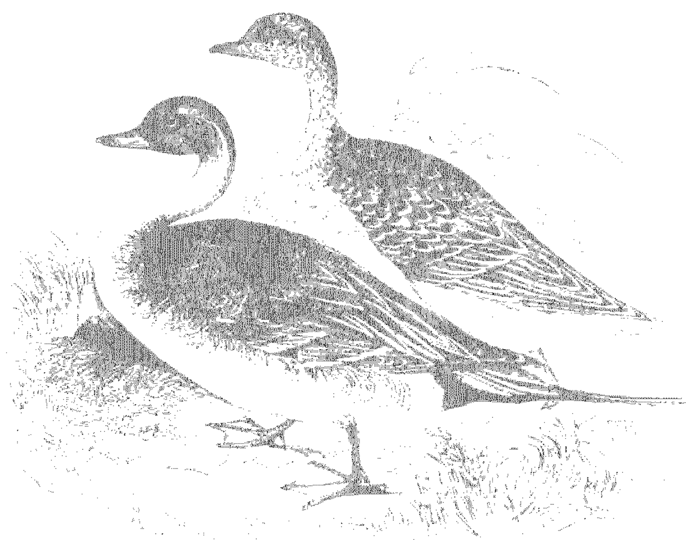
The Bay Ecosystem

The physical processes that drive the Bay ecosystem sustain the many habitats and organisms found there. Even the smallest creature plays a vital role in the overall health and production of the Bay. Forests and wetlands filter sediments and pollutants while supporting birds, mammals and fish. Small fish and crabs find shelter and food among lush beds of underwater grasses. Unnoticed by the naked eye, plankton drift with the currents, becoming food for copepods and small fish. Clams and oysters pump Bay water through their gills, filtering out both plankton and sediment. During the fall and winter, waterfowl descend upon the Bay, feeding in wetlands and shallow waters. Perched on nests high above the water, eagles feed perch, menhaden and other small fish to their young. The spectrum of aquatic environments, from freshwater to saltwater, creates a unique ecosystem abundant with life.

But, the relentless encroachment of people threatens the ecological balance. Each individual directly affects the Bay by adding waste, consuming resources and by changing the character of the land, water and air that surround it. However, through the choices we make in our everyday lives, we can lessen our impact on the Bay's health.

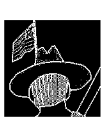
The Bay Watershed

The Bay receives about half of its water volume from the Atlantic Ocean. The rest drains into the Bay from an enormous 64,000 square-mile watershed. This includes parts of New York, Pennsylvania, West Virginia, Delaware, Maryland and Virginia and the entire District of Columbia. Freshwater from springs, streams, small creeks and rivers flows downhill, mixing with salty ocean water to form this part fresh-part salty estuarine system. Together, the soil, air, water, plants and animals that live in the watershed form the complex web of life that makes the Chesapeake ecosystem so unique.



The CITIZEN CONNECTION

Citizens Advisory Committee: *The Voice of the People*



The Chesapeake Bay Program has a unique pipeline for citizens to participate in the policy decisions that drive the restoration of the Bay. Established in 1984, the Citizens Advisory Committee provides grassroots assistance to the Executive Council and all Bay Program committees. Membership is broad-based, with representatives from agriculture, business, conservation, industry and civic groups. The 25 citizens on the committee provide a two-way link between government and the public to increase understanding of the Bay Program, its goals and commitments and the ongoing efforts to restore and protect the Bay region. They are the voice of the people.

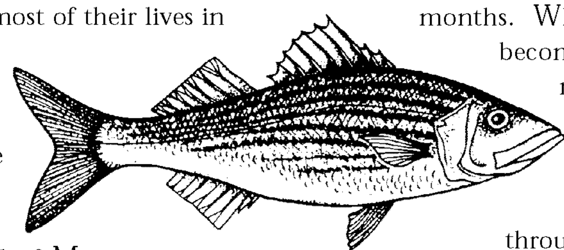
WHAT LIVES IN A HEALTHY SYSTEM

Since 1983, the Chesapeake Bay Program's highest priority has been the restoration of living resources. In total, there are about 3,000 species of plants and animals in the Chesapeake ecosystem. That's a daunting number, so we chose six of the most ecologically important and highly visible species on which to report in depth: striped bass, shad, blue crabs, oysters, bald eagles and waterbirds. In the following chapter, we present these creatures in a larger context, including their food sources and favorite habitat. For example, when we report on striped bass, we also report on plankton, one of their food sources. Although there are many stories to tell, we hope this chapter begins to clarify the complex connections that exist within the ecosystem.

Striped Bass

Top Predators of the Bay

Large striped bass, some weighing as much as 70 pounds, prowl the Chesapeake Bay, consuming smaller fish. However, these top predators, also called rockfish, begin their lives as tiny larvae that feed on microscopic animals called zooplankton. Striped bass are migratory fish that live most of their lives in saltwater, but reproduce in freshwater. They may live as long as 30 years, and females often don't mature until they are seven or eight years old. During early April through the end of May, mature adults migrate to the Bay's tidal freshwater tributaries to spawn. Unlike other fish that migrate far up the tributaries, striped bass spawn where the freshwater begins.

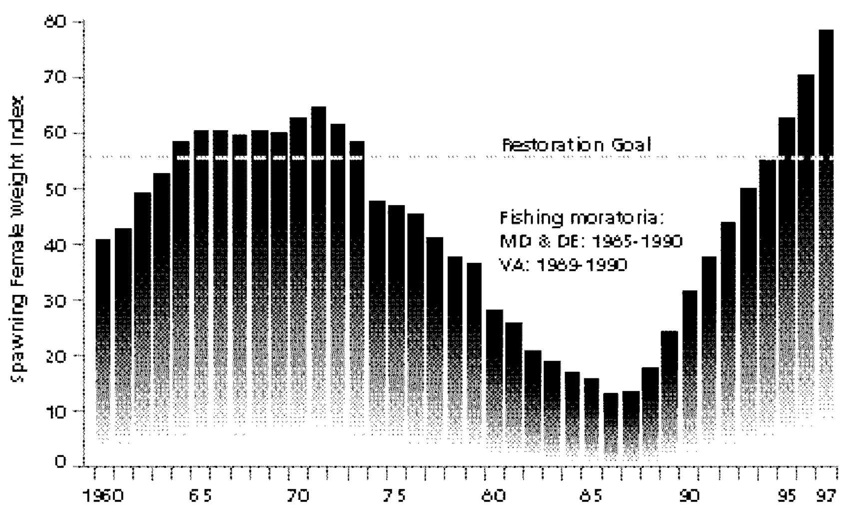


Tiny bass larvae hatch from eggs several days after spawning when the water temperature is just right. Young bass, or juveniles, often hide from predators in underwater Bay grass beds. Food such as insect larvae, tiny worms, larval fish and other small creatures abound in these grasses. As juveniles grow, they move to saltier water. By their second year, juveniles, like their parents, are consuming fish and shellfish. The striped bass diet changes with the seasons as other fish move through the Bay. Bay anchovy and Atlantic menhaden may dominate their diet during summer and fall. Spot and Atlantic croaker sustain striped bass through cold winter months. White perch and river herring become important fare as bass migrate up the Bay in spring and early summer.

Striped bass require plenty of oxygen in the water through all of their life stages. As waters warm in the summer months and algae grow and die, oxygen levels in water decline. In turn, striped bass may be squeezed out of entire regions of the Bay.

Striped bass are a fisheries management success story. Over-fishing led to very low numbers of striped bass by the late 1970s. Conservative fishery management measures first banned, then limited striped bass fishing. The goal was attained in the mid-1990s, and the Atlantic States Marines Fisheries Commission declared the striped bass stock restored as of January 1, 1995. Even now, spawning stocks continue to rise.

Striped Bass are Back!



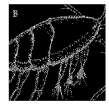
Striped bass have responded to a moratorium followed by harvest restrictions, stocking efforts and improved habitat conditions.

The stock was declared restored in January 1995!

Status of Fishery Stocks in 1998

Striped Bass	restored
Atlantic Croaker	historically high levels
Spot	appear healthy, moderate abundance
Catfish	appear healthy
White Perch	recent indices above average
Black Drum	appear healthy, abundance variable
Weakfish	moderate abundance, recovery under way
Yellow Perch	indices above previous lows since 1993
Blue Crab	slightly below long-term average abundance
Softshell Clam	depleted abundance dependent on water temperature
Atlantic Menhaden	concern over recent poor recruitment
Spotted Seatrout	recent indications of reduced abundance
Summer Flounder	overfished, medium abundance, recovery under way
American Eel	recent indications of low abundance
Hard Clam	recent signs of decreased abundance
Horseshoe Crab	recent indications of low abundance
Hickory Shad	moderate abundance, approaching historic numbers in some rivers
Red Drum	overfished, recovery plan adopted
Bluefish	overfished, low abundance
Black Sea Bass	overfished, low abundance, recovery plan adopted
Tautog	overfished, recovery plan adopted
Alewife and Blueback Herring	low abundance
American Oyster	severely depleted, recovery under way
American Shad	very depressed abundance (Bay moratorium)
Atlantic Sturgeon	40 year moratorium in place
Shortnose Sturgeon	endangered

Plankton:
The Base of the Food Web & The Main Course for Young Fish



Although scientists know a lot more about the Chesapeake Bay and its creatures today than they did 15 years ago, it is still difficult to make a direct link between water quality, fish food and fish. But the presence of two types of plankton—microscopic plants and animals—best indicate this link.

Phytoplankton are microscopic plants. They form the base of the food web in the aquatic environment and provide a measure of the effectiveness of our efforts to reduce nutrient pollution. Phytoplankton quickly respond to changes in nutrient levels, giving scientists a direct indication of the Bay's health.

Zooplankton are the community of floating animals that feed on phytoplankton. They are the most plentiful animals in the Bay and its rivers. One gallon of water can contain more than a half-million zooplankton, ranging in size from tiny single-celled Protozoa to large jellyfish. All fish are dependent on zooplankton for food during their larval life stages, and some species—including herring, shad and the Bay anchovy—eat zooplankton their entire lives.

Although difficult to measure, data show that fish food availability, plus zooplankton diversity and abundance, are improving in the upper reaches of some tidal tributaries. For example, in the Patuxent River, these changes may be related to nutrient reductions and improving water quality conditions. Also, heavy spring rains that caused high freshwater flows in the rivers in 1998 gave these zooplankton the opportunity to rebound from previous lows. Meanwhile, the number of young migratory fish has grown along with increased levels in the abundance of zooplankton.

Elsewhere in the Bay system, zooplankton show declining trends over the past 12 years. In the Bay's mainstem and the lower reaches of some tributaries, the diversity of zooplankton has declined dramatically, suggesting that nutrient and sediment pollution still impacts these waters.

SHAD & HERRING

Fish that Breach Barriers

Shad and herring, called anadromous fish, begin their lives in the free-flowing freshwater reaches of the Bay's rivers and streams, but spend the majority of their lives in the Atlantic Ocean. American shad and hickory shad are related to alewife and blueback herring, which also are called river herring.

In the ocean, shad feed on crustaceans, insects and small fish. During spring, mature shad migrate through the Bay and up freshwater tributaries to spawn. The American shad migration may begin as early as mid-February, and it peaks during April. Hickory shad spawning peaks later. Adults of all species attempt to return to the ocean after spawning, but are preyed upon by striped bass and bluefish.

Shad eggs, carried by river currents along the bottom, hatch in two to 17 days. Shad larvae live near the surface and drift downstream with the currents. They require high dissolved oxygen levels and relatively clear water to develop. The larvae change into young shad and spend their first summer in the freshwater portions of the rivers. Juveniles eat plankton. As fall approaches, they move toward the ocean where they grow for several years before returning to the rivers to spawn.

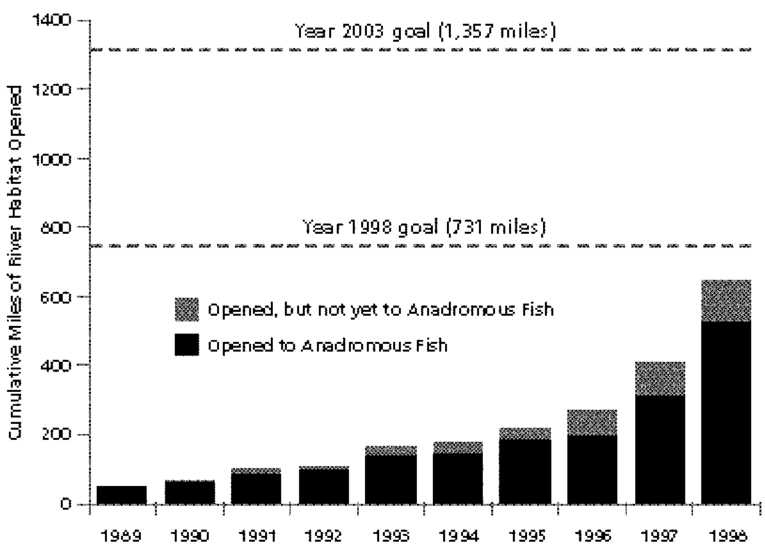
River herring have a life cycle similar to shad and are an important food source for a variety of creatures, including osprey, green heron, striped bass, largemouth bass and perch.

STOCKING UP ON FISH

Formerly one of the most abundant and valuable fisheries in the Bay, stocks of shad and herring are depleted. However, states are using a number of strategies to replenish stocks and to control fishing. A Bay fishing moratorium was placed on shad in Maryland in 1980 and in Virginia in 1994 and remains in place today. However, the shad intercept fishery, which operates coastwide in the Atlantic Ocean, still removes shad from the annual spawning run. Recently, the Atlantic States Marine Fisheries Commission amended its shad management plan to include a five-year phase-out of that fishery beginning in 2000.

Bay region restocking efforts for shad are among the most ambitious in the country. For example, between 1986 and 1998, a total of 218 million American shad fry and fingerlings were cultured and released in direct support of restoration programs in the Susquehanna, James, Pamunkey, Potomac and several Maryland rivers. In 1998 alone, nearly 34 million juvenile American shad—the highest number ever—were reared in hatcheries and released into Bay tributaries.

PROGRESS MADE GETTING MIGATORY FISH PAST DAMS AND OTHER BLOCKAGES



Fish, like shad, that live in the Bay and ocean as adults and migrate to spawn in freshwater are called anadromous fish.

Fish passages help anadromous fish swim upstream, past dams and other blockages, to reach freshwater spawning habitat.

The removal of stream blockages and construction of fish passages, between 1988 and 1998, have reopened 523.5 miles of historic spawning habitat to migratory fish and an additional 121.5 miles to resident fish. A total of 645 miles have been reopened.

FISH PASSAGE:
Projects Give a Lift to Shad & Herring

Shad and herring populations plummeted primarily because of over-fishing and their inability to reach historic spawning grounds due to human-installed stream blockages. More than 2,500 dams, road culverts and bridge aprons stop fish from moving upstream.

Fish passages have been constructed, allowing shad and herring to bypass those blockages and to reach historic spawning grounds. Fish passage goals established by the Chesapeake Executive Council in 1993 directed Bay Program partners to open more than 1,356 miles by 2003. Through 1998, 645 miles of Bay tributaries were reopened.

Giant fish lifts or elevators are one way to get shad and herring past hydroelectric facilities. Major projects to open the four largest dams in the Bay region—all located on the Susquehanna River—began in 1991, when Conowingo Dam's fishlift opened. Fish elevators at Safe Harbor and Holtwood dams—the largest-capacity fish lift operations in the nation—opened in 1997. The final project, a fish ladder at the York Haven hydroelectric facility, is scheduled to provide fish passage by 2000. In 1998, the last of five dams on the James River was breached. A ladder added at Bosher's Dam opened the river from Richmond to Lynchburg.

Dam removal is another way to breach barriers. In Pennsylvania, state agencies are working with citizens to restore habitat by breaching or removing non-beneficial dams. Between 1995 and 1997, 18 low-head dams were removed, mostly in the Susquehanna basin, where more than 200 low-head dams have been identified for possible removal.

WHAT YOU CAN DO

- **Help clean and maintain fish passages.**
- **Encourage your local and state governments to facilitate construction of fish passages.**
- **Remove old dams that are no longer used on your property.**
- **Support strong management actions to allow stocks to increase and prevent over-fishing.**

FOR YOUR INFORMATION...

Pfiesteria: A Toxic Organism Linked to Fish Kills & Human Health Effects

Outbreaks of the toxic organism *Pfiesteria piscicida* had been identified and reported in North Carolina in the early 1990s, but the Chesapeake region did not encounter this tiny creature until the drought-stricken summer of 1997. That's when several tidal creeks in the Chesapeake system experienced outbreaks, and fish kills occurred. We were luckier in 1998; no fish kills were attributed to *Pfiesteria*. However, officials continue to make more funds available for research to determine why the toxic organism was found in the Bay region.

First, a little background. In August and September of 1997, up to 50,000 fish—mostly a small bait fish called menhaden—were found dead on Maryland's Lower Eastern Shore. The incidents were in the Pocomoke River, Kings Creek (a tributary of the Manokin River) and the Chicamacomico River. Laboratory analysis confirmed that a dinoflagellate (a free-swimming, single-celled organism) called *Pfiesteria piscicida* was present at toxic levels that summer and was the probable cause of the fish kills. In Virginia, in September 1997, species within the Pfiesteria complex were identified in the Rappahannock River. Their appearance was associated with a high incidence of fish with lesions.

Medical evidence also collected during 1997 strongly suggested that exposure to an active outbreak of *Pfiesteria* may result in significant, but probably temporary, health impacts on humans, including short-term memory difficulties and respiratory problems. As a precaution, Maryland closed all three rivers until the outbreaks ceased. However, there is no evidence that *Pfiesteria* toxins accumulate in fish flesh or that they can be passed to humans by eating seafood.

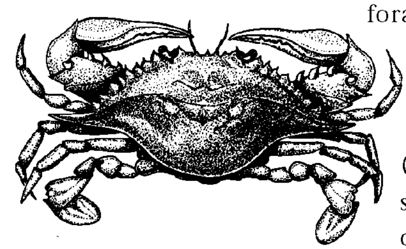
Although many factors must combine to encourage the growth of *Pfiesteria*, the only one that humans have any significant influence on is nutrient levels. Nutrient levels in the areas of the outbreaks were high compared with other areas of the Bay. The major source of these nutrients on Maryland's Eastern Shore is agriculture—in particular, the expanding poultry industry and the use of poultry litter on cropland.

Today, Maryland and Virginia are working with several federal agencies to monitor habitat quality, fish health and any future *Pfiesteria* outbreaks. One step was the installation of an extensive early warning monitoring system by Maryland and Virginia between the fall of 1997 and the spring of 1998. This early warning system helped scientists and medical professionals better detect the presence of *Pfiesteria* in rivers. In 1999, following a year when there were no outbreaks, scientists found non-toxic forms of *Pfiesteria* in two more rivers on Maryland's Eastern Shore.

BLUE CRABS

The Bay's Scavengers

Blue crabs scour the bottom of the Chesapeake Bay, preying on other crustaceans, small fish and shellfish. They also act as underwater vultures, scavenging for dead plants and animals. In turn, they are consumed by cownose rays, eels, striped bass, bluefish, herons, diving ducks, raccoons and each other. Humans are pretty fond of them too.



