OFFICE OF INSPECTOR GENERAL

Catalyst for Improving the Environment

Evaluation Report

EPA Relying on Existing Clean Air Act Regulations to Reduce Atmospheric Deposition to the Chesapeake Bay and its Watershed

Report No. 2007-P-00009

February 28, 2007

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Abbreviations

CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CBPO	Chesapeake Bay Program Office
CMAQ	Community Multiscale Air Quality
EPA	U.S. Environmental Protection Agency
ExtRADM	Extended Regional Acid Deposition Model
NAAQS	National Ambient Air Quality Standards
NO_X	Nitrogen oxides
OIG	Office of Inspector General
$PM_{2.5}$	Fine particulate matter less than or equal to 2.5 micrometers in diameter
SIP	State Implementation Plan

Cover photo: Satellite map of the Chesapeake Bay watershed. (U.S. Geological Survey)

U.S. Environmental Protection Agency
Office of Inspector General

2007-P-00009
February 28, 2007

At a Glance

Catalyst for Improving the Environment

Why We Did This Review

This review is one of several conducted by the Office of Inspector General (OIG) in response to a request from a U.S. Senator from Maryland. We were requested to determine how well the U.S. Environmental Protection Agency (EPA) is assisting its Chesapeake Bay partners in cleaning up the Bay. Since atmospheric nitrogen deposition contributes to nitrogen loads in the Bay, we sought to determine the impact air pollution control activities have had in cleaning up the Bay.

Background

The Chesapeake Bay is the largest estuary in the United States, covering 64,000 square miles. Six States and the District of Columbia, various Federal agencies, and others are involved in Bay restoration. EPA estimates that nitrogen depositing back to the earth from the atmosphere accounts for approximately 32 percent of the man-made nitrogen load to the Bay and is a significant contributor to continuing water quality problems in the Bay.

For further information, contact our Office of Congressional and Public Liaison at (202) 566-2391.

To view the full report, click on the following link:
www.epa.gov/oig/reports/2007/20070228-2007-P-00009.pdf

EPA Relying on Existing Clean Air Act Regulations to Reduce Atmospheric Deposition to the Chesapeake Bay and its Watershed

What We Found

EPA's Chesapeake Bay Program Office is relying on anticipated nitrogen deposition reductions from Clean Air Act (CAA) regulations already issued by EPA, combined with anticipated reductions from other non-air sources, to meet water quality goals for the Bay watershed. EPA believes these CAA-related activities will provide sufficient nitrogen deposition reduction to enable the Bay to meets its overall nitrogen cap load, assuming non-air activities achieve planned reductions. EPA estimates that CAA regulations already issued will reduce nitrogen that falls directly into the Bay, as well as nitrogen deposited to the Bay watershed, by 19.6 million pounds annually by 2010. Even greater reductions should occur as States undertake additional measures in the next few years to meet the ozone and fine particulate matter standards. Accordingly, State and EPA strategies do not include additional air reduction activities specifically designed to clean up the Bay. Many State activities being implemented to meet national air quality standards should have the co-benefit of reducing nitrogen deposition in the Bay watershed, including the adoption of legislation and/or regulations by four Chesapeake Bay watershed States that go beyond EPA's air regulations.

Whether all of the Bay nitrogen reduction strategies will be successful remains to be seen. EPA acknowledges that its goal of cleaning up the Bay by 2010 will not be met. EPA plans to meet with its Chesapeake Bay Program partners in 2007 to re-visit their strategy for cleaning up the Bay.

If additional reductions in air emissions are needed to clean up the Bay, one potentially significant source of deposition not currently controlled is ammonia emissions from animal feeding operations. The magnitude of these emissions to nitrogen deposition in the Bay is uncertain. Ammonia emissions monitoring of animal feeding operations, expected to begin in the spring or early summer of this year, should provide data to help EPA better determine the amount of such emissions from farming operations.

What We Recommend

We recommend that the EPA Region 3 Regional Administrator instruct the Chesapeake Bay Program Office to use the results of animal feeding operations emissions monitoring studies to determine what actions and strategies are warranted to address nitrogen deposition to the Bay from such operations. EPA concurred with our recommendation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
INSPECTOR GENERAL

February 28, 2007

MEMORANDUM

SUBJECT: EPA Relying on Existing Clean Air Act Regulations to Reduce Atmospheric Deposition to the Chesapeake Bay and its Watershed
Report No. 2007-P-00009

TO: Donald S. Welsh
Regional Administrator, EPA Region 3

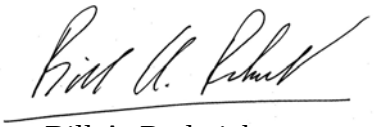
This is our report on the subject evaluation conducted by the Office of Inspector General (OIG) of the U.S. Environmental Protection Agency (EPA). This report contains findings that describe the problems the OIG has identified and corrective actions the OIG recommends. This report represents the opinion of the OIG and does not necessarily represent the final EPA position. Final determinations on matters in this report will be made by EPA managers in accordance with established resolution procedures.

