

Virginia Policy Briefs

May 2008

No. 1

Abstract

The Chesapeake Bay provides habitat to a wide array of plant, animal and marine life. Human activity has significantly increased the level of harmful substances in the Bay. The more harmful substances include nitrogen, phosphorus, and sediment. Nitrogen and phosphorus feed and trigger algal blooms, which removes oxygen from the surrounding waters. Sediment adds to this problem by smothering the oxygen-producing plant life dwelling at the bottom of the Bay. More care needs to be given to rebuilding natural buffers that filter runoff and to controlling nitrogen and phosphorus levels in runoff.

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Health of the Chesapeake Bay

A national treasure, the Chesapeake Bay provides habitats to a wide array of plant, animal and marine life, and also provides a variety of recreational activities. In addition to its value as a natural resource, it is a highly productive region, containing two of the nation's busiest ports, Baltimore and Hampton Roads. Unfortunately, over the past two decades its health has become cause for concern.

I. Background

The Chesapeake Bay is the nation's largest estuary, comprised of a mix of salt and fresh water. Approximately half of the water filling the 4,500 square miles of estuary is from the Atlantic Ocean, while the other half is comprised of the freshwater runoff from the Bay's watershed. The Chesapeake Bay's enormous watershed includes parts of six states: Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia; supports a population well over 16 million; and extends for 64,000 square miles. This means the freshwater, whether from streams or rainfall, from over 64,000 square miles of land will eventually runoff and drain into the Chesapeake Bay. Another way to view this, the ratio of land area in the watershed to actual Bay is 14 to 1. Therefore, the actions taken by individuals, industries and agriculture located

anywhere within the watershed will impact the Bay's health and water quality.

II. The Problem

The Bay's watershed plays an integral role in its well-being, and actions within its watershed are ultimately what have led to its deteriorating health. There are two main threats to the Bay's health, nutrient and sediment pollution, and both stem from the watershed runoff. When excessive amounts of nitrogen and phosphorus from runoff end up in the Bay, it is called nutrient pollution, and sediment pollution is the small particles, usually from erosion, that also drain into the Bay via runoff. Both forms of pollution end up decreasing water quality and wreaking havoc on marine life.

A certain amount of nitrogen and phosphorus are needed in the Bay for its ecosystem to function properly. However when excessive amounts are present, these nutrients trigger and feed massive algal blooms. Algae is also an important part of the Bay's ecosystem, but like the nutrients, when present in excess the algae do more harm than good. Algal bloom decreases water clarity, thus decreasing the amount of sunlight reaching underwater vegetation. For the Bay's marine life, this underwater

vegetation is not only a food source and a shelter from predators, but also a source of oxygen. When the underwater vegetation starts to die from lack of sunlight, the marine life dependent upon this vegetation for survival suffers as well.

Algal blooms often release toxin which can result in fish kills. A fish kill not only kills surrounding marine life, but also makes it unsafe for humans to swim in such areas, prompting swim advisories. In addition, when the millions of organisms that compose the algal bloom finally begin to die off, they decay with the help of bacteria that require oxygen. These bacteria remove a large amount of oxygen from the water, creating areas in the bay with too little oxygen to support life, called dead zones. Recently, Maryland and Virginia reported over 45 fish kills in a little over two months. All were due to toxic algal blooms or oxygen-deprived dead zones.

Sediment pollution in the Bay only exacerbates the problems created by nutrient pollution. Excess sediment further reduces water clarity, and also smothers life dwelling on the bottom of the Bay. What's more, the larger surface area of most sediment particles gives toxic substances from runoff, such as mercury and other toxic metals, a place to accumulate. These substances find their way into the tissues of marine life, making seafood consumption unsafe.

Water pollution enters the Bay through many different sources, some natural but most from human action. The majority of pollution is from one of two sources: point sources or runoff. A point source of pollution is one that can be identified originating from a specific point, such as a drainage pipe at a sewage treatment facility. Runoff is categorized into agricultural runoff and urban runoff. The more potent and thus most harmful form of runoff is agricultural.

In the year 2000, agricultural runoff was the number one source of nitrogen, phosphorus and sediment into the Chesapeake Bay, depositing 41%, 48% and 63% of each compound respectively. Large scale animal agricultural operations create an enormous amount of nutrient rich manure which leaches into the watershed runoff, as does any

nutrient rich fertilizer. Also, when clearing fields in preparation for planting crops, farmers often remove riparian buffers, which act as natural defense systems by filtering runoff before it reaches the Bay.

Point sources of runoff are most commonly wastewater and sewage treatment plants, or industrial waste sites. In 2000, point sources were responsible for 22% of both nitrogen and phosphorus pollution in the Bay.

Urban runoff refers to the water that accumulates on hard surfaces, such as roads, roofs and parking lots and is unable to soak into the ground. This water will eventually enter waterways either directly or through storm drains, and carry with it a variety of contaminants, including sediment, nitrogen, phosphorus, toxic metals, and oil compounds. In 2000, urban runoff contributed 11% of the nitrogen pollution, 16% of the phosphorus pollution and 9% of the sediment pollution that went into the Bay's waters.