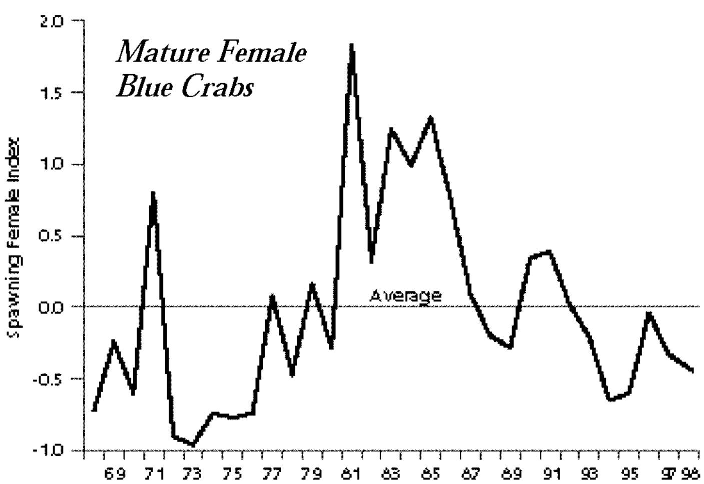
Blue crabs begin their lives in summer, near the mouth of the Bay, when females release larvae (zoeae). Zoeae are carried by currents out of the Bay's mouth and to the ocean, where they need high salinity to grow. After a month or so, zoeae change into shrimp-like megalopae that drift back into the Bay on wind-driven currents. Megalopae molt or shed their shell, turning into tiny juvenile crabs. They continue to molt the outer shells as they grow, maturing at 12 to 18 months of age, when the shell measures about five inches tip-to-tip. As young crabs grow during summer and fall, they disperse throughout the Bay. Male crabs prefer lower salinity areas in the upper Bay and tributaries. Females prefer the higher salinity of the lower Bay and the mid to lower tributaries, and many overwinter in southern Bay waters.

Immediately after molting, crabs are vulnerable to predators because they are soft, so they often hide in Bay grass beds for protection. Young crabs use Bay grass beds for nursery areas, and crabs of all sizes forage for food there. Bay scientists have found that 30 times more young crabs were found in Bay grasses than in areas without grass.

Crabs, like other Bay creatures, are susceptible to summer's low oxygen conditions. Fueled by nutrient pollution from farms, sewage treatment plants, homes and cars, algal blooms remove oxygen from the water, and crabs may be driven from low-oxygen areas. They may even die from low oxygen levels when trapped in crab pots under these conditions.

With declines of finfish and other shellfish species, there is concern that increased crab fishing efforts could affect blue crab populations. A 1997 assessment of the blue crab stock showed that population often fluctuates and, during the 1990s, numbers were about average. The 1997 *Chesapeake Bay Blue Crab Fishery Management Plan* outlines the coordinated Baywide effort to monitor and control crab harvests. Under the plan, Bay jurisdictions will continue a cautious and conservative approach to managing the blue crab stock.

BLUE CRABS HANGING ON



The Chesapeake Bay blue crab fisheries are valuable. They provide significant economic benefits for many people in the region. Mature female abundance is lower than during the 1980s but is comparable to the 1970s. The *1997 Chesapeake Bay Blue Crab Fishery Management Plan* does not recommend any regulatory changes but calls for a cautious and conservative approach to managing the stock.

Underwater Grasses: *The Bay's Unique Yardstick*

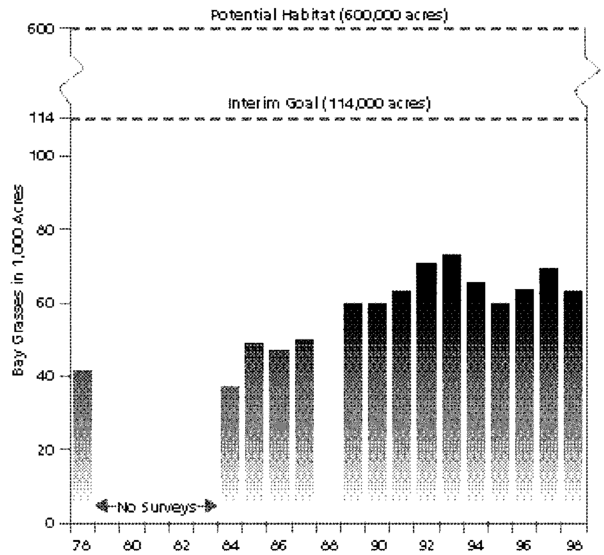
The plants growing under the surface in shallow water are called underwater grasses or submerged aquatic vegetation (SAV). They provide food for waterfowl and habitat for fish, crabs and invertebrates; remove suspended sediments from the water; protect shorelines from waves and erosion; and add oxygen to water. Grass growth is dependent on sufficient levels of sunlight reaching the underwater leaves. Scientists believe that underwater grasses once covered more than 600,000 acres of Bay bottom. However, increasing amounts of nutrients and sediment in water, including significant runoff from Tropical Storm Agnes in 1972, have contributed to declines in grass acreage.

Because they are not harvested like many other Bay resources, grasses give managers a unique yardstick for measuring progress in the Chesapeake clean-up. They also have a well-documented link to water quality. So in the late 1980s, the Bay Program began targeting underwater grasses for special protection and restoration. In 1993, the Executive Council agreed to an interim goal of 114,000 total acres of grasses Baywide in 2005. Through 1998, based on aerial surveys, the Bay Program was more than half-way to meeting that goal with over 63,000 acres.

Discovery of damage to existing underwater grass beds prompted action in the Maryland and Virginia legislatures in 1998. In Maryland, the legislature adopted laws that prohibit hydraulic clam dredging in Bay grass beds in the Chesapeake Bay and the state's coastal bays. Virginia never has allowed hydraulic dredging. In Virginia, the Marina Resources Commission adopted regulations which prohibit clamming within 200 meters of grass beds in Chincoteague Bay (a coastal bay) and regulations which prohibit the placement of new aquaculture structures within grass beds.

Between 1997 and 1998, grass acreage increased significantly in several Maryland and Virginia tributaries including the Severn, Magothy and South rivers and parts of the Potomac, Mattaponi, Pamunkey and Chickahominy rivers. However, grasses declined for the sixth straight year in 1998 in Tangier Sound—one of the most productive areas for crabs in the Bay. Scientists are looking at a variety of possible causes for the decline, including increased suspended sediment, decreased water clarity and excess nutrient. Destruction by more localized activities, like clam dredging, also is being considered.

Bay Grass Acreage



Bay grasses are vital habitat for fish and crabs. Improved water quality will promote Bay grass growth.

WHAT YOU CAN DO

- **Participate in citizen water quality monitoring.**
- **Help environmental organizations plant Bay grasses.**
- **Be a responsible boater and avoid disturbing Bay grass beds.**
- **Use environmentally friendly landscaping techniques that require less fertilizer, prevent erosion and utilize native plants. This helps prevent sediments and nutrients from reaching Bay waters.**

Oysters

The Bay's Extraordinary Filter

Oysters are odd-looking critters, but are valuable to the Chesapeake Bay for their ability to filter nutrients, toxics and sediment from the water. Except during the larval stage, they are immobile and permanently attached to reefs. Adult oysters may spawn more than once a season, releasing millions of eggs at a time. Fertilized eggs develop cilia, or tiny hairs, which enable them to swim. Within weeks, larvae develop a foot that is used to explore for hard bottom and a good place to attach. After attachment, juvenile oysters, also called spat, quickly develop and grow.

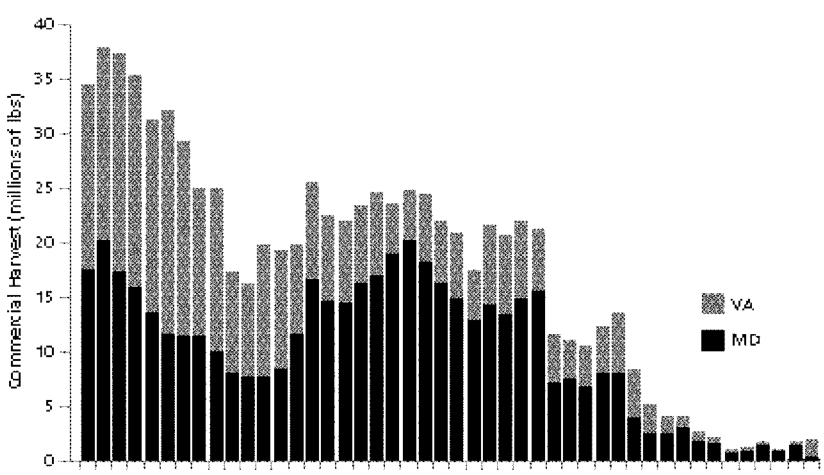
Oyster larvae are eaten by sea anemones, sea nettles and other filter feeders, while flatworms and small crabs consume new spat. Older spat and first-year oysters are fare for larger crabs and fish. Although oysters are very tolerant of changes in salinity, they stop feeding, growing and reproducing in very low salinity. That means freshwater flooding is particularly threatening to oysters because it lowers water salinity, and it carries heavy loads of sediments, which smother oysters. Oysters are more tolerant of chemical contaminants than many estuarine species, but eggs and larvae may be vulnerable to chemical pollution and heavy metals like copper.

Long ago, huge oysters once lived on underwater shell reefs that rose from the bottom of the Bay to near its surface. Millions of these large oysters fed on plankton, each filtering about 50 gallons of water per day. Because oysters were healthy and plentiful, they completely filtered the Bay's water in under a week during summer, keeping water clear as they fed. A valuable commodity worldwide, oysters were once the mainstay of the Bay's fishing industry. Chesapeake oysters were famous for their size, tenderness and taste. The reefs they grew also were well known because their height made them hazards to navigation. Now the industry, along with the natural oyster reef, is almost nonexistent.

Basically, the oyster population declined as a result of over-harvesting and the loss of habitat as the huge reefs were scraped away by fleets of oyster boats. Commercial harvests in 1998 were about 2% of those seen in the 1950s, when 30 to 40 million pounds were taken from the Chesapeake each year. Natural oyster reefs, once the stuff of legends, now exist only as flat hard surfaces on the bottom. And, the Bay's oysters now require more than a year to filter its waters because they are fewer in number.

Today, disease is the number one threat to oysters. Two diseases that were discovered in the Bay some 40 years ago, MSX and Dermo, have decimated the oyster. MSX kills spat, while Dermo kills adult oysters before they are big enough to reproduce or harvest. Despite this, oyster spat production shows strong annual peaks, and Maryland's 1997 spat set was the second highest since monitoring began in 1939. But, this resilient species continues to endure fluctuating conditions, and officials, scientists and citizens are working together to develop constructed reefs as well as disease-resistant oysters that can thrive.

Oyster Harvests Decline Dramatically



Oyster harvests in the Bay have declined due to harvesting, disease, pollution, and loss of oyster reef habitat.

The HABITAT CONNECTION

Oyster Reefs

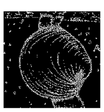
Oysters can attach to many hard surfaces, but grow best when they live on oyster shell reefs. Oyster reefs provide hard structure where barnacles, clams and other filter feeders also attach. Crabs and finfish take advantage of the reefs, hiding among the shells and dining on each other. Destruction of these reefs due to harvesting techniques has greatly reduced suitable habitat for oysters and the many other creatures that live on and around their reefs.

State and federal fishery agencies have begun constructing protected oyster reefs by placing oyster shells on the hard bottom where oyster reefs used to exist. Constructed reefs get oysters off the bottom where they may be smothered by sediments. More than a dozen reefs—all protected from harvest—have been created in the Bay's tidal regions.

The Lynnhaven oyster reef, the 13th reef constructed in Virginia's part of the Chesapeake Bay since 1993, was built with 80,000 bushels of oyster shells. The Lynnhaven reef allows oysters to spawn, grow and compete effectively despite disease pressure.

The CRITTER CONNECTION

Benthos



Benthos refers to the wide variety of animals that live on or in the bottom sediments of the Chesapeake Bay and its tributaries. Clams, crustaceans and worms are some of the animals that make up the benthic community. Many of these creatures are a food source for blue crabs and fish such as croaker, spot, striped bass and white perch. Benthic animals filter plankton and organic particles from the water column and are good indicators of pollution and low dissolved oxygen levels. A low level of dissolved oxygen in bottom waters, which is ultimately caused by excess nutrients, harms the Bay's benthos. Toxic contamination also is a threat to benthos in a few isolated areas. Experts agree that we must reduce nutrient loads to the Bay and toxic contamination in the sediments before benthic communities can be restored. In 1997, more than 50% of the benthic community and habitat in the middle mainstem Bay and in the tidal Potomac, Rappahannock and York rivers did not meet benthic restoration goals.

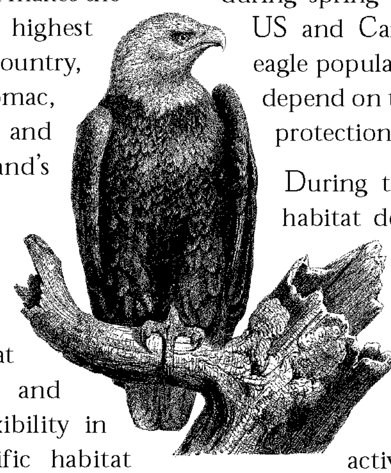
WHAT YOU CAN DO

- **Join organizations that raise oysters for release on Bay oyster reefs or build oyster gardens.**
- **Volunteer to help stock oysters on reefs.**
- **Encourage your local and state governments to consider construction of protected reefs and to further protect existing reefs.**
- **Urge strong regulations on harvest.**

Bald Eagles

Pride of the Bay

Bald eagles, the living symbol of our nation, nest throughout the Chesapeake region. They are attracted to the Bay's forested shorelines and fish. This combination of habitat and food makes the Chesapeake home to one of the highest concentrations of eagles in the country, especially in areas along the Potomac, Rappahannock and James rivers and in Dorchester County on Maryland's Eastern Shore.

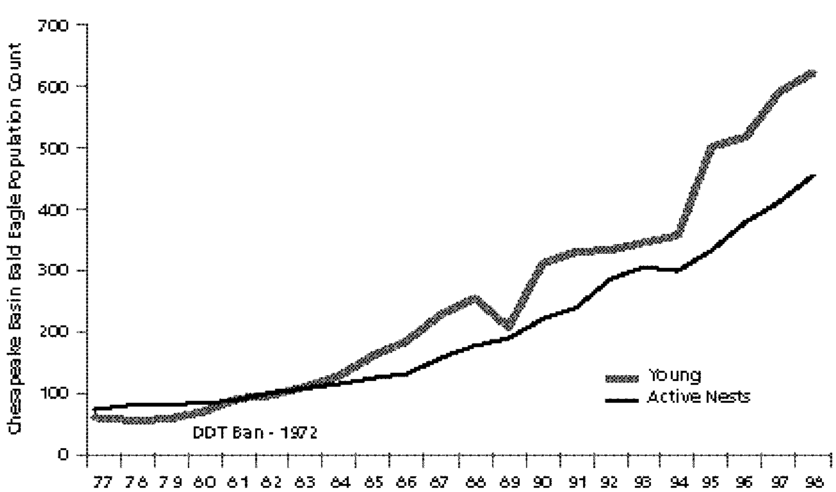


Weighing between 10 and 30 pounds and with a wingspan of up to seven feet, adult eagles are opportunistic scavengers and predators. They eat whatever is available—fish, birds and mammals—dead or alive. This flexibility in feeding contrasts with their specific habitat requirements. Eagles are big birds that need tall, sturdy trees for nesting and perching. Because eagles are easily disturbed by human activity, suitable trees must be located in undisturbed areas, usually within a mile of water. In the Bay watershed, eagles construct nests throughout the year and lay one to three eggs from January through March. Young eaglets leave the nests from May through July and remain close to their parents for several weeks.

Bald eagles can be seen in the Bay region all year. Those raised near the Bay usually stay their entire lives. The Bay also is an important migratory route during spring and fall for eagles from northeastern US and Canada. Although the Bay has a large eagle population now, their long-term success will depend on the health of the Bay's fisheries and the protection of forested habitat along shorelines.

During the early 1900s, illegal shooting and habitat destruction jeopardized the Bay's bald eagle population. By mid-century, however, the pesticide DDT had become the greatest threat. The number of young eaglets dropped from one or two per nest in the 1930s to one young for every five active nests in the early 1960s. DDT was widely used for controlling insects at the time, and it quickly contaminated the aquatic food web. DDT contamination caused eagles and other predators to lay eggs with very thin shells that cracked easily under the weight of the parents. As a result, the Bay's eagle population declined from more than 1,000 pairs in the early 1900s to fewer than 90 pairs in 1972, when DDT was banned in the US. The bald eagle was placed on the Endangered Species List in 1973.

Bald Eagle Population on the Rebound!



Actions to control chemical contaminants have led to improved conditions in the Bay. Bald eagles have rebounded due to the ban on the pesticide DDT in 1972, protection provided by the *Endangered Species Act* in 1973, and increased public awareness.

As a result of the DDT ban and the protection provided by its endangered status, eagle numbers increased as more young were produced. In 1995, the US Fish & Wildlife Service downlisted the bald eagle from endangered to threatened. In 1998, more than 450 active nests produced more than 600 young in the Bay region.

Because the bald eagle has rebounded, the US Fish and Wildlife Service in 1999 began its process to remove it from the Endangered Species List.

OSPREY: *The Bay's Acrobats*

Osprey are another success story in the Bay region. Every March, around St. Patrick's Day, these sharp-eyed hunters return from Central and South American wintering areas to nest on channel markers, buoys and other platforms. Osprey stay through September raising young and performing aerial acrobatics as they hunt and dive for fish. In recent years, the Bay region has been home to more than 2,000 nesting pairs a year or 25% of the nation's breeding pairs. The future productivity and stability of the osprey population in the Bay region will be tied closely to restoration of our fisheries and to protection of their habitat on wintering grounds.

Young osprey are a common sight in every part of the Chesapeake region each summer.

FORESTS: *Healthy Forests Mean a Healthy Bay*

Experts agree that healthy forests are directly linked to the health of our rivers and, ultimately, the Bay. Forests are important because they play a key role in nearly every part of the Bay system. They protect our streams and soil; filter our air; clean our water; provide places for recreation; and supply the raw materials for fuel, lumber and paper. Forests also provide many kinds of habitat important to the survival of fish and wildlife. More than half of the Bay's species use riparian forests during their lifecycles.

Scientific findings clearly show that forests are the most beneficial land use for clean water. Acting as a living filter, forests capture rainfall, reduce storm water runoff, maintain stream flow, reduce erosion, trap nutrients and stabilize soil. When streams and shorelines are buffered by forests, the amount of nutrients and soil washing into the Bay is reduced significantly. Large areas of healthy forest and streamside forests are essential to keeping nutrient and sediment pollution out of the rivers and Bay.

WHAT YOU CAN DO

- **Plant native trees on your property, especially along waterways.**
- **Organize and/or volunteer for streamside forest restoration and stream monitoring projects in your community.**
- **Encourage your local government to incorporate forest conservation and stream corridor protection in local land use planning and zoning.**
- **Call your state forestry agency if you have questions about forests in your area.**

For Your Information...

What's Happening to Our Forests?