The estimated cost of this report – calculated by multiplying the project's staff days by the applicable daily full cost billing rates in effect at the time – is $360,529.

Action Required

In accordance with EPA Manual 2750, you are required to provide a written response to this report within 90 calendar days. You should include a corrective action plan for agreed upon actions, including milestone dates. We have no objections to the further release of this report to the public. This report will be available at http://www.epa.gov/oig.

If you or your staff have any questions regarding this report, please contact Rick Beusse, Director for Program Evaluation, Air Issues, at (919) 541-5747 or beusse.rick@epa.gov; or James Hatfield, Assignment Manager, at (919) 541-1030 or hatfield.jim@epa.gov.



Bill A. Roderick
Acting Inspector General

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Purpose

In 2000, the Chesapeake Bay watershed partners agreed to reduce nutrient loads in the Bay to improve water quality and remove the Bay from the U.S. Environmental Protection Agency's (EPA's) impaired waters list by 2010. However, Bay stakeholders have questioned whether the needed nutrient load reductions will be met. Because of these concerns, U.S. Senator Barbara A. Mikulski of Maryland requested the EPA Office of Inspector General (OIG) to evaluate the Chesapeake Bay Program's progress in meeting its nutrient reduction goals. As a result, we are evaluating the Chesapeake Bay Program's progress in reducing excess nutrients (nitrogen and phosphorous) from four key sources: agriculture, urban land, point sources, and air deposition.

For this evaluation, the OIG sought to answer the following questions regarding air deposition in the Chesapeake Bay and its watershed:

1. To what extent are current and planned Clean Air Act (CAA) requirements expected to help the Chesapeake Bay Program meet its goal of reducing nitrogen loads by 2010?

2. To what extent are voluntary measures or State-specific regulations that go beyond current and planned CAA requirements needed to help the Chesapeake Bay Program meet its nitrogen load reduction goals?

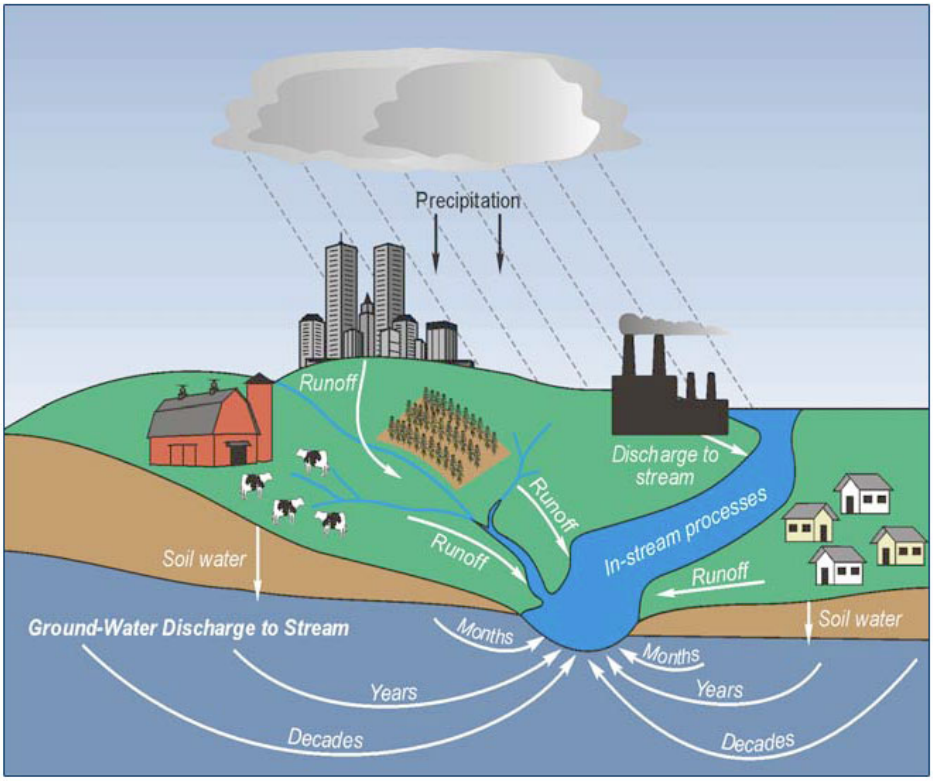
3. What progress have States made in implementing voluntary measures and State-specific regulations to reduce nitrogen deposition to the Chesapeake Bay?