Lastly, air pollution is another way excess nitrogen enters the Bay. Industry smoke stacks and automobile emissions are the two leading contributors of such air pollution. The Bay watershed has a population of almost 17 million. The number of automobiles, plus the energy needs of a population this size puts roughly 97.5 million pounds of nitrogen into the Bay a year.

Human action has substantially increased the amount of pollution reaching the Bay's waters. Road projects, construction and suburban sprawl have increased the area covered by paved and impervious surfaces, while decreasing the Bay's natural filtering defenses. Since colonial times, the Bay has lost over half its wetlands and at least half of its shoreline forests. Moreover, as the population increases, more challenges present themselves. A larger population results in more drivers on roadways, more sewage and wastewater going into treatment plants, more housing developments built, and so on. With the Chesapeake Bay watershed population projected to reach well over 18 million by 2020, the strain on the Bay will only increase.

III. Solving the Problem

During the 1970s and 1980s, Virginia began

enacting laws protecting the Bay's wetlands and marine life, banning phosphates and other dangerous chemicals, and also forming organizations to study the Bay's ecosystem. More importantly, Virginia signed the first Chesapeake Bay Agreement in 1983. This agreement was the first of its kind in environmental law, taking an inter-governmental approach. Other parties to the Agreement included Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and the EPA. In 1987 the parties revisited the Chesapeake Bay Agreement and revised its target goals. The 1987 Agreement set a target goal to reduce nitrogen and phosphorus levels entering the bay by 40% by the year 2000.

The 1990s saw an even harder push for environmental action in the Bay. Virginia enacted many laws, with goals ranging from improving water quality and agricultural waste management, to preserving open land spaces and encouraging agricultural stewardship. Virginia even tried granting an income tax credit to those who donated an easement to the Chesapeake Bay cause.

Despite these effects, the Chesapeake Bay Agreement of 1987 did not meet its original objectives. In 2000 the signers came together once again to reaffirm their commitment to saving the Chesapeake Bay. The Agreement of 2000 created even more challenging criteria: reducing nitrogen entering the Bay by of 110 million pounds annually by the year 2010. Since the establishment of these goals, there has been only a 19 million pound reduction in nitrogen entering the Bay. Unfortunately, with only 2 years before reaching the target year of 2010, it seems as though the 2000 Agreement is destined to join its 1987 counterpart in failing to meet its stated objectives.

The federal government's Farm Bill has also been an important piece of legislation for conservation efforts. Passed in 2002, it contained federal funding specifically aimed toward helping farmers offset the costs of implementing conservation programs. Such programs included helping farmers to establish conservation buffer zones, plant cover crops, and better manage animal waste. The Farm Bill is being reevaluated in 2008, and if the draft is passed as it is currently written, will contain an unprecedented \$200 million in funds for such conservation programs.

Since 2002, Virginia has passed bills aimed to improve storm-water management, to establish a nutrient credit exchange program, and to regulate industrial smokestacks. Furthermore, the Governor and the General Assembly have both stated that the preservation of the Chesapeake Bay should be a top priority.

IV. What could still be done?

In the last 20 years or so, human action has caused excessive amounts of both nitrogen and phosphorus to enter the bay. On the other hand, human action has also helped to bring about some improvement. In the year 1985, the amount of pollution entering the Bay was estimated at 338 million pounds of nitrogen and 27 million pounds of phosphorus. As of 2000, these levels had been reduced to 285 million pounds and 19.1 million pounds, respectively.

Regardless of the incremental progress, the Bay is still deteriorating. Can this trend be turned around? Most agree that restoration of the Bay is indeed possible. However, such a task will require a lot of hard work, sound public policy, increased funding and

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regional cooperation. More specifically, it would involve:

Rebuilding and increasing the buffers and other natural defenses of the Chesapeake Bay.

Finding ways to better control runoff, some of which could be:

- Smart land use and better planning in development
- Implementing agricultural conservation programs
- Upgrading the nutrient removal technology in wastewater and sewage treatment plants

Provide economic incentives for businesses and individuals to encourage adopt conservation practices, some of which include:

- Expanding the tax credits given to those who either donate an easement to the Chesapeake Bay, or to farmers who implement conservation programs.
- Nutrient trading as a market-based way to reduce overall nitrogen and phosphorus levels in the Bay.

Increase funding to existing programs. These include those programs aimed at

- Upgrading nutrient removal technology in wastewater plants
- Improving the water quality
- Increasing the awareness of the public through educational programs
- Enforcement of existing legislation

Public officials and government agencies need to be held accountable when not meeting their stated environmental objectives.

In conclusion, the Chesapeake Bay is a valuable and irreplaceable natural resource and its well-being should be a concern for all. By working together and taking the proper actions toward con-

servation, the Chesapeake Bay could once again be a thriving natural beauty.

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