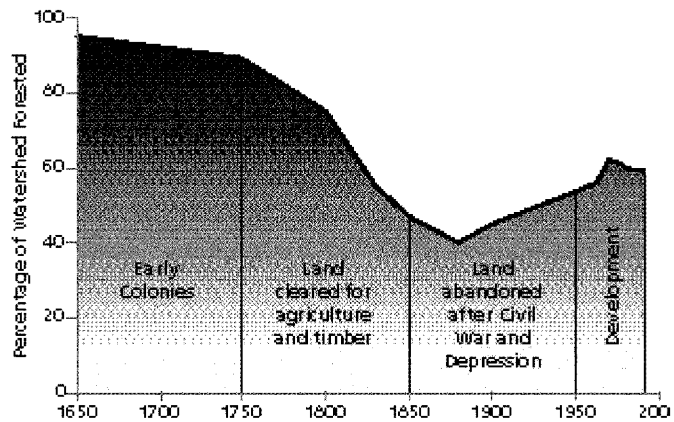
When explorer John Smith arrived in the Chesapeake Bay in 1607, forests covered almost 95% of the land in the region. Then came the settlers, and by the late 1800's, only 40% of the watershed remained forested. This dramatic loss was due to two centuries of extensive timber harvesting for fuel, shelter and fences, plus land clearing for agriculture. From that low point, forests began to recover and expand. The expansion lasted until the mid-1970s when, once again, forested acres began to decline and forests became increasingly fragmented.

Today, forests are still the dominant land cover in the Bay region, covering 59% of the watershed. However, we are losing forests at a rate of up to 100 acres per day. And, the forests we have are unevenly distributed across the watershed, with the areas closest to the Bay showing more rapid declines. Most of the recent loss is due to suburban development spurred on by population growth. If estimates are correct, the region's population will increase by three million people to nearly 18 million by 2020, and a total of 1.7 million new homes will be constructed. With the current pattern of development, this will consume more than 636,000 acres of forests and farmland and will change our natural landscape permanently.

Forest Fragmentation

When large tracts of forest are carved up into smaller and more isolated patches, it leads to what we call forest fragmentation. Forest fragmentation can disrupt animal travel corridors, increase flooding, increase the invasion of non-native vegetation, expose isolated forest interiors and create conflicts between people and wildlife. Forest fragmentation affects water quality, fish and wildlife populations and the biological health and diversity of the forest itself. When many small habitat losses occur over time, the cumulative impact can be as dramatic as one large loss. When habitat is lost and fragmented, wildlife populations decline and some species may be eliminated.

Forest Acreage Declining



Forests provide critical habitat and help prevent pollutants and sediment from reaching the Bay and rivers. About 59% of the Bay basin is currently forested.

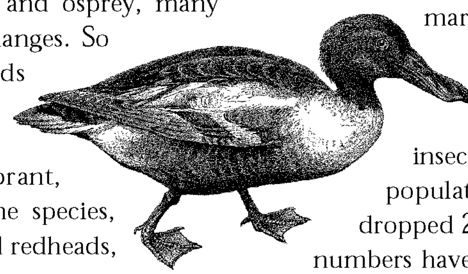
Protect & Restore Riparian Forests

Experts have long known that the forests along streams, rivers and shorelines—known as riparian forests—are especially critical to water quality and stream health. Riparian forests are the last line of defense for protecting waterways from pollution washing off the land. The Chesapeake Bay Program is actively addressing the decline and degradation of streamside forests in the region. In 1996, the Chesapeake Executive Council adopted the *Riparian Forest Buffer Initiative*, a Baywide set of goals and recommendations that some consider the strongest riparian buffer protection and restoration policy in the country. The overall goals are to protect existing buffers throughout the region and to restore 2,010 miles of riparian forests by the year 2010. Involving private landowners in this effort through new incentives and partnerships also is an important part of the buffer initiative.

Ducks, Herons & Egrets

Our Favorite Bay Birds

Think of the Chesapeake Bay and birds will fly through that image. Almost 30 species of waterfowl, including ducks, geese and swans, visit the Bay during winter. Wading birds, such as the great blue heron, are prominent throughout the region. Birds of all sizes are intricately entwined in the Bay's ecosystem and, like eagles and osprey, many are sensitive to environmental changes. So how are the Bay's waterbirds doing? Overall, trends show a mixed picture. Most species show improvement, such as brant, mergansers and canvasback. Some species, including scoters, black ducks and redheads, are down substantially.



Increasing waterfowl populations are not always good for the Bay. In addition to resident mallards, growing populations of resident Canada geese and non-native mute swans harm the ecosystem by consuming food resources such as Bay grasses needed by other waterfowl and by out-competing native species for breeding areas. Humans often don't appreciate large flocks occupying their beaches and ponds, and the increasing bacteria levels in swimming areas and shellfish grounds can be a health hazard. Snow geese populations also have dramatically increased in recent years. They are destroying their tundra breeding areas by eating all the vegetation and increasing erosion. Flocks of snow geese may contain thousands of birds that can destroy large areas of marsh and agricultural crops in a short time.

Wood Ducks and Black Ducks

Wood ducks are beautiful, shy creatures that live and nest in the watershed's forested wetlands, from the Bay's tidal marshes to the smallest tributaries of the watershed. They nest in tree cavities, as well as boxes provided by humans. Their predominantly herbaceous diet includes duckweeds, underwater grasses, acorns and seeds from sedges, grasses and water lilies. Populations have rebounded since the turn of the century, when wood ducks were hunted to near extinction. However, destruction of streamside forests and wetlands due to agricultural clearing, development and timber harvest remains a threat to wood ducks.

Black ducks also nest on the Bay on uninhabited islands, on hunting blinds and in isolated coastal marshes. Like the wood duck, black ducks feed on the many types of plants growing in wetlands and along shorelines, as well as insects and small fish. The wintering population of the Bay black duck has dropped 26% since the 1970s. As black duck numbers have decreased, non-migratory mallard numbers have increased. It is possible that mallards released for hunting are more adaptable and are out-competing black ducks for limited nesting habitat and food resources. Black ducks also are affected by the combination of sea level rise, the degradation and loss of wetlands and coastal marshes, competition with mallards, hunting, and predation by gulls, raccoons and foxes.

Wading Birds

Up to nine species of colonial wading birds nest on the Bay's shorelines. The great blue heron, great egret, snowy egret, cattle egret, little blue heron, green heron, black-crowned night heron, American bittern and glossy ibis are skilled hunters that feed on rodents, fish and insects. The good news is that the numbers of these wading birds did not decline in the past two decades, and great blue heron numbers actually have increased. These wading birds use undisturbed forests near the Bay to build woody nests close to others of their own species. Most species of colonial wading birds forage in wetlands, marshes and tidal pools for fish, crabs, crustaceans, rodents and frogs. Protection of forested nesting areas, coastal marshes and tidal wetlands that provide food for wading birds is key to maintaining healthy populations.

1999 Bay Waterfowl Trends

Our goal is to restore populations and habitats of valuable Bay waterfowl to 1970s levels by the year 2000.

Increasing

	% change since mid-1970s
Mallard (migratory)	14*
Northern Pintail	63
Northern Shoveler	44
Gadwall	975
American Wigeon	93
Green-winged Teal	626
Canvasback	5
Scaup	9
Ring-necked Duck	233
Bufflehead	73
Ruddy Duck	265
Mergansers	420
Brant	546

Decreasing

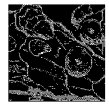
	% change since mid-1970s
Black Duck	-26
Common Goldeneye	-22
Scoters	-60
Oldsquaw	-27
Redhead	-64
Canada Goose (migratory)	-46*
Tundra Swan	-30

Problem Species

Snow Goose	3,447
Mallard (resident)	over 500*
Canada Goose (resident)	over 1,500*
Mute Swan	7,600

***Estimates**

Wetlands: *The Vital Link Between Land & Water*



Wetlands are a vital link between land and water because they help maintain water quality, control flooding and erosion, and provide wildlife habitat. The Chesapeake Bay region has more than 1.5 million acres of wetlands. Basically, they are areas that are flooded or saturated with water long enough to cause plants that grow there to adapt to wet conditions. While some wetlands are obviously wet, such as cattail marshes, many wetlands do not look wet most of the year. For example, water in forested wetlands often is present only during the spring. Although water may not be visible, soils, vegetation and other tell-tale signs of hydrology are used to determine whether or not an area is a wetland.

Population and development pressures are threatening wetlands in all Bay states. For example, about 5 acres per year of estuarine wetlands were lost between 1982 and 1989, and nearly 3,000 acres per year of freshwater wetlands also were lost during that time. Freshwater wetlands, including winter wet woods, are hard to identify and protect, but are just as valuable as the wetlands found along shorelines, close to open water.

Clearly, protecting wetlands is important to maintaining the health of the Bay region. But, this is no easy task given the range of diverse and sometimes contradictory problems that threaten wetlands. In the Bay region, we try to maintain a measure of flexibility when deciding how to protect wetlands and plan to utilize a wide range of strategies to protect them.

Following a 1997 Chesapeake Executive Council directive, the Bay Program partners began developing strategies to identify and track wetlands in the Bay watershed to achieve a net gain in wetlands acreage. Wetlands identification through inventory and mapping is a critical step in protection efforts. Additional protection can be achieved through preservation of existing wetlands; rehabilitation and restoration of degraded wetlands; and education and research. The Wetlands Initiative, a new Bay Program effort, is under way and is designed to assist local governments and watershed groups in wetlands management.

Protecting wetlands is important to maintaining the health of the Bay and its rivers.

WHAT YOU CAN DO

- **Preserve any wetlands on your property, even small areas.**
- **Plant native marsh grasses along shorelines.**
- **Plant native, water-tolerant trees in wet areas.**
- **Encourage your local government to include wetland protection in local land use planning and zoning.**
- **Support strong state and federal wetlands regulatory programs.**

FOR YOUR INFORMATION...

The Effect of Exotic Species

Exotic species, also called non-indigenous or introduced species, are just that—not native to the Bay region. During the summer of 1998, a snail—the Veined Rapa Whelk of Japan - was discovered in Virginia. As with a variety of non-indigenous plants and animals, the Rapa Whelk probably was introduced by accident. And, like other non-native species, its presence here could upset some part of the ecosystem.

Exotic species enter the Chesapeake through unintentional introduction, such as discharge of ballast water from ships or escape from aquaculture facilities. There's also intentional introduction, such as certain sport fish being placed in freshwater streams. Some of the better known exotic species are the tall shoreline plant Phragmites, grass carp, nutria, resident Canada geese, resident mallard ducks and the immense mute swan.

Exotics threaten the Chesapeake ecosystem through disease transmission and competition with native species for food and habitat. For instance, mute swans are detrimental to the Bay system because they tear up huge amounts of underwater grasses, and they produce large amounts of fecal waste that foul the water and shoreline. They also are highly territorial and may prevent black ducks from nesting.

Although beautiful, the mute swan damages the Bay.

What can we do about exotic species? Vigilance is the watchword. In 1993, the Chesapeake Executive Council adopted the *Policy for the Introduction of Non-Indigenous Aquatic Species.* The policy's goal is to minimize the economic or ecological risk associated with first-time introduction of exotic aquatic species in the Bay region. Although regulatory controls currently exist to prevent further introduction of non-native species, public education is the best possible method for controlling accidental and intentional introduction.

Stressors on the System

The Bay's Top Challenges

In this section, we report on the effect of the top four stressors on the Chesapeake system: excess nutrients, toxic chemical contaminants, air pollution and landscape changes. All four influence the health of the Bay, its rivers and the people and animals that call the region home. As shareholders in this effort, you should note that we can only scratch the surface of these complex issues. However, it's important to realize that the efforts to reduce the impacts of these stressors are paying dividends in the form of fewer nutrients and toxics entering the Bay airshed and watershed.

Nutrients

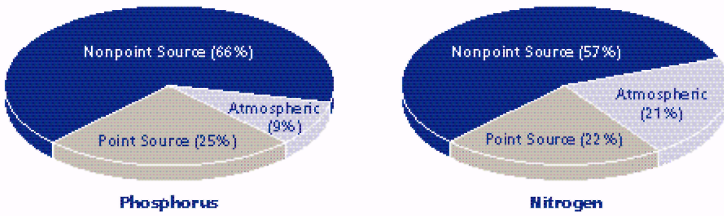
The Chesapeake Bay's worst problems are caused by the overabundance of the nutrients nitrogen and phosphorus, which can come from air, land and water. Excess nutrients cause algal blooms that are rapid, uncontrolled growth of microscopic plants in the water. Algal blooms harm the system in two ways. First, they cloud water and block sunlight, causing underwater Bay grasses to die. Second, when algae die and decompose, they use up the oxygen needed by other plants and animals living in the water.

Sources of Nutrients:

Point & Nonpoint

In the Bay region, excess nutrients are supplied to the system through two sources: point and nonpoint sources. A point source is a specific location or point of entry, such as a pipe, where nutrients enter waterways. Point sources, like industrial sites and wastewater treatment facilities, are usually regulated. Nonpoint sources deliver nutrients from broad areas of the watershed. For example, storm water picks up nutrients from cities to rural areas as it pours over roofs, through suburban developments, over eroding streambanks, through farm fields and into rivers. However, people's everyday activities, like driving an automobile, also are a major contributor to nonpoint sources of pollution.

Sources of Nitrogen & Phosphorus Pollution to the Bay: 1996



Nutrient pollution seeps into the groundwater, runs off the land when it rains, and enters streams, rivers and the Bay from two major sources: nonpoint and point sources.

Nutrient pollution also enters the air, from both point and nonpoint sources, and then falls onto the land and water.

The TECHNICAL CONNECTION

Computer Modeling:
Cutting-Edge Science & Technology

Bay managers and scientists need a way to predict changes in water quality, as well as responses from living resources, when nitrogen and phosphorus levels decline. Computer models, verified using years of monitoring data, can help make those predictions. Chesapeake Bay Program scientists and other experts developed three integrated, cutting-edge computer models to track changes. The Watershed Model, the Bay Water Quality Model and the Regional Atmospheric Deposition Model give a picture of how the watershed, airshed and estuary interact. The models are used to pinpoint the amount of nutrients contributing to the Bay's water and air pollution problems. The Bay ecosystem models also are beginning to explore how nutrient reductions may affect plant and animal interactions and the health of the estuary.

Making Progress:
The Year 2000 Goal

The most important goal set by the Chesapeake Bay Program is the 40% reduction of the controllable loads of nitrogen and phosphorus entering the Bay by 2000. In 1997, after reevaluation, the Bay Program concluded that we would meet the phosphorus goal, but would fall short of the nitrogen goal unless reduction efforts were accelerated. More specifically:

Phosphorus — It's estimated that between 1985 and 1997, flow-corrected loads delivered to the Bay from all its tributaries declined six million pounds per year. We need to reduce phosphorus loads by an additional one million pounds.

Nitrogen — Estimates show that between 1985 and 1997, flow-corrected loads delivered to the Bay from all its tributaries declined 32 million pounds per year. We need to reduce nitrogen loads by an additional 40 million pounds.

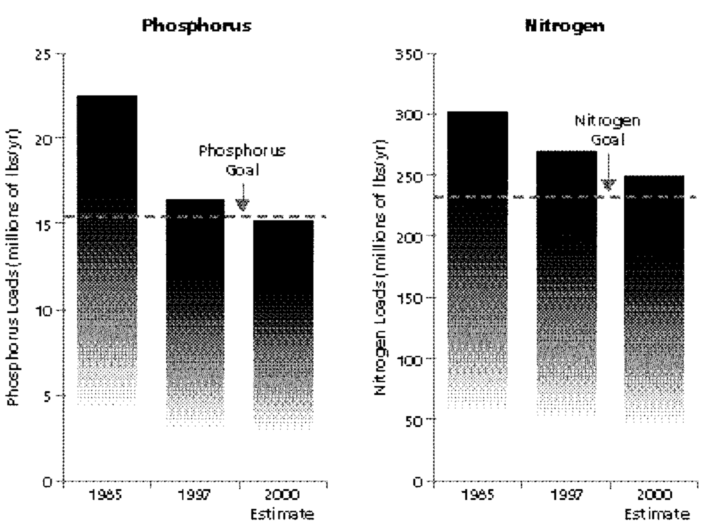
Making Progress:
Reducing Nutrients from Point Sources

Nutrient loadings from point sources are being reduced by actions implemented at both industrial and municipal facilities. Future reductions will come from the implementation of biological nutrient removal, also called BNR, at a large number of major municipal facilities. A relatively new technology, BNR has proved to be extremely effective in reducing nutrients. Historically, the focus of conventional wastewater treatment has been on the removal of organic content from wastewater. BNR is unique because it removes nutrients from the wastewater by adjusting the facility's biological processes.

For phosphorus, estimates show that point source loads were reduced by five million pounds between 1985 and 1997. Most of this reduction was due to the implementation of phosphate detergent bans that went into effect in each of the states and the District between 1985 and 1990, plus wastewater treatment upgrades and the implementation of effluent standards for phosphorus.

Bay managers also measured major reductions in point source nitrogen loads. Between 1985 and 1997, nitrogen loads from point sources were reduced by approximately 16 million pounds. Between 1985 and 1998, 43 major municipal wastewater treatment facilities in the watershed upgraded to BNR. This advanced technology reduces effluent concentrations and keeps the municipal loads in check, in spite of population increases in the region.

Nutrient Pollution Declining, but We Still Need to Do More



Total Nutrient Pollution Delivered to the Bay from All Bay Tributaries (MD, PA, VA, DC)

- Results from computer modeling show that phosphorus loads delivered to the Bay from all of its tributaries declined 6 million pounds per year between 1985 and 1997. We expect to reach the goal by 2000.
- Nitrogen loads declined 32 million pounds per year. More will need to be done in order to meet the goal by 2000.
- Maintaining reduced nutrient levels after 2000 will be a challenge due to expected population growth in the region.

BIOLOGICAL NUTRIENT REMOVAL: *Winning the Wastewater Battle*

A normal byproduct of everyday living is nutrient-rich organic waste. More specifically, human waste or sewage. Because of the growing population in the Chesapeake Bay watershed, the introduction of effective sewage or wastewater treatment processes have been a priority for officials concerned about protecting human health and water quality. Currently, about 22% of the total nitrogen load to the Bay comes from point sources including the municipal facilities that treat sewage and wastewater from industrial facilities.

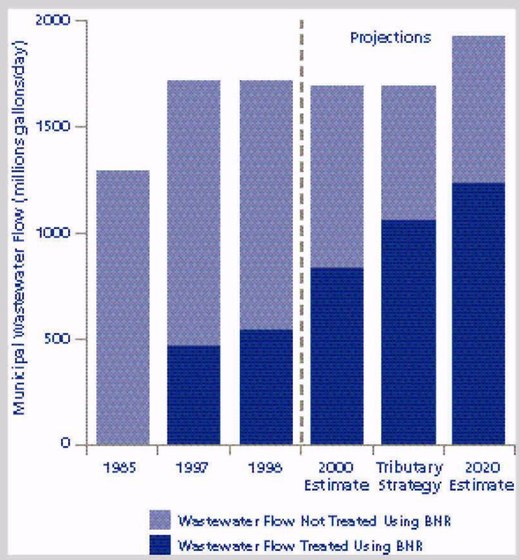
Through 1998, biological nutrient removal (BNR) was installed in 43 of the major municipal wastewater treatment plants in the Chesapeake region with excellent results. The major facilities are plants that treat more than a half million gallons of wastewater per day. One is the Blue Plains Wastewater Treatment Plant in the District of Columbia, where the immediate benefits of BNR installation are exceeding expectations. Located on the Potomac River, Blue Plains is the largest municipal wastewater treatment facility in the Bay region and the single largest source of nitrogen loadings to the Bay. This facility treats up to 370 million gallons of wastewater per day.

The Blue Plains BNR demonstration project is designed to treat half the plant's flow. Without BNR, Blue Plains would discharge 12.9 million pounds of nitrogen annually to the Potomac. With BNR, the plant has reduced nitrogen discharges by at least three million pounds per year. In 2000, when BNR goes full scale, the nitrogen reductions will double.