Background

The Chesapeake Bay is North America's largest and most biologically diverse estuary, home to more than 16 million people and 3,600 species of plants, fish, and animals. The Bay's watershed, the geographic area that drains water to the Bay, covers 64,000 square miles. The watershed includes parts of six States – Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia – as well as all of the District of Columbia.

For more than 300 years, the Bay and its tributaries have sustained the region's economy. However, over time, excess nutrients (such as nitrogen) and sediment have accumulated in the Bay, resulting in a degradation of water quality and a loss of aquatic life. The diagram in Figure 1 shows how excess nutrients from all sources end up in the Bay, including air pollutants that can deposit back to the earth through precipitation or by settling under dry conditions.

Figure 1: Conceptual Diagram of Nutrient and Sediment Sources and Pathways in the Chesapeake Bay Watershed



Source: U.S. Geological Survey

Formal efforts to restore the health of the Bay have been ongoing since 1983. Despite these efforts, EPA and its partners acknowledge that the Bay will not meet the targeted nitrogen load reductions by the current goal of 2010. The Chesapeake Bay Program partners plan to meet in 2007 to review progress and re-visit their current strategy for cleaning up the Bay.

Efforts to Restore the Chesapeake Bay

The Chesapeake Bay Program is a regional partnership of State and Federal agencies, academic institutions, and non-governmental organizations formed in 1983 to lead and direct restoration of the Bay. Bay Program members include EPA, Maryland, Pennsylvania, Virginia, the District of Columbia, and the Chesapeake Bay Commission (a tri-State legislative advisory body). As the representative of the Federal Government, EPA and its Chesapeake Bay Program Office (CBPO) coordinate activities and implementation of strategies to meet the restoration goals of the Bay. The CBPO, headquartered in Annapolis, Maryland, is part of EPA's Region 3. The States of Delaware, New York, and West Virginia are also actively involved in the Bay program, but are not signatories to the 2000 agreement for cleaning up the Bay.

Since 1991, the CBPO budget has remained stable at approximately $20 million annually. Other Federal agencies, such as the National Oceanic and Atmospheric Administration and the U.S. Geological Survey, provide expertise and resources to the CBPO to help in the Bay restoration. The Bay Program partners have signed three Chesapeake Bay agreements, the most recent in 2000. The first Chesapeake Bay agreement, established in 1983, did not address air deposition's

contribution to the Bay's water quality problems. The 1987 agreement included an objective to "quantify the impacts and identify the sources of atmospheric inputs on the Bay system." An amendment to the 1987 agreement stated that nutrient reduction strategies would include an air deposition component that builds upon the CAA.

Under the latest agreement, known as *Chesapeake 2000*, the Bay Program partners recommitted to their overall mission of Bay restoration and established new, more ambitious goals. The 2000 Agreement established the goal of improving water quality in the Bay and its tributaries so that these waters may be removed from EPA's impaired waters list by 2010. The partners agreed that annual nitrogen loads entering the Bay from tributaries should not exceed 175 million pounds by 2010, an estimated 110-million-pound annual reduction from 2000 levels. The overall 175-million-pound nitrogen load was allocated among all the tributaries that feed into the Bay. Each partner State developed a State tributary strategy to meet its nitrogen cap load allocation.

The 110-million-pound annual reduction includes 8 million pounds of annual nitrogen deposition reductions anticipated from implementing EPA's March 2005 Clean Air Interstate Rule (CAIR). The remaining 102-million-pound annual reduction is expected to come from existing CAA regulations and non-air sources. The air and non-air reductions are combined and reflected in the overall nitrogen load goals for each tributary. According to EPA modeling estimates, other air regulations are estimated to achieve about 7 million pounds of nitrogen reductions annually. The 15 million pounds of nitrogen reductions expected annually from CAIR and other air regulations are related to deposition that falls in the Bay watershed and eventually ends up in the Bay. EPA modeling also projects that CAIR and other air regulations will reduce nitrogen deposition that falls directly into the Bay by 4.6 million pounds annually. Thus, CAIR and other air regulations are expected to reduce nitrogen that falls to the Bay watershed and directly into the Bay by about 19.6 million pounds annually.

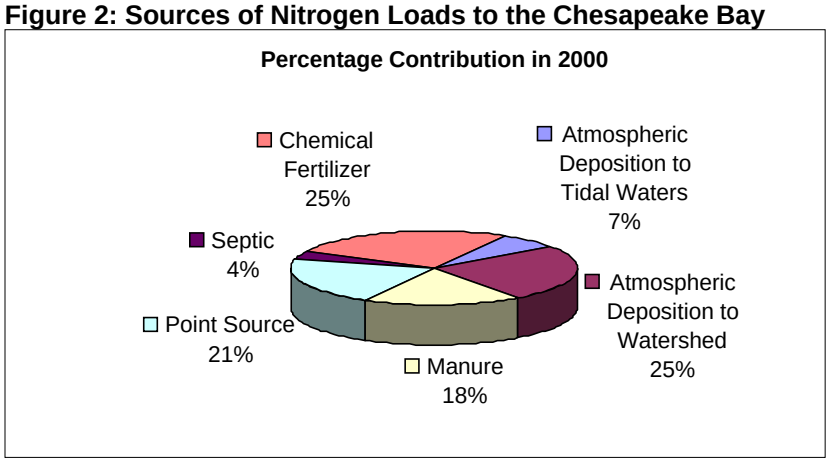
Contribution of Air Emissions to Nitrogen in the Chesapeake Bay

Excess nitrogen in the Bay comes from many sources. These sources include chemical fertilizer (nonagricultural and agricultural), municipal and industrial wastewater treatment plants (point sources), septic systems, livestock (manure), and the air, as shown in Figure 2.

EPA has identified air emissions of nitrogen oxides (NO_X) as a significant contributor to the excess nitrogen loads in the Bay. The NO_X emissions that contribute nitrogen deposition to the Bay and its watershed come from States both inside and outside the watershed. This geographical area is referred to as the airshed.[1] NO_X air emissions can wind up in the Bay by depositing directly into the Bay (i.e., tidal waters) or by depositing in the Bay watershed. The time it takes from the emission of NO_X in the airshed to its deposition into the watershed ranges from within minutes to about 1.5 days, according to model estimates. Deposition in the Bay watershed can eventually wash into the Bay from streams, rivers, and runoff, or through groundwater flow.

[1] EPA defines the Bay airshed as the area where nitrogen emission sources are estimated to cumulatively contribute 75 percent of the total nitrogen deposition to the Bay and its surrounding watershed.

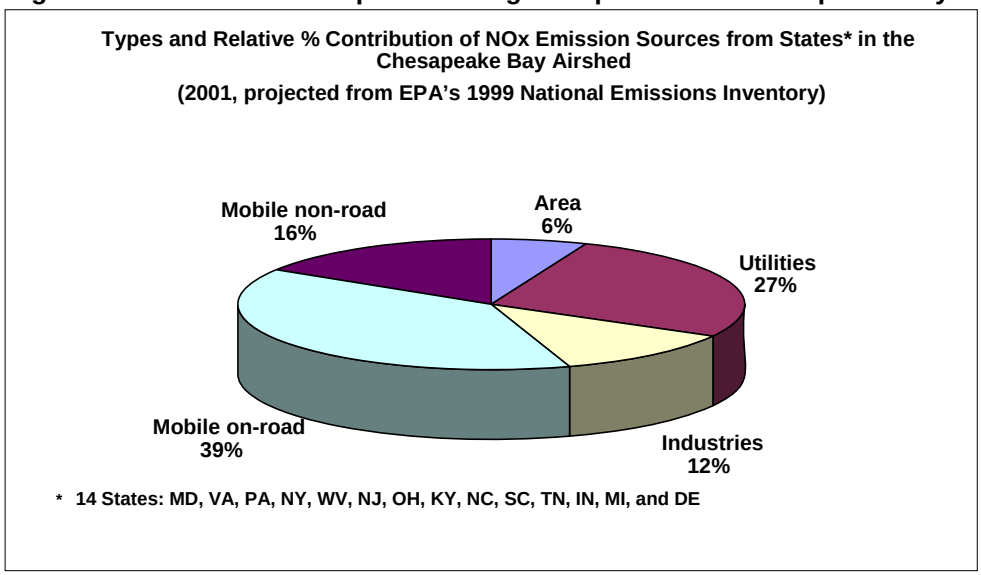
Figure 2: Sources of Nitrogen Loads to the Chesapeake Bay



Source: OIG staff from data provided by CBPO

At the time of the *Chesapeake 2000* agreement, air deposition was estimated to contribute approximately 32 percent[2] of the nitrogen entering the Bay, as shown in Figure 2 above. Figure 3 shows the relative contribution of the major types of NO_X air emission sources to atmospheric nitrogen deposition in the Bay.

Figure 3: Sources of Atmospheric Nitrogen Deposition to Chesapeake Bay



Source: EPA and National Oceanic and Atmospheric Administration

As shown in the figure above, the primary sources of NO_X air emissions that deposit in the Bay are utilities and mobile on-road sources, such as cars and trucks. Utilities and mobile on-road sources together account for nearly two-thirds of all air pollution sources in the airshed. Mobile non-road (e.g., lawnmowers, locomotives, marine vessels), industry, and area sources (e.g., dry cleaners, gas stations) account for 16, 12, and 6 percent, respectively.