In 1998, Virginia officials announced a plan to spend about $40 million to improve pollution controls at wastewater treatment plants in Northern Virginia and in the Shenandoah Valley. Improvements will include the installation of new technologies, including BNR. The bulk of the upgrades will occur at plants located along the Potomac River, in densely populated Northern Virginia. The upgrades at these plants are expected to be in place by 2002, and experts project a nutrient load reduction of as much as 3.4 million pounds annually once the projects are complete. By 2003, almost 100 major municipal wastewater treatment facilities will have BNR treating a total of 63% of the wastewater flow in the region.

Through 1998, biological nutrient removal (BNR) was installed at 43 of the major municipal wastewater treatment plants in the Chesapeake region with excellent results.

REDUCING NUTRIENT POLLUTION USING BIOLOGICAL NUTRIENT REMOVAL (BNR)



In 1998, 31% of the flow from major wastewater treatment facilities was treated using BNR technology for nutrient removal. 49% of the flow will be treated using BNR by the year 2000. 63% of the flow will be treated using BNR after Tributary Strategies are fully implemented.

Making Progress:
Reducing Nutrients from Nonpoint Sources

Nutrient loadings also are being reduced and prevented through implementation of a range of nonpoint source management practices and control techniques. Overall, through 1997, nonpoint source phosphorus loadings are estimated to have decreased more than one million pounds per year. Nitrogen loadings delivered to the Bay from nonpoint sources are estimated to have decreased by 16 million pounds per year through 1997. The majority of the nonpoint source loading reductions for nitrogen and phosphorus anticipated by 2000 will come from those Chesapeake basins with tributary strategies in place.

For Your Information...
Best Management Practices

Best management practices (BMPs) are designed to reduce or prevent nonpoint source runoff of nutrients. Several examples of the more widely applied practices include:

- **Agricultural Practices**: These BMPs include a range of different activities that reduce or eliminate soil loss and provide for the proper application rates of nutrients to cropland. Practices include vegetated buffer strips at the edge of crop fields, conservation tillage, strip cropping, diversion and waterways, nutrient management and stream bank fencing.
- **Animal Waste Management Practices**: They include state of the art animal waste management systems, such as manure storage structures, runoff controls for barnyards, guttering and nutrient management. These systems address the handling, storage, transport and utilization of animal waste as fertilizer on cropland.
- **Riparian Forest Buffers and Other Buffers**: Forested and other vegetated buffers serve as a trap for nutrients and sediment from upland sites.
- **Stream Protection Practices**: These include stream bank fencing and alternative watering sites so livestock access to the stream is restricted.
- **Urban Practices**: These BMPs include erosion and sediment controls on areas under development and storm water controls in developed areas. These practices are applied across a broad spectrum from industrial, commercial and residential facility construction sites to the management of lawns and open spaces, reducing nutrient runoff.

Nutrient Management:
Certification Programs are the Key

Agricultural nutrient management is a good example of how Chesapeake Bay area farmers have joined the effort to reduce nutrients. Nutrient management matches the amount of nutrients farmers put on crops with how much is really needed. In the suburban/urban environment, nutrient management limits fertilizer use on lawns, gardens and recreation areas. The goal is to maintain crop yields or green lawns, while minimizing the amount of nutrients washing away and entering surface or groundwater. In many cases, nutrient management lowers fertilizer costs and may result in higher profits for farmers.

Since 1995, the Bay Program partners have worked together to develop nutrient certification programs. By 1997, all three states had successful agricultural nutrient management certification and education outreach programs in place. The result has been one of the most successful voluntary nutrient management programs in the country. To date, more than 400 public and private nutrient management planners from six states have been trained and certified, and this certification is reciprocal among the states. Nutrient management plans were written in 1997 for approximately 1.7 million acres of agricultural land. By the year 2000, it's projected that more than 3 million acres of agricultural land in the Chesapeake region will be under nutrient management plan recommendations.

WHAT YOU CAN DO

- **Use BayScape techniques on your yard, including native vegetation that requires less fertilizer, pesticides and water.**
- **Start a compost pile to reduce the amount of waste you put into the garbage disposal.**
- **Maintain your septic system by having it pumped out every three to five years.**

MAKING PROGRESS: *Tributary Strategies*

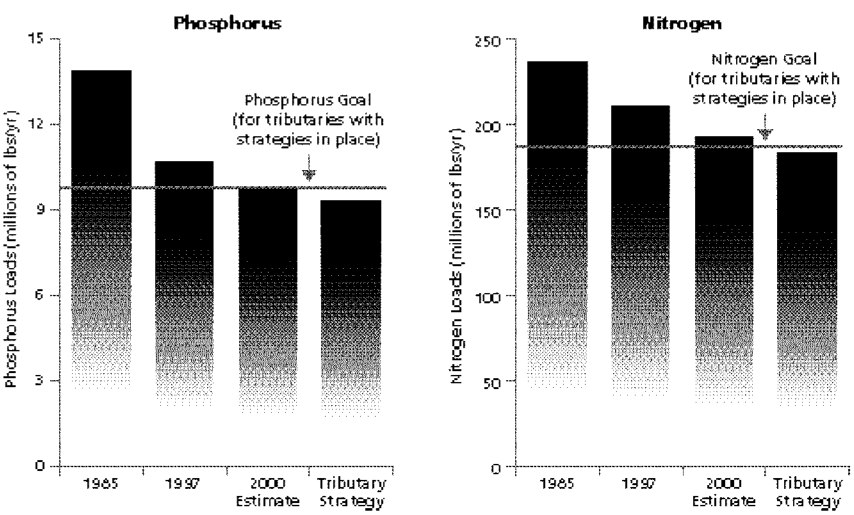
Tributary strategies are nutrient reduction plans for each of the Chesapeake Bay watershed's major tributary basins. The momentum for tributary strategies was sparked in 1992 when the Chesapeake Executive Council made a commitment to attack nutrients at their source - upstream in the Bay's tributary rivers. As a result, Pennsylvania, Maryland, Virginia and the District of Columbia began developing strategies to achieve specific nutrient reduction targets for the nine major tributary basins. In 1997, the Bay Program calculated the nutrient reduction progress in areas where tributary strategies were in place from the Potomac River north. Where strategies are not yet in place, there are statutory deadlines to complete them and to set appropriate goals.

MAKING PROGRESS: *How Have We Done So Far?*

For phosphorus, the latest computer model estimates show we will achieve by 2000 the four million pound nutrient reduction goal identified by the Bay Program for basins where tributary strategies are in place. For nitrogen, the latest model estimates show that, by 2000, we will be within four million pounds per year of the 50 million pound per year reduction goal identified by the Bay Program for basins where tributary strategies are in place. The tributary strategies are projected to achieve the goal when fully implemented, but have fallen behind the 2000 deadline in some areas. The challenge is to identify opportunities to accelerate our actions to achieve the nitrogen goal by 2000.

In tributaries south of the Potomac, where the 40% goal is interim, tributary strategies will be completed in the summer of 1999. Strategies are being developed for the Rappahannock, York and James rivers and for the Eastern Shore.

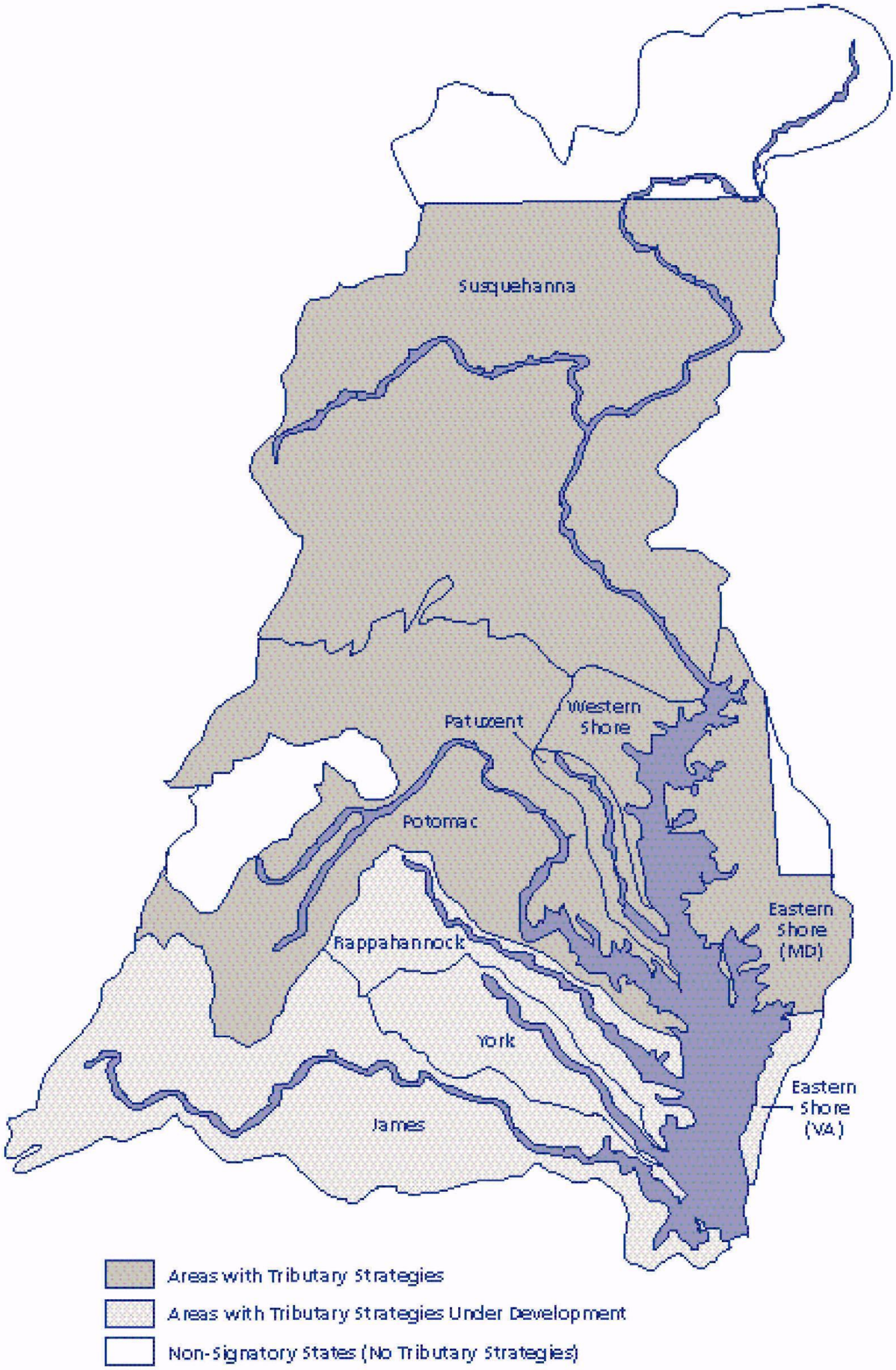
NUTRIENT REDUCTIONS ARE BEING ACHIEVED THROUGH THE TRIBUTARY STRATEGIES



TOTAL NUTRIENT POLLUTION DELIVERED TO THE BAY FROM BASINS WITH TRIBUTARY STRATEGIES (MD, PA, VA, DC)

- Results from computer modeling show that in areas of the Bay where tributary strategies have been implemented phosphorus loads declined 3 million pounds per year between 1985 and 1997. We expect to reach the goal by 2000.
- Nitrogen loads declined 26 million pounds per year. We expect to reach the goal through tributary strategy implementation, however, more will need to be done in order to meet the goal by 2000.

CHESAPEAKE BAY WATERSHED: AREAS WITH TRIBUTARY STRATEGIES



Toxic Chemicals/Chemical Contaminants

Another major stressor to the Chesapeake Bay is toxic chemicals. By toxic chemicals, we mean the chemical contaminants that harm plants, animals, fish and humans. Toxic chemicals are not nutrients, and they do not affect the Bay system the same way nutrients do. The nature, extent and severity of toxic effects vary widely throughout the Chesapeake system. A few areas, called Regions of Concern, have serious, localized problems; some other regions show evidence of toxic effects. Overall, however, there is no evidence of severe, system-wide toxic problems.

In order to reduce chemical releases, Bay managers are working to identify and target sources of chemical contaminants. Like nutrients, toxic chemicals enter the system from point and nonpoint sources. For example, manufacturing processes we have come to rely on for products often involve the use of potentially harmful chemicals. Also, many everyday household cleaning and pest control products contain toxic ingredients. Exhaust from automobiles and emissions from fossil fuel power plants also contain toxic chemicals. Although we do not know as much about the sources of chemical contaminants as we do about the sources of nutrients, scientists and managers agree that:

- Point sources, such as industries and wastewater treatment plants, are not always the biggest source of chemical contaminants to the Bay and rivers.
- Nonpoint sources, such as urban and suburban storm water runoff, are significant sources of chemical contaminants.
- Air pollution is a source of chemical contaminants.
- The primary sources of chemical contaminant loads to the Bay vary depending on the chemical.
- Sources of chemical contaminant loads vary by watershed.

Scientists and Bay managers also agree that as tough controls continue to be applied to point sources, the importance of controlling nonpoint sources of contaminants will increase.

Based on the goal of a toxics-free Bay, Chesapeake Bay Program partners have been working to reduce or eliminate the input of chemical contaminants from all controllable sources to levels that result in no toxic impact on the Bay's living resources or on human health.

To better understand, control and reduce toxic pollution in highly impacted areas, the Bay Program designated three Regions of Concern in 1994. These regions—Baltimore Harbor in Maryland, the Anacostia River in the District of Columbia and the Elizabeth River in Norfolk, Virginia—are the areas with the most severe known toxic problems (hot spots). In 1996, the Bay Program adopted Regional Action Plans for the reduction and elimination of toxic impacts in these areas. Maryland, Virginia and the District worked with local stakeholder groups to clearly define chemical contaminant problems and implement viable options for reducing and preventing more pollution in these areas. In 1997, studies began in the three regions as part of the ongoing toxic research program. Outside of the Regions of Concern, the Bay Program has collected and analyzed data on the toxic conditions in water, sediment and fish tissue. The data reveals that there are no new hot spots, but there are areas where there is potential for toxic problems (warm spots). There also are areas where there are no toxic problems or where there is insufficient data to label a region. This new characterization of the Bay's tidal rivers will help managers better target prevention and reduction efforts.

Pollution from Industry

As a result of the Bay Program's toxics reduction efforts, pollution prevention activities have increased, and chemical releases from industry have declined. The latest Toxics Release Inventory, a report published annually by the EPA, shows that Bay basin industries cut their releases of certain chemicals by 67% between 1988 and 1997. That report confirms that industry already has met a voluntary Bay Program goal of reducing chemical releases and transfers by 65% basinwide by 2000. The Bay Program is working with industry representatives to set a new goal.

Toxics of Concern

In 1990, Bay Program managers identified 14 chemicals considered to be the most harmful to the Bay's aquatic life. These chemicals were grouped together on the Toxics of Concern list. They are atrazine; benz[a]anthracene; benzo[a]pyrene; cadmium; chlordane; chromium; chrysene; copper; flouranthene; lead; mercury; naphthalene; PCBs; and tributylin (TBT). The Bay Program has set a goal calling for a 75% reduction in the releases of Toxics of Concern chemicals from point sources between 1988 and 2000. As with the other Baywide reduction goals, it is difficult to track progress toward this goal because only eight of the 14 Toxics of Concern are included in the national Toxics Release Inventory report. The most recent national report showed that releases of the eight Toxics of Concern chemicals it tracks decreased 29% between 1988 and 1997.

For Your Information...

Pesticide Disposal

Maryland, Pennsylvania and Virginia are working to prevent pollution by implementing pesticide collection and disposal programs throughout the region. Between 1990 and 1998, more than 1.1 million pounds of pesticides were disposed of and nearly 600,000 pesticide containers were collected and recycled.

For Your Information...

Integrated Pest Management

Integrated pest management, or IPM, is a pollution prevention technique that can help farmers, growers, and other pesticide users minimize economic, health, and environmental risks resulting from pesticide use. In 1997, IPM was practiced on 4.4 million acres, or 61%, of the cropland in the Bay watershed. The Bay Program's IPM goal calls for 75% of all agricultural, recreational, and public lands in the basin; 50% of all commercial land; and 25% of all residential land to be under IPM by the year 2000.

Businesses for the Bay:
A Voluntary Program that Works

Businesses for the Bay is a voluntary, non-regulatory pollution prevention program developed by the Chesapeake Bay Program in cooperation with industry. The goal of the program, which started in 1996, is prevention of toxic chemicals from point sources. Businesses, as well as federal, state and local government facilities, are encouraged to develop their own annual pollution prevention commitments, which range from activities such as educating employees about pollution prevention to changing manufacturing processes to reduce wastes. Businesses for the Bay spreads the pollution prevention message through a Mentor Program. Mentors from participating facilities volunteer their pollution prevention expertise to help other facilities in need of technical assistance. Through pollution prevention efforts, participants save money through increased production efficiency and reduced waste disposal costs. More than 250 participants have joined the program and at least 90 individuals are volunteering as mentors. Business for the Bay has been recognized as a unique way to partner with the private sector. It has won two national awards and one regional award.

WHAT YOU CAN DO

- **Use safer, non-toxic alternatives for cleaning and controlling pests.**
- **Take household chemicals to a recycling center instead of pouring them down drains or putting them in the trash.**
- **Use less water at home. That means less will have to be treated at your local wastewater facility.**
- **Purchase energy efficient home appliances.**
- **Purchase products made from recycled materials and that use less packaging.**

Air Pollution

Air pollution now is recognized as a major stressor on the Chesapeake Bay system. Air pollution contributes nitrogen and toxic chemicals directly to the waters of the Bay and to land. The Chesapeake Bay Program is at the leading edge of identifying the sources of atmospheric nitrogen. However, the sources of toxic air pollution are harder to identify, and the Bay Program is just starting to get a handle on it. Determining the sources for air pollution is significant because reductions in air pollution can have a direct effect on improvements in water quality. With this connection in mind, resource managers are beginning to factor air pollution into their decisions about water quality improvements.

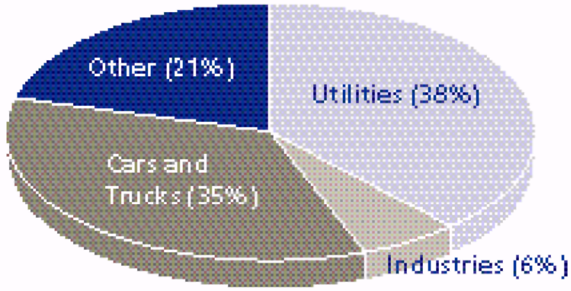
The Bay's nitrogen oxide airshed is approximately 418,000 square miles—six and a half times the size of the watershed. Current modeling efforts estimate that a quarter of the nitrogen delivered to the Bay comes from the air. About 75 percent of that airborne load is deposited on land and then is transported to the Bay by surface water runoff and groundwater flow. The remaining 25 percent is deposited directly on the water.

Computer models also show that a majority of the nitrogen deposited from the air to the Bay and its watershed comes from combustion. There are three different categories for the sources of combustion: stationary, mobile and area sources. Stationary sources include electric power plants and factories; mobile sources include automobiles, boats, ships and airplanes; and area sources include machines like lawn mowers and heavy construction equipment. Nitrogen compounds also are emitted by agricultural sources from activities such as fertilizer application and animal waste storage practices. Depending on wind patterns and weather conditions, nitrogen compounds can travel short or long distances through the air before being washed out in rain or snow (wet deposition) or before falling directly to the ground (dry deposition). Wet deposition is measurable, but dry deposition is difficult to measure. It's important to note that even if the pollution does not fall directly on water, it can be transported to the Bay and rivers by surface water runoff or through groundwater flow.