[2] Nitrogen deposition to the watershed (25 percent) plus nitrogen deposition directly to tidal waters (7 percent).

Noteworthy Achievements

CAA regulations, such as CAIR, are expected to reduce airborne nitrogen loads to the Bay by about 19.6 million pounds annually by 2010. State-specific activities to meet the National Ambient Air Quality Standards (NAAQS)[3] for ozone and $PM_{2.5}$ should further reduce nitrogen loads to the Bay. In fact, four Chesapeake Bay watershed States have already adopted legislation and/or regulations that go beyond EPA's air regulations.

Scope and Methodology

We performed our evaluation in accordance with *Government Auditing Standards* issued by the Comptroller General of the United States. We conducted field work from April 2006 through August 2006. To answer the three evaluation objectives, we reviewed numerous Chesapeake Bay-related documents and interviewed EPA and State officials and staff. Key documents reviewed included State-tributary strategies, reports explaining how nitrogen cap loads were set, and the results of nitrogen deposition modeling. We interviewed EPA officials and staff from the CBPO in Annapolis, Maryland; the Office of Research and Development in Research Triangle Park, North Carolina; and the Office of Water in Washington, DC. In addition, we obtained input from EPA's Office of Air Quality Planning and Standards on our detailed findings outline. We also interviewed State officials and staff involved in Chesapeake Bay restoration from the Maryland Department of Natural Resources, the Maryland Department of the Environment, the Pennsylvania Department of Environmental Protection, and the Virginia Department of Environmental Quality. See Appendix A for additional details on our scope and methodology, including prior coverage, internal controls, and data limitations.

Results of Review

Federal CAA regulations designed to decrease NO_X emissions should reduce the amount of nitrogen that reaches the Bay in the future. These regulations are being implemented to achieve national air quality standards designed primarily to protect human health, but have the co-benefit of reducing airborne emissions that contribute to Bay pollution problems. Consequently, current strategies for cleaning up the Bay are based on the expectation that existing and planned CAA-related air emissions reductions will enable the Bay Program to meet its overall nitrogen load reduction goals, provided that the non-air nitrogen reduction goals are also met. We did not assess the feasibility of implementing additional air regulations beyond the current CAA-related requirements.

The following sections discuss the results of our review for the three questions we raised regarding air deposition to the Chesapeake Bay.

[3] The CAA requires EPA to set NAAQS for air pollutants considered harmful to public health and the environment. EPA sets health-based or primary NAAQS limits to protect public health with an adequate margin of safety. EPA has set primary standards for six common air pollutants, including ozone and particulate matter.

1. To what extent are current and planned CAA requirements expected to help the Chesapeake Bay Program meet its goal of reducing nitrogen loads by 2010?

Based on EPA modeling projections,[4] existing and planned CAA-related actions are expected to obtain sufficient nitrogen deposition reductions to enable the Bay to meet its overall nitrogen reduction goals, if planned non-air reduction goals are met. However, CBPO officials have acknowledged the overall goal will not be met by 2010 at the current rate of implementation. CAA regulations are expected to reduce nitrogen loads to the Bay by 15 million pounds annually by 2010, as follows:

- CAIR is expected to reduce nitrogen loads to the Bay by 8 million pounds of nitrogen a year beginning in 2010.
- EPA estimates that existing clean air regulations in addition to CAIR will provide an additional 7 million pounds of reductions annually.

EPA expects future State actions to address nonattainment areas for ozone and fine particles (fine particulate matter less than or equal to 2.5 micrometers in diameter, or $PM_{2.5}$) to further reduce nitrogen deposition to the Bay. EPA plans to model the impact of these activities on the Bay after State implementation plans for addressing these nonattainment areas are submitted to EPA in 2007 and 2008.

The 15-million-pound annual reductions expected from current regulations and CAIR are based on the assumption that watershed conditions, such as land use patterns, are the same for 2000 and 2010. EPA used this land use assumption to isolate the impact of the CAA regulations on the Bay, and it is not meant to suggest that the land use patterns will in fact remain constant. This is an important assumption because land use patterns greatly impact the percentage of atmospheric deposition that is absorbed and conveyed by the land, thus impacting what is delivered to the Bay. For example, forests in the Bay watershed are able to absorb most of the atmospheric nitrogen and prevent it from entering the Bay. Conversely, land surfaces that have been paved will not absorb significant amounts of nitrogen. The Conservation Fund and the U.S. Department of Agriculture's Forest Service recently reported that, since 1970, the forests in the Bay watershed have been declining at a rate of at least 100 acres each day.