The Bay Program is working to reduce air pollution and its effect on the Bay system. Currently, Bay Program managers are using advanced computer model simulations to measure the benefits that will come from air pollution regulations included in the 1990 *Clean Air Act Amendments*. The latest computer modeling results show that when current control actions are fully implemented in about ten years, they should reduce the amount of nitrogen entering the Chesapeake by more than ten million pounds annually. Emissions of chemical contaminants also are expected to be significantly reduced as control standards are developed and put in place. In the meantime, the Bay Program will continue to promote air pollution prevention and control actions on the state level because these will yield maximum benefit to the Bay and the region's air quality.

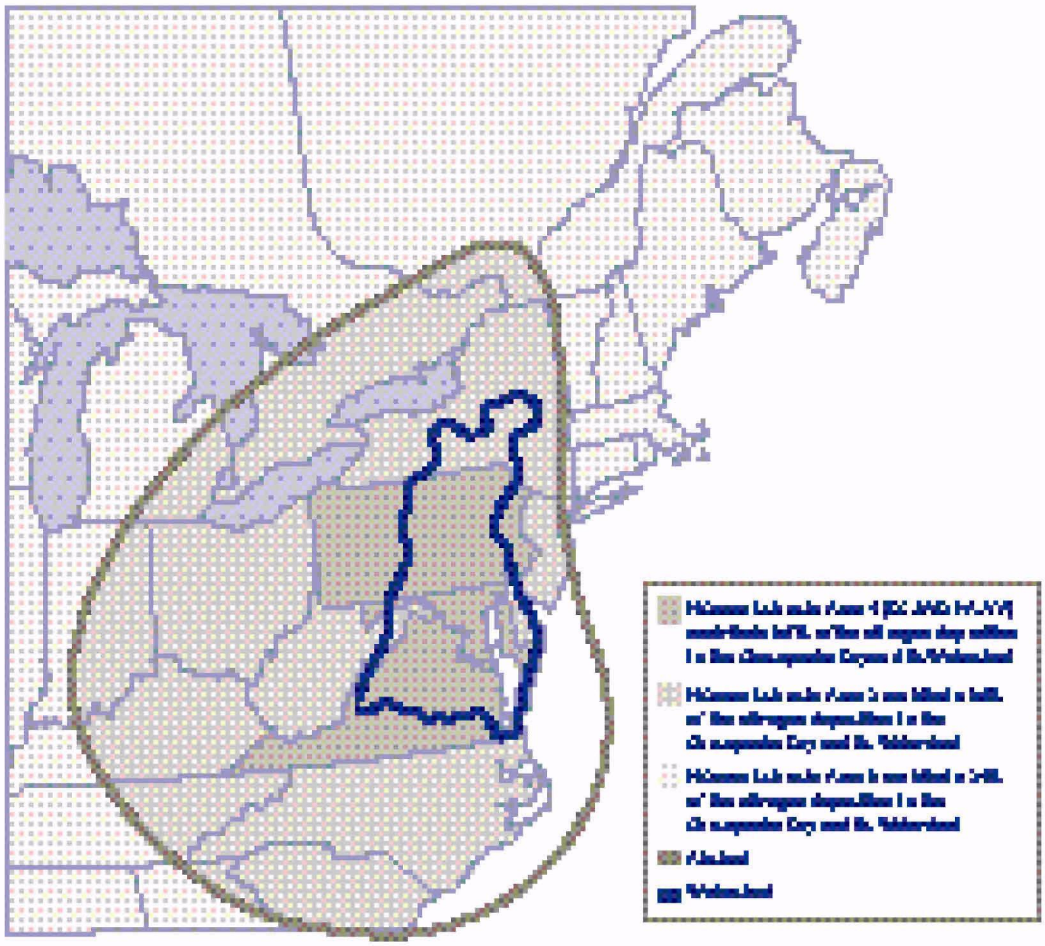
In addition, the EPA has issued its first-ever action to force air pollution reductions on upwind states to improve downwind air quality. When fully implemented, the action is projected to significantly reduce nitrogen oxide emissions from various sources. This could translate into a reduction of hundreds of thousands of pounds of nitrogen deposition to the Bay.

Types of Nitrogen Oxide Emission Sources from States* that Contribute the Most Nitrogen Deposition to the Bay & its Watershed



*MD, VA, PA, NY, WV, NJ, OH

Areas of Nitrogen Oxide Emissions that Contribute Nitrogen Deposition to the Chespeake Bay & its Watershed



Between 1970 and 1997, vehicle miles traveled increased at four times the rate of population in the Bay region. Pollution from car exhaust and sprawling development harms the Bay.

WHAT YOU CAN DO

- **Reduce the amount of miles you drive. This will result in reductions in the amount of nutrients and toxic substances entering the watershed.**
- **Maximize fuel efficiency by keeping your car maintained and by properly inflating tires. Also follow your state's guidelines on emissions testing.**
- **Conserve electricity. This will result in reductions in the amount of nutrients and toxic substances entering the watershed from power plants that burn fossil fuels.**

LANDSCAPE CHANGES

We call the fourth major stressor affecting the Chesapeake system landscape changes. We mean the changes to land brought about by human activities. Those changes include the loss of wetlands, forests, farms and other open space to development. They also include the most costly development pattern of all—sprawl. Most of these landscape changes place an incredible amount of stress on an already over-stressed system. Put simply, these changes threaten to undo more than 25 years of environmental improvements in just a few short years. In this section, we report on the enormous population growth in the Bay region since 1970 and the dramatic changes in land development patterns that this boom created. We also explore the positive changes a smart growth or sustainable development approach could bring to the region. The Bay Program goal is to conserve and increase wetland and forest land uses, while reducing the water quality impacts of urban development and agriculture.

POPULATION BOOM

It's no secret that population pressure is changing the Chesapeake landscape. These pressures are helping to produce or lead to much of the excess nutrient load, including air pollution, that affects the Bay. Between 1970 and 1997, the population in the Chesapeake region grew 28% to 15.1 million people. Experts predict that the Bay region's population will continue to grow at a rate of 300 new people each day. In order to handle all these people, more homes will be built. And, if the current development pattern holds, many of these new houses will be located farther away from existing infrastructure, such as schools, businesses and wastewater treatment facilities. This pattern of sprawl development has taken hold all over the Bay region and now ranks among the top threats to the Bay's recovery.

PATTERNS CHANGE

Sprawl development is relatively new to the Bay region. Back in the 1800s and early 1900s, compact towns and cities, surrounded by farms and forests, dotted the watershed. After World War II, the automobile made it easy to live out of town and suburbia was born. Suburban development often is characterized by low-density, single-use patterns. These patterns separate households from other community needs such as businesses, schools and jobs. While urban and suburban land acres increased between 1985 and 1997, this type of development consumed farms, wetlands and forests at a rate of roughly 35,000 acres per year during that period.

Sprawl is costly in terms of its impact on the Bay ecosystem because it increases impervious surfaces such as roads, parking lots and rooftops. When it rains, pollutants from impervious surfaces run into drainage systems which often lead directly to streams, rivers and the Bay. The runoff does not filter through the ground like it would in a natural setting, such as forests. The runoff from suburban streets and rooftops adds excess nutrients, toxics and sediment directly into the system with devastating effects. For example, a recent study showed that sprawl patterns produce from five to seven times the amount of sediment and phosphorous as a forest.

SPRAWL & AIR POLLUTION

Sprawl development patterns also increase traffic and, ultimately, the amount of air pollution that falls on land and in water. Because the density of sprawl development is usually too low to support mass transportation, the car is usually the only means of transportation to work, school and shopping. That means more people are commuting farther every year to reach jobs and basic services. They also are spending more time in the car as increased congestion slows the flow of traffic. In the case of the Bay region, the number of vehicle miles traveled in the watershed increased at four times the rate of population growth between 1970 and 1997.

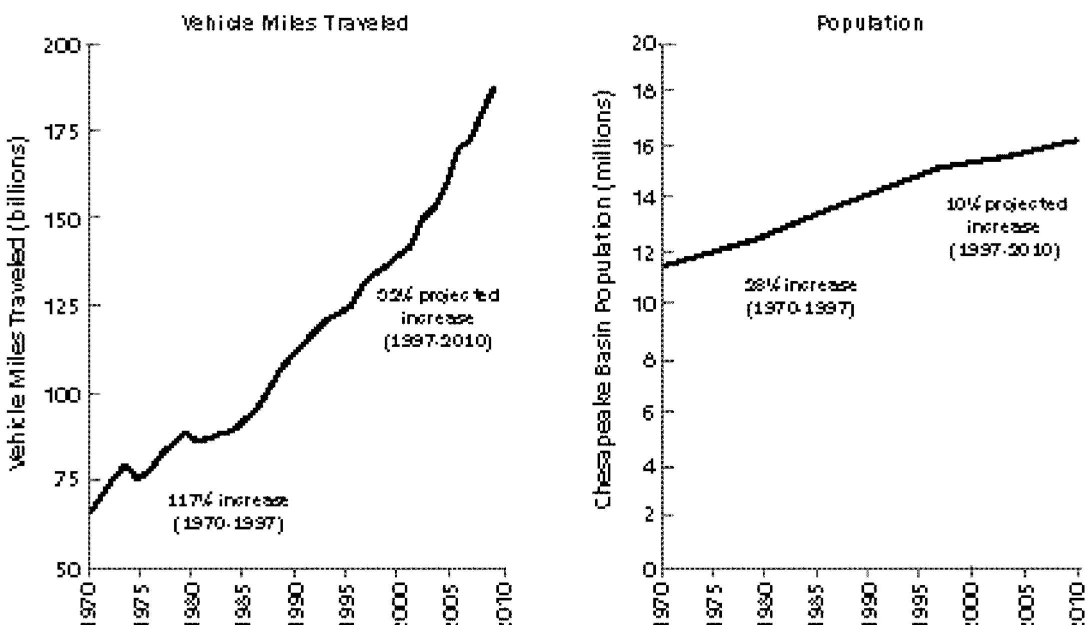
Sustainable System

In 1987, the World Commission on Environment and Development published a report titled *Our Common Future*. In it, the concept of sustainable development was defined as "the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs." With our current development patterns and lifestyle choices, we are in danger of losing the character, beauty and resources that initially made the Bay region so attractive. More efficient, or sustainable, development patterns would help protect natural areas and traditional uses of land, including farming and forestry. These development patterns are less costly to local governments because they require fewer municipal services such as roads and sewers. These patterns also enhance the quality of life by maintaining open space and by conserving those historic and cultural resources that are so much a part of community identity.and protection effort at the community level. Warwick Township in Lancaster County, Pennsylvania was the site of the first pilot project held April 1998. Plans are under way to conduct reviews in Maryland and Virginia.

WHAT YOU CAN DO

- **Get involved in local organizations that monitor land management and participate in efforts to manage growth.**
- **Encourage government officials to improve existing infrastructure instead of building new roads, schools and other facilities, and encourage them to engage citizens in growth management decisions.**
- **Plant trees, especially in areas near waterways. This will not only help reduce soil erosion and nutrient and toxic inputs to the watershed, but also will provide habitat for many creatures that live in the watershed.**

People are Driving Farther to Reach Jobs & Services



Between 1970 and 1997 vehicle miles traveled increased at four times the rate of population in the Bay region. Pollution from car exhaust and sprawling development harms the Bay.

Chesapeake Bay Community Partnerships

The Bay Program is working hard to help local and state governments in the region grow in ways that support sustainable development. In 1996, the Executive Council adopted the *Priorities for Action for Land, Growth and Stewardship* to help meet the challenges posed by population growth and development. The *Priorities* represents a new way to meet these challenges in a manner that is sensitive to local issues and autonomy. This approach recognizes that communities are the basic unit for addressing growth, land use and long-term stewardship of the natural environment. The goal of the *Priorities* is "... to encourage sustainable development patterns that integrate economic health, resource protection and community participation." They are voluntary actions that are expected to be accomplished through a variety of public and private partners, including the Bay Program.

Countryside Stewardship Exchange: The Exchange encourages communities to develop solutions for managing growth, maintaining community character and achieving sustainable economies. Seven communities in Pennsylvania, Maryland and Virginia have received Countryside Stewardship Exchange assistance.

Sacred Places: Sacred Places workshops help communities identify those natural, cultural and economic resources that create a sense of place—the community's Sacred Places. Sacred Places workshops have been held in Union County, Pennsylvania and in Rockbridge County, Virginia.

Heritage Tourism Plans: The Bay Program assisted three Maryland communities to develop Heritage Tourism Plans: Southern Maryland, Havre de Grace and Dorchester County. The plans will help the communities leverage funding to promote and protect their natural resources.

Chesapeake Bay Partner Communities: The Chesapeake Bay Partner Communities Program recognizes local governments that have demonstrated a commitment to protecting the Bay through their policies, local ordinances and operating practices. In 1997, 28 Bay Partner Communities were recognized in Maryland, Pennsylvania and Virginia and, in 1998, 14 were honored.

Small Watershed Grants Program: The Small Watershed Grants Program provides funds to communities undertaking small-scale demonstration projects in the Bay region. In the program's first year in 1998, there were 37 grants recipients.

Five Star Restoration Grant Program: Five Star Restoration projects involve at least five different private, public or governmental partners that support wetland and streamside restoration efforts. In 1999, a total of $395,000 was awarded to approximately 40 conservation projects.

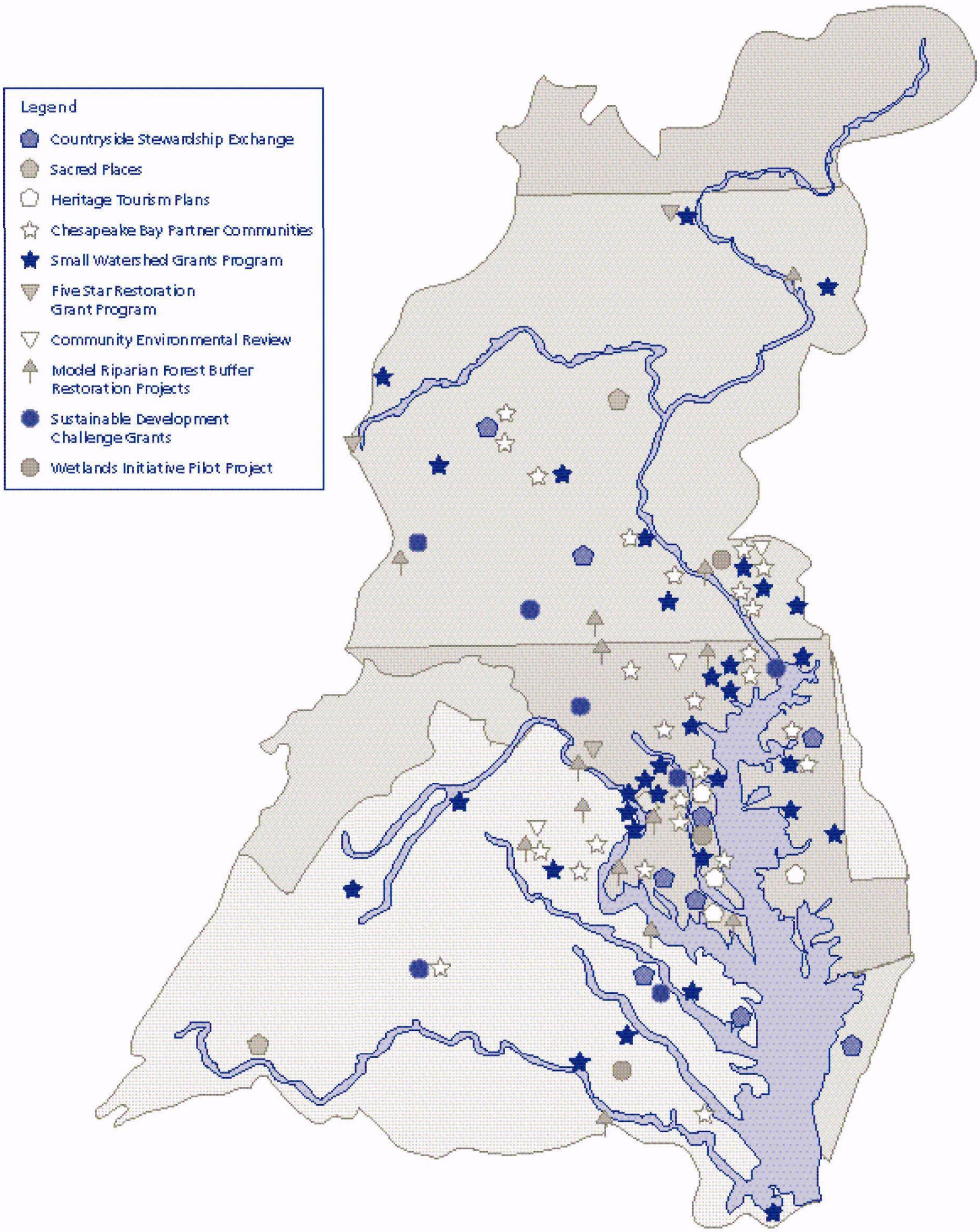
Community Environmental Review: The review is related to the Chesapeake Bay Partner Communities Program. It is designed to increase the involvement of local governments in the Bay restoration and protection effort at the community level. Warwick Township in Lancaster County, Pennsylvania was the site of the first pilot project held April 1998. Plans are under way to conduct reviews in Maryland and Virginia.

Model Riparian Forest Buffer Restoration Projects: In 1996, the Executive Council set a Baywide goal of the restoration of 2,010 miles of riparian or streamside forest buffers by the year 2010.

Sustainable Development Challenge Grants: Started in 1996, this program provides an opportunity to develop locally oriented approaches that link environmental management and quality of life activities with sustainable development and revitalization.

Wetlands Initiative Pilot Project: The Wetlands Initiative, a new Bay Program effort, is under way. In 1997, pilot projects were launched in Pennsylvania's Lititz Run, Maryland's Hunting Creek and in Virginia's Chickahominy River watershed.