The 15-million-pound reduction discussed above is related to deposition that falls in the Bay watershed (excluding Bay tidal waters) and eventually winds up in the Bay. In addition to this 15-million-pound reduction, EPA modeling projects that CAIR and other existing air regulations will reduce atmospheric deposition that falls directly into the Bay by 4.6 million pounds annually. This 4.6 million pounds represents a 22-percent reduction from 2000 to 2010, and is unaffected by land use. Collectively, EPA estimates that CAA regulations already issued will reduce nitrogen that falls directly into the Bay, as well as nitrogen deposited to the Bay

[4] These projections are based on air deposition estimates obtained from the Extended Regional Acid Deposition Model (ExtRADM) and preliminary estimates from the Community Multiscale Air Quality (CMAQ) model. EPA's Office of Research and Development is responsible for carrying out the modeling. CBPO has started using the CMAQ modeling results to provide its air deposition estimates, but estimates using the CMAQ model had not been finalized at the time we completed our review.

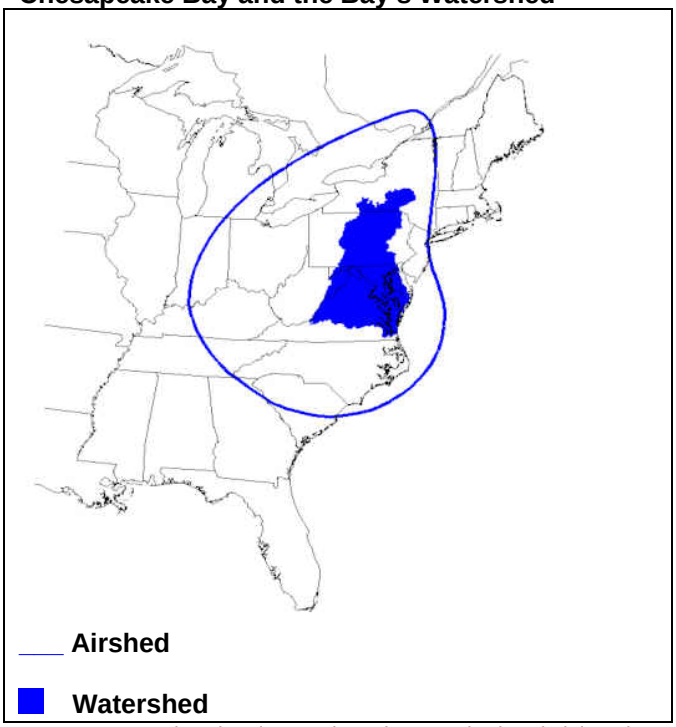
watershed, by 19.6 million pounds annually by 2010. Appendix B presents the relative contribution of atmospheric deposition to the Bay's overall nitrogen loads for 2000 and 2010, assuming land use patterns and land use nitrogen loads change to meet the goals and activities outlined in the State-tributary strategies.

CAIR Expected to Reduce Nitrogen Deposition to the Bay

The Bay watershed model estimated that roughly 305 million pounds of nitrogen entered the Bay in 2000.[5] Of that sum, an estimated 97 million pounds were from direct and indirect atmospheric deposition (see Figure 3 for the relative contribution of the major types of NO_X air emission sources to nitrogen deposition in the Bay).[6]

The CBPO estimates that airshed States contribute 76 percent of the airborne nitrogen deposition to the watershed; the Bay watershed States alone contribute 49 percent of the watershed's airborne nitrogen deposition. Figure 4 shows the airshed and the watershed for the Bay.