Chesapeake Bay Community Partnerships



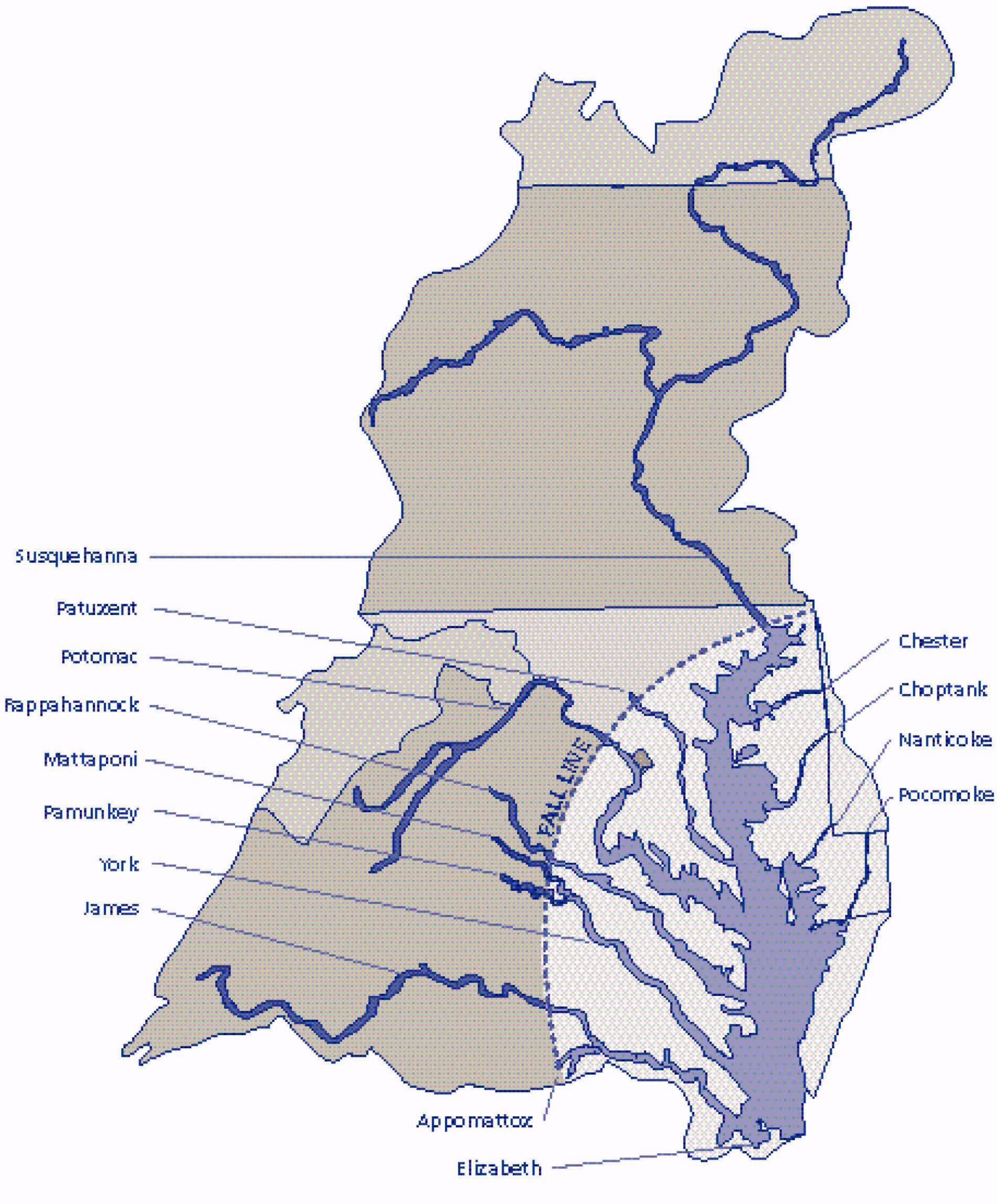
Water Quality in the Rivers & Main Bay

We've explained that each year, millions of pounds of nutrients are removed from the system, but what do these reductions mean? In broad terms, management actions taken between 1985 and 1997 in controlling nutrients have resulted in better water quality in the Chesapeake Bay system.

Top Findings: Non-tidal portions of many of our rivers were running cleaner in 1997 than they were in 1985. And, lower levels of nitrogen and phosphorus were measured in portions of the tidal rivers and main Bay between 1985 and 1997. However, the opposite was true for other portions.

Before we move into specific measurements, let's take a step back to understand that the Bay is not just one body of water; it's a large mainstem with many tributary rivers flowing into it. Every part of the Bay system responds differently to nutrient reduction efforts and to the forces of Mother Nature. So, for the purposes of monitoring and reporting on the health of the Bay and rivers, we've created two sections in this chapter: first the upstream, non-tidal portion of the system and, second, the downstream, tidal portion including the main Bay.

The Chesapeake Bay Watershed & its Major Rivers



The Chesapeake Bay watershed is 64,000 square miles. The natural break separating the non-tidal and tidal portions of the Bay system is called the fall line. Upstream of the fall line, the rivers are free-flowing and not affected by tidal flow. It consists completely of freshwater. Downstream of the fall line, the rivers and the main Bay are affected by the natural tidal flow from the Atlantic Ocean, and they are generally a mixture of salt and freshwater.

Non-Tidal Rivers

In this section, we report on nitrogen, phosphorus and sediment levels in the non-tidal rivers. **Top Finding**: Latest results show that flow-adjusted [see high flows sidebar] nitrogen, phosphorus and sediment levels declined between 1985 and 1997. All of these declines are significant because they mean that management actions are having a positive effect and are leading to improved water quality in the non-tidal portions of the rivers.

- **Susquehanna River**: At the very top of the Bay system is the Susquehanna River. As the Bay's largest tributary, it supplies approximately 50% of the freshwater flow to the Bay. Long-term water quality monitoring of the river indicated significant decreases in nitrogen levels throughout the river. Decreases in phosphorus levels also occurred in the central and southern areas of the river. Sediment levels also declined in portions of the river. These water quality improvements in the Susquehanna reflect the cumulative impact of better land management practices, wastewater treatment plant upgrades and the phosphate detergent ban.

  While the improvements are good news, a troubling issue is the capacity of the Susquehanna's large hydroelectric dams to continue to trap phosphorus-rich sediment and prevent its flow downstream. These dams, which have been in place since the 1920's, may completely fill in and lose their sediment-trapping capacity in another 15 to 20 years. This would cause the amount of phosphorus-rich sediment entering the Bay to increase substantially.

- **Patuxent River**: Nitrogen, phosphorus and sediment levels in the non-tidal portion of the Patuxent River declined.

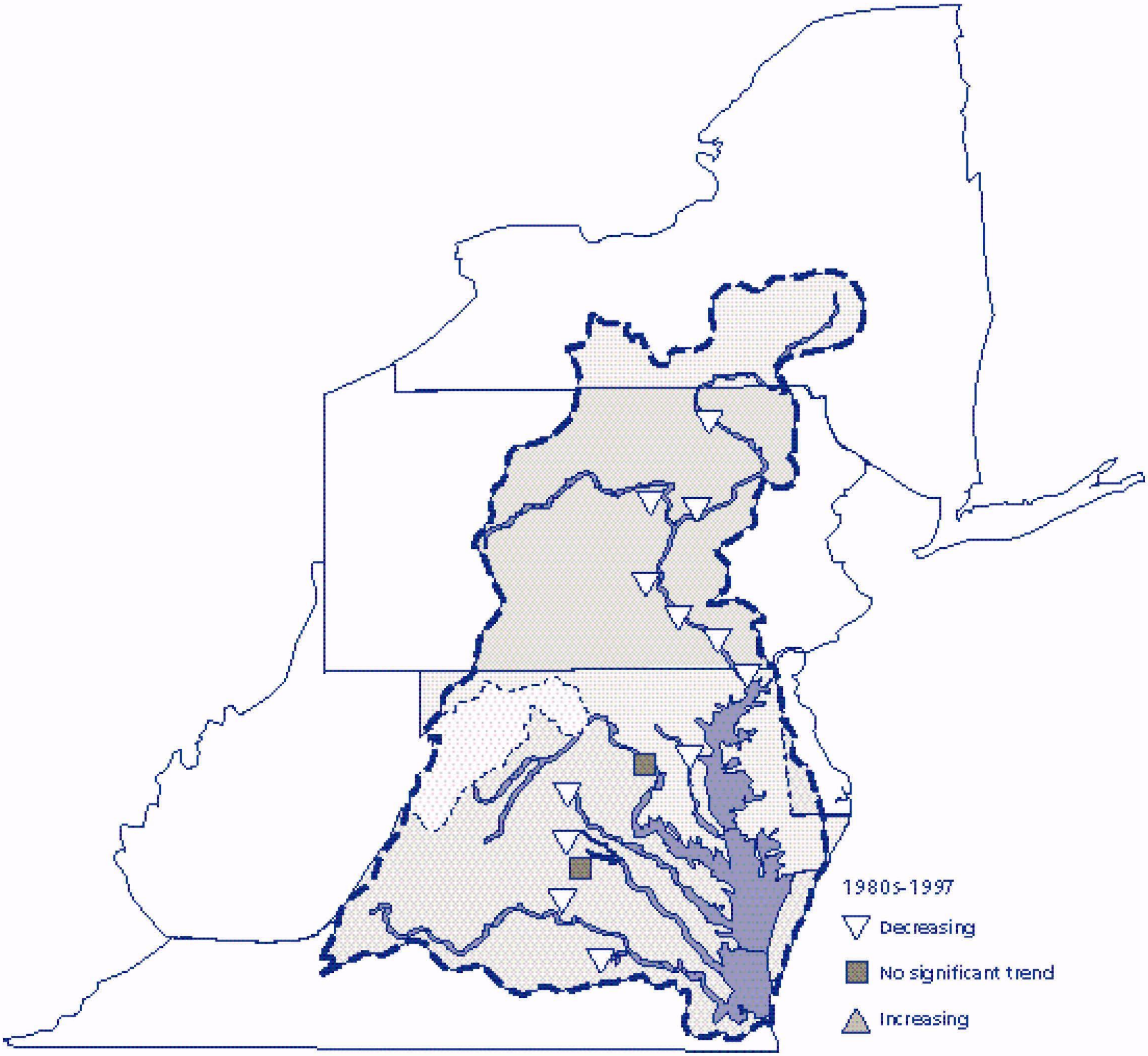
- **Potomac River**: The Potomac is second only to the Susquehanna in the amount of freshwater supplied to the Bay (approximately 16%). Phosphorus and sediment levels declined; however, there was no significant change for nitrogen in the non-tidal portion of the river.

- **Rappahannock River**: Nitrogen, phosphorus and sediment levels in the non-tidal Rappahannock River declined.

- **York River Basin**: Non-tidal portions of the York actually are in two tributaries: the Mattaponi and Pamunkey Rivers. In the Mattaponi, nitrogen and phosphorus levels declined; however, there was no significant change for sediment. In the Pamunkey, phosphorus levels declined, but nitrogen and sediment did not change significantly.

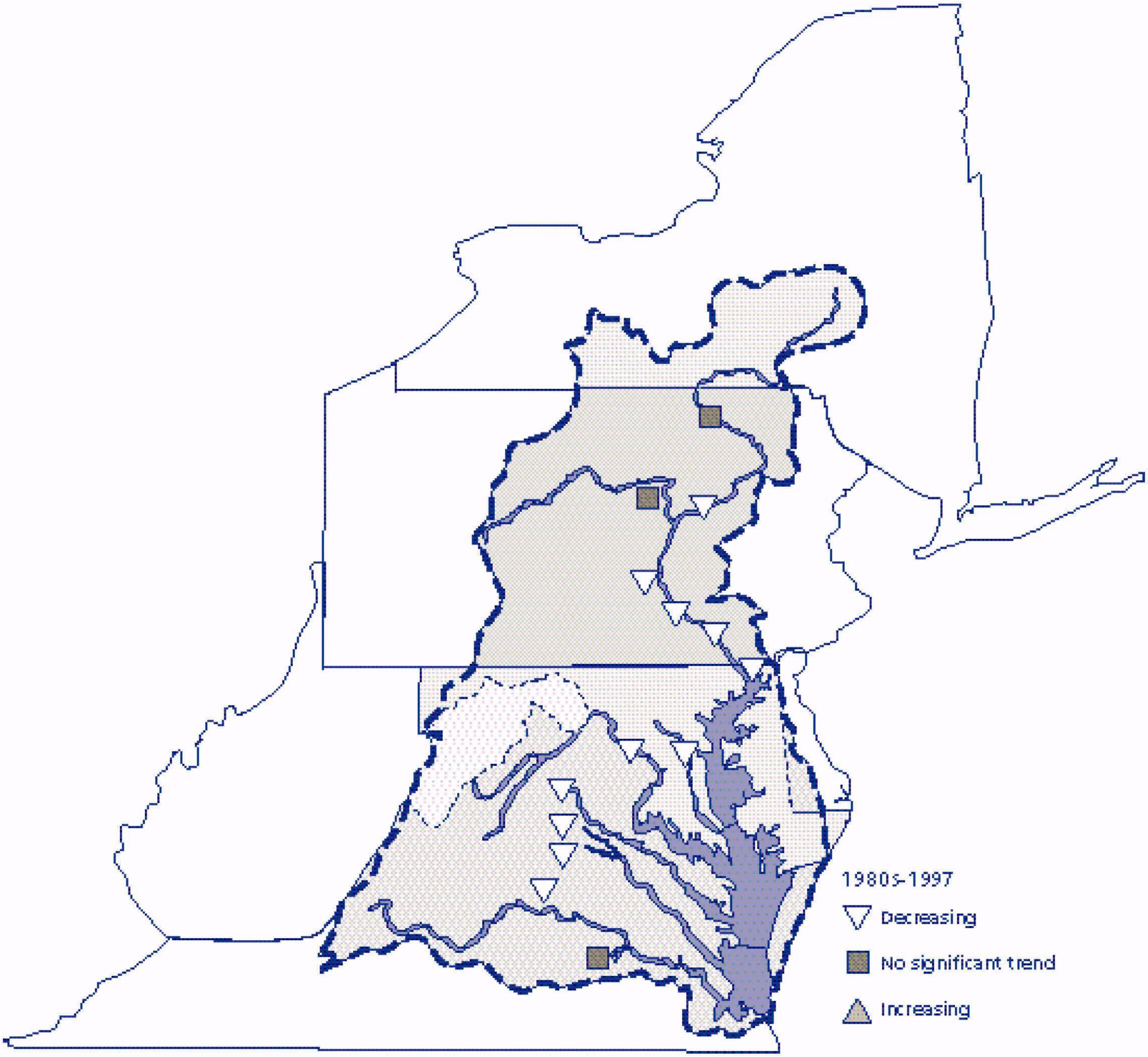
- **James River**: The James supplies approximately 12% of the freshwater supplied to the Bay. In the non-tidal portion of the James, nitrogen and phosphorus levels declined; however, there was no significant change for sediment. In the Appomattox River, a tributary to the James, nitrogen levels declined, but phosphorus and sediment levels did not change significantly.

NITROGEN LEVELS DECLINING IN NON-TIDAL PORTIONS OF CHESAPEAKE BAY RIVERS



Monitoring data from major rivers entering the tidal waters of Chesapeake Bay show that flow-adjusted nitrogen concentrations are declining in the Susquehanna, Patuxent, Rappahannock, Mattaponi (a tributary to the York), James and the Appomattox (a tributary to the James) rivers. The Potomac and Pamunkey (a tributary to the York) show no trend.

PHOSPHORUS LEVELS DECLINING IN NON-TIDAL PORTIONS OF CHESAPEAKE BAY RIVERS



Monitoring data from major rivers entering the tidal waters of Chesapeake Bay show that flow-adjusted phosphorus concentrations are declining in the Susquehanna, Potomac, Patuxent, Rappahannock, Mattaponi (a tributary to the York), Pamunkey (a tributary to the York) and James rivers. The Appomattox, a tributary to the James, shows no trend.

Sediment Levels Declining in Non-tidal Portions of Chesapeake Bay Rivers

Monitoring data from major rivers entering the tidal waters of Chesapeake Bay show that flow-adjusted sediment concentrations are declining in the Potomac, Patuxent, Rappahannock and in portions of the Susquehanna. Concentrations remain unchanged in the other rivers.

For Your Information...

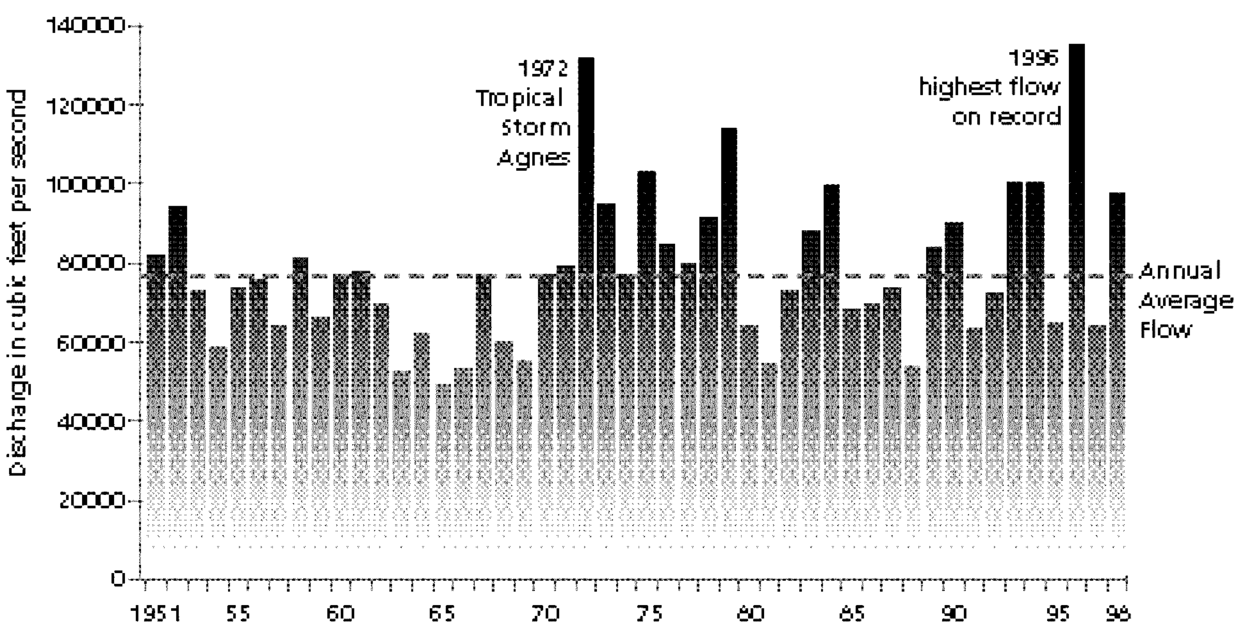
Understanding High Flows

Each of the major rivers in the Chesapeake system supplies millions of gallons of water every year to the main Bay. Much of that flow is driven by weather patterns and, ultimately, rainfall. Depending on the amount of rain that swells the thousands of streams, creeks and rivers that flow into the Bay, some years are considered wet or high flow years, and others are dry or low flow years. Bay managers track flow closely because flow influences Bay and river responses to nutrient reduction measures.

Higher freshwater flows can be bad for the Bay because they capture the nutrient-rich runoff from the land and quickly transport it to the rivers and Bay in large quantities. Freshwater flows also affect Bay water quality because they influence circulation, salinity and dissolved oxygen levels, and they indirectly affect finfish and shellfish populations.

Flow records kept since the early 1950s show that since 1972, we have witnessed a period including many higher-than-average flow years. When we want to assess progress, the effects of flow variations on observed nutrient and sediment levels are taken into account, or adjusted, in the calculation of trends. The flow adjustment is done so that we can evaluate the success of point and nonpoint source management programs, which could be masked due to changes in flow conditions.

River Flow into Chesapeake Bay



TIDAL RIVERS & THE MAIN BAY

In this section, we report on status and trends [see sidebar] in nitrogen, phosphorus and water clarity [see sidebar] in the tidal rivers and the mainstem Chesapeake Bay between 1985 and 1997. The conditions in the tidal rivers and 200-mile-long mainstem of the Bay vary from year to year depending on the forces of Mother Nature, freshwater flow and the cumulative effect of the pollution control measures that have been installed on the land and in wastewater treatment plants since the early 1980s.

TOP FINDINGS FOR THE TIDAL RIVERS:

Status: Many of Maryland's smaller Eastern and Western Shore tributaries and the Potomac River had higher nitrogen concentrations than elsewhere. For phosphorus, regions of the Patuxent, York and James rivers and a few Maryland Eastern and Western Shore tributaries had higher concentrations.

Trend: We saw responses to management actions in varying degrees, even in the face of lag times [see sidebar] and high flow events. Rivers with significant reductions in point source nutrient loadings showed clear signs of recovery. Specifically, for nitrogen, the trend improved in the Back, Patuxent, York, James, and portions of the Potomac, Rappahannock and Elizabeth rivers. For phosphorus, the trend improved in several Maryland tributaries, including the Patuxent, and in the James and Elizabeth rivers.

Status: Nearly all tidal tributaries had poor or fair water clarity conditions.

Trend: Water clarity in the tidal rivers got worse, especially in Tangier Sound and in the Patuxent, Potomac, James and Maryland's Eastern Shore rivers. Only Maryland's Middle River had improving conditions.

TOP FINDINGS FOR THE MAIN BAY:

Status: Nitrogen concentrations in portions of the Bay's mainstem were generally good. Phosphorus concentrations were good in all portions of the mainstem.

Trend: There was no significant trend for nitrogen in the mainstem Bay. For phosphorus, the trend became worse in the middle mainstem Bay but improved in the upper and lower portions.

Status: Water clarity in the mainstem Bay was fair.

Trend: Water clarity got worse in most portions of the mainstem Bay.

High river flows in the Bay region in 1993, 1994 and 1996 increased runoff from the land and added high levels of sediment to the water throughout the system. Bay managers attributed declines in water clarity between 1985 and 1997 to the increased runoff and high amounts of sediment in the water. Poor water clarity is of concern, especially in the Lower Eastern Shore around Smith Island and Tangier Sound, where Bay grasses have been declining significantly since 1992.

In addition, between 1985 and 1997, there was no clear trend in oxygen levels in the lower layer waters of the main Bay and tidal tributaries. In the mainstem Bay in 1997, however, oxygen levels were among the best since monitoring began. This improvement was significant for the Bay's living resources because the improved oxygen levels meant that more underwater habitat was available to them. Often in summer months, the lower layer of water (critical habitat for fish and shellfish) can be deprived of oxygen because of excess nutrients and poor mixing between the upper and lower layers of the water. Experts pointed to the cooler water temperature in 1997 and the low river flow during that summer as part of the reason for this improvement.

For Your Information...

Understanding Status & Trends

In order to give us the complete story on water quality, scientific experts analyze mountains of data and information collected each year under the Bay Program's nationally-recognized water quality monitoring program. Based on this information, the experts report on the status and trends in the rivers and the main Bay. The status is the current condition based on observed water quality conditions. The trends are the long-term changes in conditions.

To determine the status of a particular section of the Bay system, Bay managers compare current water quality conditions—1995 to 1997—to a scale developed using Baywide data from 1985-1997 across regions of the Bay with similar salinity. For nutrients, the water quality at each station is categorized as good (lowest concentrations), fair (moderate concentrations) and poor (highest concentrations). An area with low nitrogen or phosphorus and high water clarity is considered good. However, it is important to note that an area categorized as having good status still may need nutrient reductions to improve its water quality in order to meet the habitat requirements needed by the Bay's fish, shellfish, grasses and other living resources.

Trends are based on observed concentration data collected from 1985 through 1997. The trend is determined with a statistical analysis test called Seasonal Kendall. A decreasing trend for nitrogen and phosphorus is considered a positive trend for the Bay, while a decreasing water clarity trend is considered bad for the Bay.

Understanding Lag Time

Nutrient reduction progress can be masked or slowed down by natural lag times between actions taken on the land and the delivery of resulting reductions to the Bay. For example, nutrients are transported in the watershed in several ways. Nutrients dissolved in water—mostly nitrogen—or attached to sediments—mostly phosphorus—are washed off the land into streams as runoff during rain events. Once in the stream, the nutrients associated with water move along the surface and flow to a nearby stream or river and eventually the Bay. Nitrogen-rich runoff also can infiltrate the ground before reaching a stream, move with groundwater and eventually seep back into streams, rivers and the Bay. But, this process can take five years or more. This is called groundwater lag time.

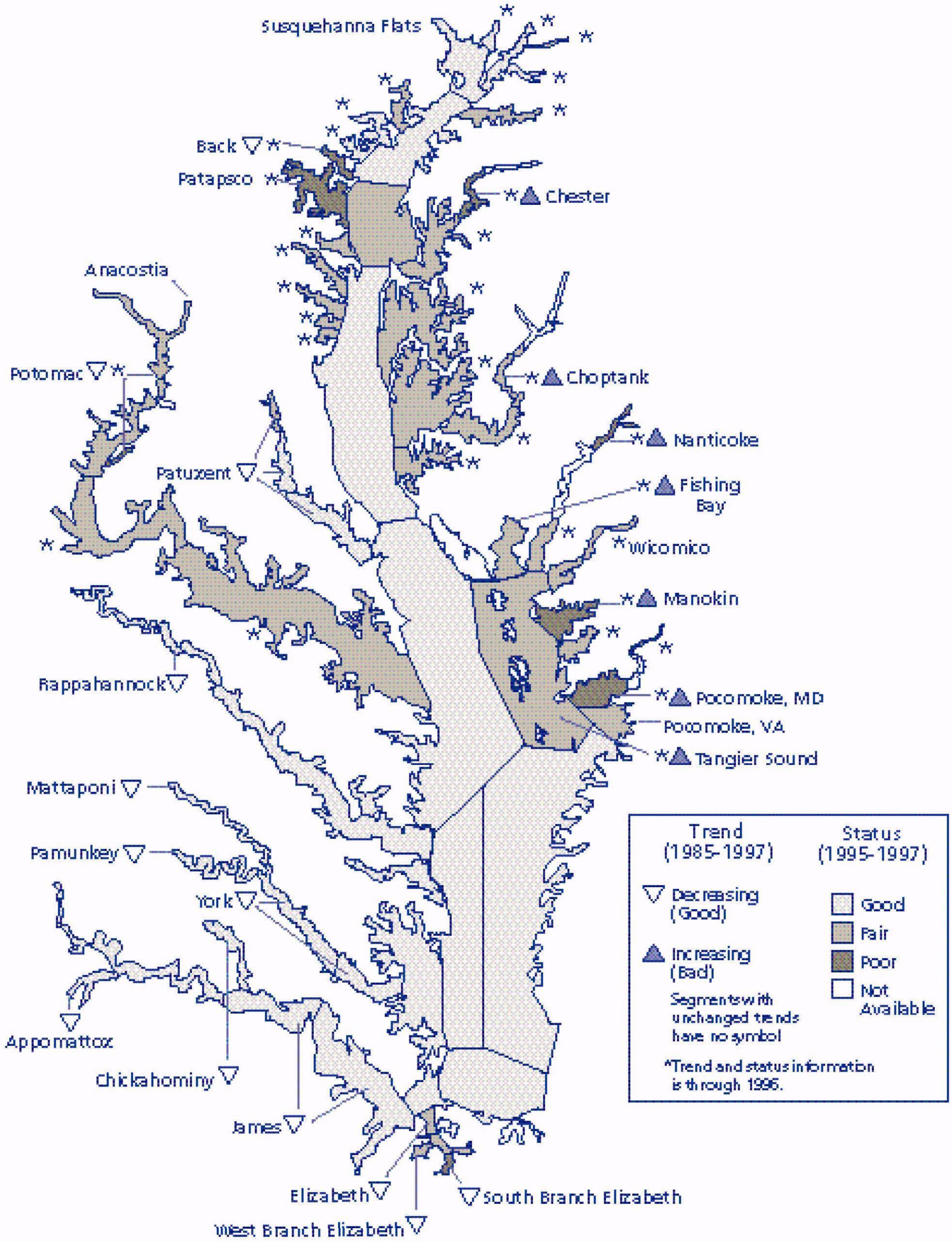
There are also lag times in the Bay system associated with the time it takes for living resources to recover once water quality and habitat conditions have improved. For example, once water quality conditions suitable for underwater grasses are attained, it still may be years before enough seeds or vegetative plant materials are transported to the restored habitat to support regrowth.

Understanding Water Clarity

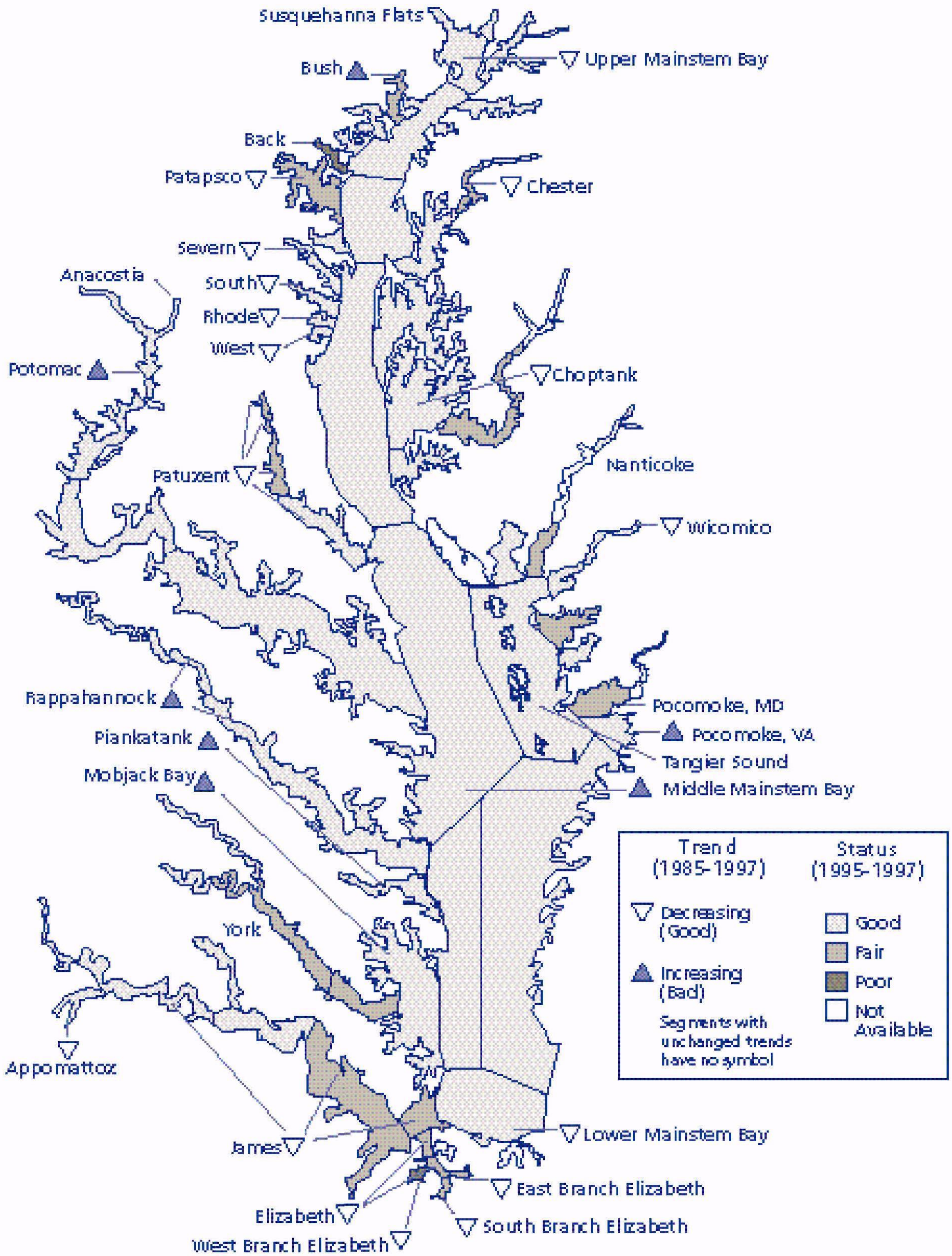
Water clarity is measured with a simple round black and white device called a Secchi disc, which is lowered into the water on a string until it disappears from view. That distance is measured because that's how far sunlight is penetrating the water. Sunlight is needed for Bay grasses to grow.

Improvements in water clarity are necessary in order to ensure the growth of Bay grasses, which totaled 63,495 acres in 1998. Scientists note that underwater grasses tend to flourish during the Bay's low-flow years because there is less sediment in the water to block sunlight.

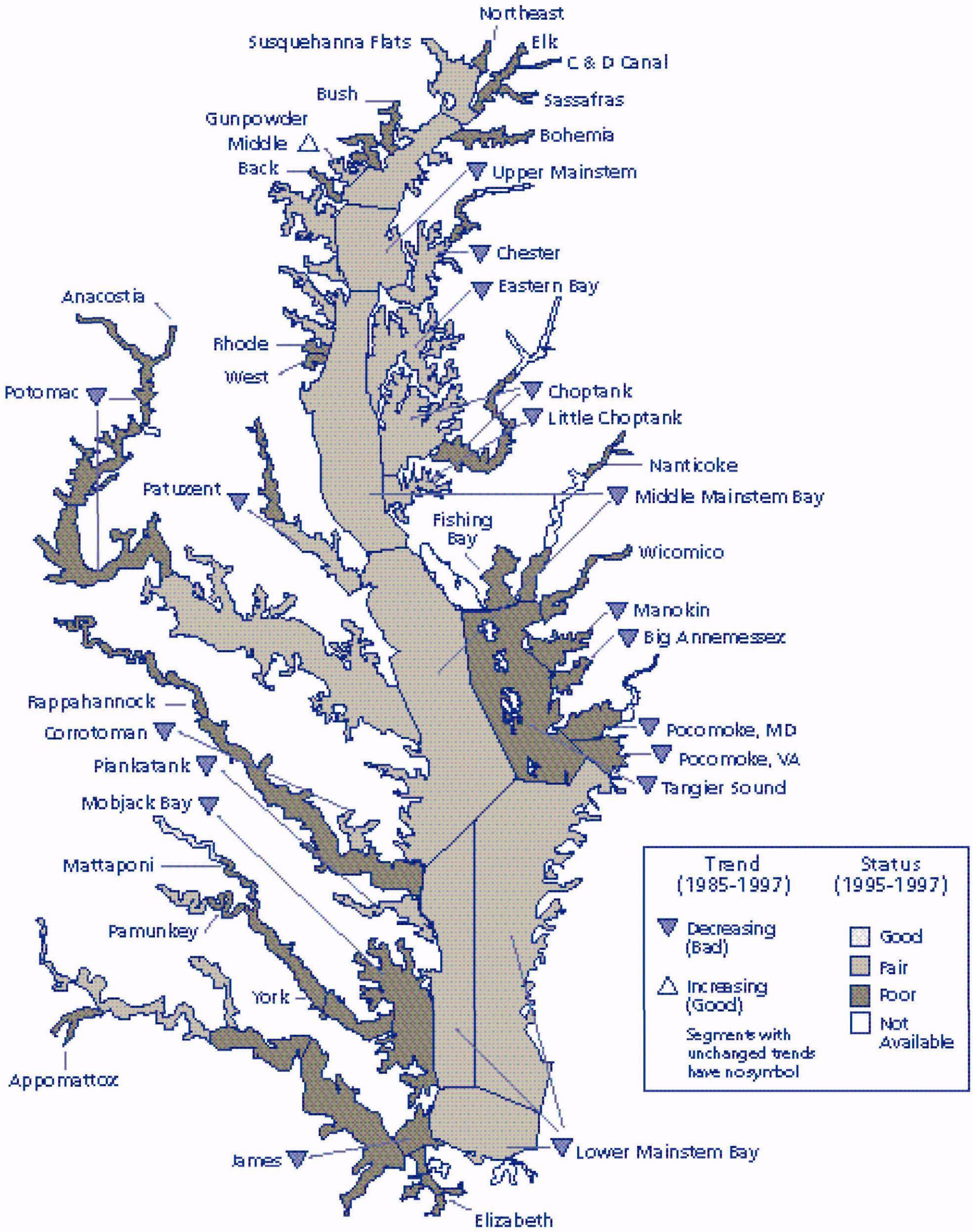
Status & Trends in Nitrogen Concentrations in the Mainstem Bay & Tidal Tributaries



Status & Trends in Phosphorus Concentrations in the Mainstem Bay & Tidal Tributaries



Status & Trends in Water Clarity in the Mainstem Bay & Tidal Tributaries



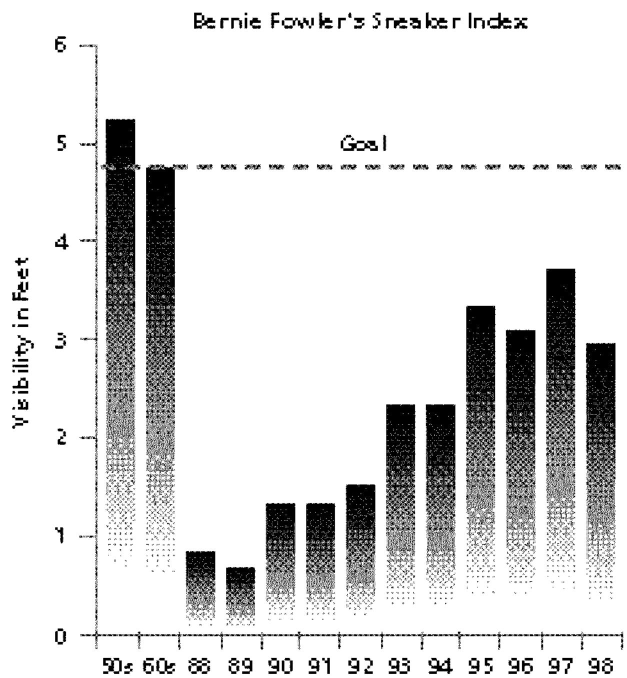
The CITIZEN CONNECTION

BERNIE FOWLER'S SNEAKER INDEX:
Testing the Bay's Water Clarity the Old-Fashioned Way

Even though there are formal methods to take water clarity measurements, the most famous water clarity test in the Bay region is an informal one conducted annually by former Maryland State Senator Bernie Fowler of Broomes Island, Maryland. Every year since 1988, on the second Sunday in June, Senator Fowler, a long-time environmental activist, conducts his wade-in with the help of family and friends. Senator Fowler's water clarity measurement is simple: he wades into the Patuxent River as far as he can until his white sneakers disappear. He stops at that point and wades back to shore. There, the high water mark on his overalls is measured and the annual Sneaker Index is announced. In 1998, the Bernie Fowler Sneaker Index was 35.5 inches, down from an all-time high of 44.5 in 1997. "Although this is not a scientific measurement, it puts restoring the river on a human scale," says Fowler.

Senator Fowler's wade-in has its roots in the childhood he spent fishing and crabbing in the Patuxent River. In the 1950s, the water clarity was high, and fish, crabs and grass were plentiful. However, the water quality in the river degraded over the next two decades, due to land use changes and increased sewage flow from the population growth upstream in the metropolitan Washington area. Senator Fowler led the fight that forced the construction of better, more efficient wastewater treatment facilities upstream. These changes led to the improved water quality and clarity conditions we see in the Patuxent River today.

CITIZENS ARE INTERESTED IN TRACKING PROGRESS IN BAY CLEAN-UP



Wading in the Patuxent River at Broomes Island, Maryland, Bernie Fowler has seen improvements in water clarity during the last ten years. He says, "although this is not a scientific measure, it puts restoring the river on a human scale." Pictured (left to right) are Betty Fowler, Congressman Steny H. Hoyer (D-MD), EPA Administrator Carol M. Browner and Fowler.