Figure 4: NO_X Emissions Airshed for the Chesapeake Bay and the Bay's Watershed



Source: EPA and National Oceanic and Atmospheric Administration

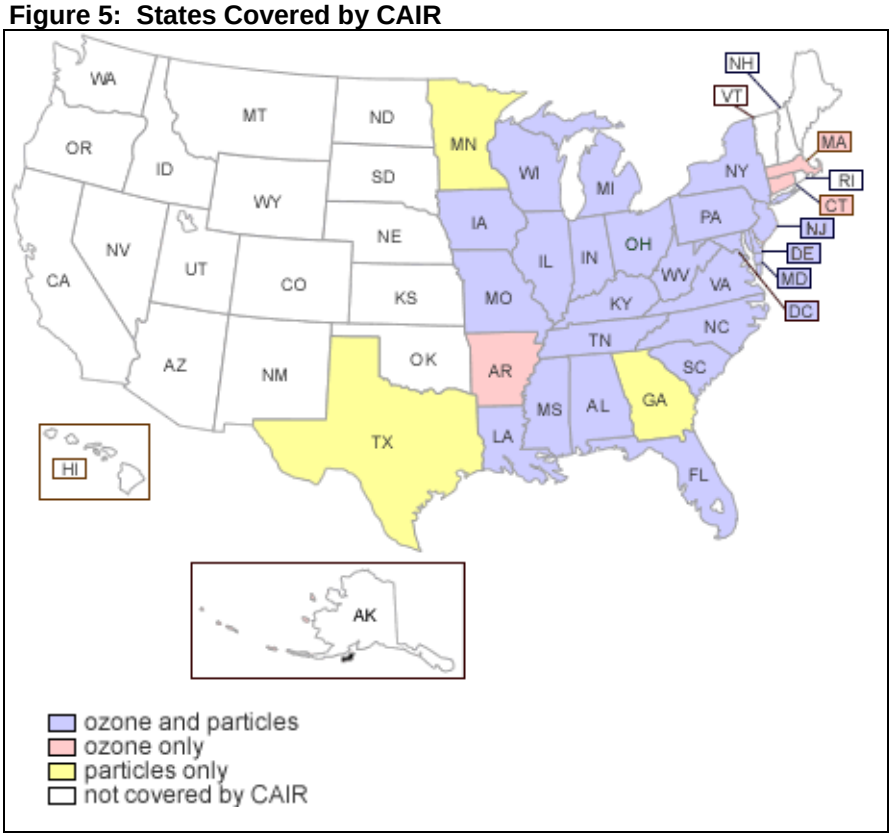
[5] Of the 305 million pounds of nitrogen that entered the Bay, EPA estimated that 20 million pounds directly deposited in the Bay and 285 million pounds flowed into the Bay and its rivers from the watershed.

[6] Deposition to the watershed of 76.5 million pounds plus deposition directly to tidal waters of 20.5 million pounds equals 97 million pounds.

In 2005, EPA promulgated CAIR, a cap and trade program[7] designed to reduce emissions of NOx and sulfur dioxide in the eastern United States. The States subject to CAIR include all of the States in the Chesapeake Bay airshed plus 14 surrounding States. Air emissions in these States contribute to unhealthy levels of ground-level ozone and/or fine particles. CAIR should achieve significant year-round NO_X reductions across the 28 States and District of Columbia covered by the rule. The first cap on NO_X emissions required by CAIR occurs in 2009. In that year, EPA estimates that CAIR will reduce NO_X emissions from utilities by 3.4 billion pounds, or 53 percent, from 2003 levels. Based on EPA modeling projections, the 3.4-billion-pound emission reduction is expected to result in an 8-million-pound reduction in nitrogen loads to the Bay by 2010.

When the final cap on NO_X emissions takes effect in 2015, CAIR is expected to reduce utility plant NO_X emissions by an additional 600 million pounds from the 2009 cap, a 61-percent reduction from 2003 levels. Thus, CAIR is expected to have a positive impact on the Bay. Figure 5 shows the States covered by CAIR.

Figure 5: States Covered by CAIR



Source: EPA

[7] Cap and trade is a market-based program that sets a cap, or maximum limit, on emissions. Sources covered by the program receive authorizations to emit in the form of emissions allowances, with the total amount of allowances limited by the cap. Each source can design its own compliance strategy to meet the overall reduction requirement, including sale or purchase of allowances, installation of pollution controls, or other options.

State Control Measures to Attain the NAAQS for Ozone and Fine Particles Expected to Decrease Nitrogen Deposition to the Bay

State-specific activities to meet the NAAQS for ozone and $PM_{2.5}$ should provide additional NOx emission reductions and have the co-benefit of reducing nitrogen loads to the Bay. The air quality in numerous counties within the Chesapeake Bay airshed exceeds the NAAQS for ozone and $PM_{2.5}$. EPA has designated these areas as nonattainment.[8] Accordingly, all States in the Chesapeake Bay watershed (including the District of Columbia) and many States in the airshed are required to implement steps to reduce ozone and $PM_{2.5}$ levels in these nonattainment areas.

The steps States plan to take to meet the NAAQS are outlined in State Implementation Plans (SIPs) and submitted to EPA for approval. States are required to submit their ozone SIPs to EPA by June 2007, and their $PM_{2.5}$ SIPs by April 2008. Depending on the severity of the ozone nonattainment, an area may have from 3 years (for marginal nonattainment) to 20 years (for severe nonattainment) from the effective date of nonattainment designation to achieve the standard. Ozone nonattainment areas in the Bay watershed States range from marginal to moderate in severity. Compliance with the 8-hour ozone standard for these areas ranges from June 15, 2007, to June 15, 2010. The attainment date for the $PM_{2.5}$ standard is April 2010, but this date can be extended up to April 2015. Once these SIPs are received, EPA plans to model the impact that the activities outlined in these SIPs will have on nitrogen deposition in the Bay.