Conclusion

The State of the Chesapeake Bay

On a broad scale, there are many challenges and opportunities ahead for the Chesapeake Bay watershed. And, as far as your investment in the clean-up effort, it's paying dividends. True, there may be some downward trends in the near future but, basically, your long-term investment is sound. The most pressing challenge will be to meet our 40% reduction goal on time and maintain the nutrient cap. Once the nutrient cap goes into effect, other issues will challenge us, including:

- Increased phosphorus pollution — The phosphate detergent bans of the 1980s cut pollution dramatically. However, recent increases in population and wastewater flows are starting to offset those early gains.
- Nutrient pollution from other Bay states — Only the Bay Program partners—Maryland, Virginia, Pennsylvania and the District—have agreed to a nutrient cap. Increased nutrient pollution from the other Bay states—West Virginia, New York and Delaware—could offset reductions. Nutrient pollution from air also could be a factor.

  In addition to the issues that face us concerning nutrient reduction, there also is a myriad of natural resource management issues ahead, including:

- Increased population growth — About 300 new people call the Chesapeake region home daily. Right now, the watershed supports 15.1 million people, with another three million expected by 2020. More people mean more sewage, more pollution and further changes to the landscape.
- Increase in vehicle miles traveled — By 2010, we can expect that vehicle miles—a significant source of water and air pollution in the region—will increase at three times the rate of population.
- Conflicts over resources — In 1998, we saw, for the first time, regulations on the clamming industry designed to limit damage to Bay grass beds. In other areas, jet skiing is being limited to reduce noise and damage to shallow water habitats.
- Fishery management — We are at a crossroads with blue crab and several other fisheries. All eyes are on the managers to make the right decisions to preserve these resources. One of the Bay's most famous fisheries—the oyster—continues to struggle.

In the face of these issues, it's fair to say that the Chesapeake Bay Program will work hard and will continue to anticipate and meet challenges. The Bay Program, under the leadership of the Executive Council, has an excellent 16-year track record based on strong partnerships, innovative thinking, cooperation and the political will to set clear, challenging goals for the restoration of the Bay and its resources. Your investment already has paid dividends, but the years beyond 2000 will be filled with challenges. The Executive Council will continue to make the difficult management decisions that move the Bay restoration forward. These leaders will also continue to encourage their shareholders to roll up their sleeves, dig in, learn the issues, learn how the natural system works, reduce pollution and, by protecting their investment, make a healthy Bay system one of their top priorities.

Chesapeake Bay Program

Chesapeake Bay Time Line

9000 B.C.

- Sea level rise from melting glaciers fills the lower Susquehanna valley and begins forming the Chesapeake Bay.
- Native tribes arrive in the Bay region.

2000 B.C.

- The Bay assumes its current shape.

1000 B.C.

- Native American agriculture begins. Crops include corn, squash and beans. Native Americans fish the Bay with spears, traps and hook and line.

1500s

- Spanish and French explorers reach the Bay.

1607

- The first permanent New World English settlement is established in Jamestown, Virginia. John Smith, a member of its governing council, begins his exploration of the Bay.

1600s

- Virginia enacts laws addressing fishery wastes and the blockage of fish migrations by commercial dams.
- In Maryland, by 1639, game laws are enacted to protect species like the great blue heron.

1650s

- The Colonists establish booming businesses in ship masts and timber. They clear land for agriculture and use hook and line on shallow water species of fish.

1750s

- The Colonists strip 20 to 30% of forests for settlements. They grow tobacco, which depletes the soil and causes erosion.
- Bay shipping ports begin to fill with eroded sediments and become too shallow for navigation.
- The Colonists begin to catch fish in nets.

1776

- Farmers begin to use plows extensively, starting a cycle of permanent tillage that prevents reforestation, dramatically alters the natural fabric of the soil profile, and begins a massive period of soil erosion.

1785

- Virginia and Maryland sign the Compact of 1785. Virginia agrees to give vessels bound for Maryland free passage at the entrance to the Bay in return for an agreement by Maryland that the right to fish in the Potomac River was to be enjoyed by citizens of both states.

1813

- Oyster raking begins in the Bay.

1835

- By now, half of the Chesapeake region forests is cleared for agriculture, timber, and fuel for homes and industry.
- The first imported fertilizers are used after ships bring bird guano from Caribbean rookery islands and later from nitrate deposits on the coast of Chile.

1890s

- Nearly 60% of the watershed's forests are cleared. However, a process of land abandonment and reversion to forest begins and continues through the early 1900's.

1900

- Railroad tie replacement consumes an estimated 15 to 20 million acres of Eastern forests.
- Steamships and the railroad allow fish, crabs and oysters to be marketed to distant cities.

1914

- The City of Baltimore is the last major American city to install sewer lines, but one of the first to adopt a waste treatment system. The system is installed based on its ability to save valuable oyster beds.

1918

- The University of Maryland Chesapeake Biological Laboratory is founded. The first water quality surveys indicate that the Bay is in good shape, except in heavily industrialized areas.

1930

- Reversion to forests continues as farmers relocate to more productive land. Reforestation programs result in an increase of forests.

1933

- An interstate conference on the Bay is held. The concept of treating the Bay as a single resource unit is developed.

1938

- Aerial photographs of several Chesapeake tributaries show extraordinary underwater Bay grass beds.

1940

- The Interstate Commission on the Potomac River Basin is established.

1945

- Widespread use of chemical fertilizers begins.
- The human population explodes and the "suburb" is born.
- Changes in fishing boat and equipment technology cause many fish species to decrease.

Chesapeake Bay Time Line

1948

- Both Maryland and Virginia have water pollution control agencies in place.

1950s

- Calvert County, Maryland resident Bernie Fowler can see his white sneakers after wading to shoulder-depth in the Patuxent River. The clear water is a sign of good water quality.
- MSX and Dermo—two diseases that kill oysters—appear in the Bay.

1965

- In his State of the Union address, President Johnson pledges that the Potomac River will become a "model of beauty and recreation" for the country.

1967

- The Chesapeake Bay Foundation is founded. It's now one of the largest private environmental organizations in the nation.

1970s

- The federal *Clean Air Act* is passed.
- The trend in increasing forest cover reverses due to population growth and development.
- The Susquehanna River Basin Commission is established by the federal government and the states of New York, Pennsylvania and Maryland.
- The Bay jurisdictions enact laws to protect wetlands.

1972

- In late June, tropical storm Agnes ravages the Basin, destroying many underwater Bay grass beds.
- The federal *Clean Water Act* is passed.
- The pesticide DDT is banned. This eventually reduces toxic effects on osprey, eagles and other fish-eaters.
- The Alliance for the Chesapeake Bay is formed. This organization is designed to ensure public participation in policy decisions affecting the Bay.

1975

- High levels of Kepone, a toxic chemical, are found in Virginia's James River, threatening fish, shellfish, wildlife and public health.
- US Senator Charles Mathias (R-MD) successfully introduces legislation that directs the EPA to conduct a five-year study and produce a report on the Bay.

1980

- The Chesapeake Bay Commission, a tri-state legislative body, is created.

1981

- Biological Nutrient Removal (BNR) is introduced at treatment plants on the Patuxent River following a lawsuit filed by three Maryland counties challenging the state and EPA over poor water quality in the river.

1983

- The congressionally-mandated EPA report on the Bay is completed. It highlights four areas that require immediate attention: the overabundance of the nutrients nitrogen and phosphorus in the water; dwindling underwater Bay grasses; toxic pollution; and the over-harvesting of living resources.
- The Chesapeake Bay Program, a unique voluntary partnership, is established with the signing of the first *Chesapeake Bay Agreement* by Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission; and the EPA. The agreement establishes the Chesapeake Executive Council as the chief policy-making authority in the Bay region. Executive Council members are the governors of Maryland, Pennsylvania and Virginia, the mayor of the District, the EPA administrator, and the chair of the Chesapeake Bay Commission.

1984

- The Chesapeake Bay water quality monitoring program is initiated by the Bay Program.
- The first federal agency agreements are signed between EPA and the US Army Corps of Engineers, the US Fish and Wildlife Service, the US Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA).
- The Maryland legislature passes the *Chesapeake Bay Critical Areas Protection Act*, a plan to control development along the shores of the Bay and its tributaries.

1985

- The Alliance for the Chesapeake Bay begins a first-of-its-kind volunteer citizen water quality monitoring program.
- Maryland places a moratorium on fishing for striped bass.
- A phosphate detergent ban is enacted in Maryland. DC follows in 1986, Virginia in 1988 and Pennsylvania in 1990.

1986

- The Bay Program initiates its first nutrient management efforts.

CHESAPEAKE BAY TIME LINE

1987

- The 1987 *Chesapeake Bay Agreement* is signed by the Bay Program partners. The Agreement sets a goal to reduce the nutrients nitrogen and phosphorus entering the Bay by 40% by the year 2000 and directs the Bay Program to study atmospheric inputs to the Bay.

1988

- Virginia adopts the *Chesapeake Bay Preservation* Act to provide land use guidance to local governments.
- Bernie Fowler, now a Maryland state senator, wades into the Patuxent River. Water clarity is so poor he cannot see the tips of his white sneakers beyond ten inches deep.

1989

- The *Chesapeake Bay Basinwide Toxics Reduction* Strategy is adopted.
- The *Chesapeake Bay Wetlands Policy*, which commits the Bay Program partners to a no net loss of wetlands goal, is adopted.
- Virginia places a moratorium on fishing for striped bass.

1990

- The federal *Clean Air Act Amendments* establish the Great Water Bodies Program, which acknowledges air deposition as a contributor to water pollution.
- Striped bass moratoria are lifted and limited seasons are allowed in Maryland and Virginia.

1992

- The *Chesapeake Bay Agreement 1992 Amendments* are issued, giving nutrient reductions a tributary focus. The amendments call for a permanent nutrient cap after 2000.
- More than 450,000 acres of land in the Bay region are under nutrient management plans.

1993

- The Bay Program issues directives addressing tributary strategies, regional action plans to reduce toxics, underwater Bay grasses restoration, fish passage openings, and reduction of agricultural nonpoint source pollution.
- Pennsylvania enacts a law requiring large animal farm operations to implement nutrient management plans.

1994

- Twenty-five agencies and departments sign the *Agreement of Federal Agencies on Ecosystem Management in the Chesapeake Bay.*
- Nearly one million acres of land in the Bay region are under nutrient management.
- The 1994 *Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy* is adopted.
- New initiatives for riparian forest buffers, habitat restoration and aquatic reefs, and reciprocal agricultural certification programs begin.

1995

- The striped bass stock is declared restored by the Atlantic States Marine Fisheries Commission.
- The *Local Government Partnership Initiative* is signed, engaging the watershed's 1,650 local governments in the Bay restoration effort.
- The *Public Access Guide* is released, highlighting more than 500 public access sites in the watershed.
- Adoption Statements on ballast water and pesticide management are signed.
- Maryland creates ten watershed-based Tributary Teams to bring the Bay cleanup to the local level.

1996

- Record high flows are recorded as a result of heavy winter snowfall and Hurricane Fran.
- The *Businesses for the Bay* program is launched by the Bay Program.
- The Toxics Regional Action Plans for the Elizabeth River, Baltimore Harbor and the Anacostia River are finalized.
- The *Local Government Participation Action Plan* is adopted, reaffirming the Bay Program's commitment to strengthening its partnership with local governments.
- The *Priorities for Action for Land, Growth and Stewardship in the Chesapeake Bay Region* is adopted, addressing land use management, growth and development, stream corridor protection, and infrastructure improvements.
- The new *Riparian Forest Buffers Initiative* calls for conserving existing forests along streams and sets a goal of restoring 2,010 miles of forest buffers on stream and shoreline in the Bay watershed by the year 2010.
- The largest wastewater treatment facility in the Bay region, the Blue Plains Wastewater Treatment Plant in the District of Columbia, begins BNR for half of its flow capacity.
- Virginia passes the *Agricultural Stewardship Act*, considered to be the most far-reaching "bad actor" law in the nation for controlling agricultural pollution.

1997

- The *1997 Nutrient Reduction Reevaluation* concludes that the 40% goal is in sight.
- Former Maryland State Senator Bernie Fowler conducts his annual wade-in on the Patuxent

River at Broomes Island. Accompanied by his family, friends, local and state officials and EPA Administrator Carol M. Browner, Fowler wades in to 44 inches—his best measurement since the 1950s and 1960s.

- Maryland, Pennsylvania and Virginia all have successful agriculture nutrient management certification and education programs in place. Approximately 1.7 million acres in the Bay region are under nutrient management.
- Installation of the BNR pilot at Blue Plains leads to record reductions of nitrogen discharges into the Potomac River.
- *Pfiesteria piscicida*, a toxic dinoflagellate, is discovered in three tidal tributaries of the Bay, causing fish kills and raising concerns about nutrient impacts on human health and water quality.
- Three important indicators of the health of the Bay show improvement: acres of underwater Bay grasses increased, more oxygen was available to fish and crabs during the early summer, and less nitrogen and phosphorus were found in the Bay's waters compared with previous years.
- Maryland adopts a series of Smart Growth and Neighborhood Conservation initiatives aimed at directing growth and enhancing older developed areas.
- Virginia passes the *Water Quality Improvement Act*, setting a process for establishing goals and providing funds for both point and nonpoint source improvements.
- Pennsylvania establishes the 21st Century Environment Commission to determine environmental priorities for the next century.

1998

- Maryland adopts a bill that requires farmers to implement management plans to reduce both nitrogen and phosphorus.
- The federal *Clean Water Action Plan* provides a blueprint for restoring and protecting the nation's waters using the Bay Program as a model. It's later implemented in the Bay region with the signing of FACEUP (Federal Agencies' Chesapeake Ecosystem Unified Plan).
- American Forests kicks off the *Global ReLeaf for the Chesapeake* campaign to plant one million trees in the Bay region by 2000.
- *Small Watersheds Grants* are awarded to 17 local communities and 20 citizen groups in the Bay watershed to assist with on-the-ground restoration projects.
- Bay Program data confirm that industries showed a 67% reduction in toxic releases in the Bay region between 1988 and 1996.
- The Blue Plains Wastewater Treatment Plant commits to full BNR by 2000.
- The Atlantic States Marine Fisheries Commission closes the entire East Coast to Atlantic Sturgeon fishing for the next 40 years. It's the longest fishing moratorium on record.
- Virginia announces it will spend $48 million on new clean water programs.
- The Executive Council signs directives that make education, a renewed *Chesapeake Bay Agreement*, technology and animal waste management top tools for the future.
- The last of five dams on the James River is breached. A fish ladder added to Bosher's Dam opens the river from Richmond to Lynchburg, Virginia.

1999

- Pennsylvania Governor Thomas Ridge issues an Executive Order to establish land use goals and to assist local governments in implementing sound land use objectives.
- Representatives of Maryland and the District of Columbia sign the Anacostia Watershed Restoration Agreement, which includes goals of restoring the waterway and 176 square miles of surrounding land.

BEYOND 2000

2000

- Nitrogen and phosphorus loadings to the Bay are capped at the 40% reduction level.

2003

- More than 1,356 miles are opened for fish passage in order to restore spawning habitat for migratory fish.

2005

- Recovery of Bay grasses reaches a total of 114,000 acres.

2010

- Riparian forests on 2,010 miles of stream and shoreline in the Bay watershed are restored.

2020

- The Bay region's population approaches 18 million.

For more information about the Chesapeake Bay & its rivers, contact:

Chesapeake Bay Program
Communications Office
410 Severn Ave., Suite 109
Annapolis, MD 21403
(800) YOUR-BAY/(410) 267-5700
www.chesapeakebay.net

D.C. & State Government & other partners

Chesapeake Bay Commission
(410) 263-3420
www.chesbay.state.va.us

District of Columbia Department of Health
(202) 645-6617
www.environ.state.dc.us

District of Columbia Public Schools
(202) 442-4016
www.k12.dc.us

Maryland Department of Education
(888) 246-0016
www.msde.state.md.us

Maryland Department of the Environment
(800) 633-6101
www.mde.state.md.us

Maryland Department of Natural Resources
(410) 260-8710
www.dnr.state.md.us

Pennsylvania's Chesapeake Bay Education Office
(717) 545-8878
www.pacd.org

Pennsylvania Department of Conservation and Natural Resources
(717) 787-9306
www.dcnr.state.pa.us

Pennsylvania Department of Education
(717) 783-6788
www.pde.psu.edu

Pennsylvania Department of Environmental Protection
(717) 787-2300
www.dep.state.pa.us

Virginia Department of Conservation and Recreation
(804) 786-1712
www.state.va.us/-dcr/

Virginia Department of Education
(800) 292-3820
www.pen.k12.va.us

Virginia Department of Environmental Quality
(800) 592-5482/(804) 698-4000
www.deq.state.va.us

Federal Government & Other Partners

National Oceanic and Atmospheric Administration (NOAA) Chesapeake Bay Office
(410) 267-5660
www.noaa.gov

U.S. Army Corps of Engineers District Office in Baltimore
(410) 962-7608
www.nab.usace.army.mil

U.S. Army Environmental Center
(410) 436-7113
www.hqda.army.mil

U.S. Department of Education
(800) USA-LEARN
www.ed.gov

U.S. Environmental Protection Agency Chesapeake Bay Program Office
(800) YOUR-BAY/(410) 267-5700
www.chesapeakebay.net or www.epa.gov

U.S. Fish and Wildlife Service Chesapeake Bay Field Office
(410) 573-4500
www.fws.gov/r5cbfo

U.S. Geological Survey
(703) 648-4000
www.usgs.gov

Academic Organizations

Maryland Sea Grant
(301) 405-6371
www.mdsg.umd.edu

Pennsylvania State University
(814) 865-4700
www.psu.edu

University of the District of Columbia
(202) 274-5000
www.wrlc.org/udc.htm

University of Maryland Cooperative Extension Service
(301) 405-2072
www.agnr.umd.edu

University of Maryland Center for Environmental Science
(410) 228-9250
www.umces.edu

Virginia Cooperative Extension
(540) 231-6704
www.ext.vt.edu

Virginia Institute of Marine Science
(804) 684-7000
www.vims.edu

Nonprofit Organizations

Alliance for the Chesapeake Bay
Chesapeake Regional Information Service
Hotline (800) 662-CRIS
www.acb-online.org

Center for Chesapeake Communities
(410) 267-8595
www.chesapeakecommunities.org

Chesapeake Bay Foundation
(410) 268-8816
www.cbf.org

Chesapeake Bay Trust
(410) 974-2941
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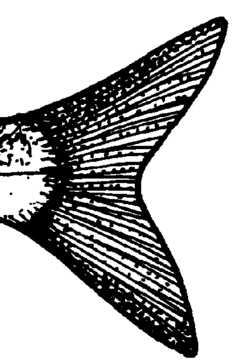
CHESAPEAKE 2000

Renewing the Bay Agreement

Chesapeake 2000 refers to the effort to renew the *Chesapeake Bay Agreement* in the year 2000 and to define the priority goals and commitments for the Chesapeake Bay Program into the next millennium. Also called C2K, the project is under way with the Bay Program working in partnership with its advisory committees, subcommittees, all levels of government and key stakeholder groups.

The *Chesapeake Bay Agreement*, adopted in 1987 and amended in 1992, established the overall vision and interstate policy framework for the restoration and protection of the Bay. However, many of the original goals and commitments of the *Bay Agreement* were indexed to the year 2000. Many of the original restoration milestones have been achieved, so it is time to take stock of the latest science, the emerging challenges and public interests, and the various strategies adopted by the Bay Program in order to renew the *Agreement*. The C2K effort will put the priority goals and commitments of the Bay Program into one master plan to restore and protect the Bay for years to come.

For more information on how you can get involved in the C2K effort, call the Bay Program at 1-800-YOUR BAY or see our website at www.chesapeakebay.net.



Chesapeake Bay Program

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