2. To what extent are voluntary measures or State-specific regulations that go beyond current and planned CAA requirements needed to help the Chesapeake Bay Program meet its nitrogen load reduction goals?

Currently, the CBPO does not consider voluntary or State-specific regulations that go beyond current and planned CAA requirements necessary to meet the overall nitrogen load for the Bay. However, the Chesapeake Bay Program partners may pursue voluntary and regulatory actions beyond CAA requirements that yield additional reductions in nitrogen loads delivered to Chesapeake Bay tidal waters. The CBPO stated that the Bay Program partners have agreed to quantify and account for these State-specific regulatory actions as anticipated nitrogen reductions from air emission reductions. The CBPO also said the potential Chesapeake Bay water quality benefits from these anticipated reductions will be quantified and factored into the States' tributary strategies. As noted earlier, the Bay Program will not meet its nitrogen reduction goals by 2010, but plans to re-visit its strategy for cleaning up the Bay in 2007.

Even if future analyses were to determine that the Bay could not be cleaned up without additional NO_X emission reductions, the CBPO does not have the authority to establish or promulgate air-related regulations. Absent the promulgation of additional air regulations by EPA's Office of Air and Radiation, the CBPO would have to rely upon regulatory or voluntary measures from the State partners to achieve these reductions. However, promulgating State air regulations that are stricter than Federal air regulations can be difficult. For example,

[8] In the 14 States and the District of Columbia that comprise the Chesapeake Bay airshed, 300 counties are designated nonattainment for ozone and 147 counties are designated nonattainment for $PM_{2.5}$.

Pennsylvania officials told us they are prohibited by State law from developing regulations for the agricultural industry that are not specified by the CAA. Even when State law allows stricter regulations, the amount of detailed justification required and other procedural barriers can make adopting more stringent regulations difficult. Nevertheless, at least four Chesapeake Bay watershed States have already adopted legislation and/or regulations that go beyond EPA regulations in reducing NO_X emissions, as follows:

- **New York (Acid Deposition Reduction Program - 2004).** Requires certain utilities to reduce emissions of sulfur dioxide and NO_X to 50 percent below Phase 2 levels of the Federal Acid Rain Program.
- **New York (Low Emission Vehicle Program – 2005).** Adopts California's second generation low emission vehicle program for light-duty vehicles (LEV II), which is more stringent than EPA's Tier 2 vehicle emission standards.
- **Maryland (Healthy Air Act - 2006).** Accelerates the timeline for utilities to meet the NOx reductions outlined in CAIR, and sets a lower NOx cap than CAIR.
- **Virginia (Clean Smokestack Act - 2006).** The State can prohibit utilities in nonattainment areas from purchasing allowances under the EPA-administered cap and trade system in order to meet their NO_X and sulfur dioxide budgets.
- **Pennsylvania (Clean Vehicles Program – 2006).** Adopts California's second generation low emission vehicle program for light-duty vehicles (LEV II), which is more stringent than EPA's Tier 2 vehicle emission standards.

All of these regulations were adopted to ensure that attainment dates for NAAQS will be met. However, they have the co-benefit of helping to reduce airborne nitrogen loads in the Bay. As shown earlier in Figure 3, on-road mobile sources and utilities are the two primary sources of NOx emissions in the Bay airshed. All the programs mentioned above are directed at these two sources of NOx emissions.

If EPA determines that additional reductions in nitrogen loads to the Bay are needed to clean up the Bay, ammonia emissions from animal feeding operations represent a potentially significant contributor of nitrogen loads to the Bay that is not currently controlled. Continuing increases in emissions of ammonia,[9] a nitrogen compound, and subsequent deposition of ammonia and ammonia-derived compounds are expected to offset some of the benefits from NO_X emissions regulations. This is compounded by the fact that ammonia emissions from animal feeding operations are not currently controlled by CAA-related regulations. Ammonia contributes to the formation of ammonium-based fine particulate matter, a CAA criteria pollutant that can deposit onto the watershed and contribute to the accumulation of excess nitrogen loads in the Bay.

Quantifying the extent of ammonia emissions is needed to determine the impact on nitrogen deposition in the Bay watershed and better address the problem. The largest source of ammonia emissions in the United States, including the Chesapeake Bay region, is animal feeding operations. However, there is significant uncertainty in the emissions inventory for this source.

[9] Ammonia is a chemical compound of nitrogen and hydrogen. The majority of these emissions come from the volatilization of manure/animal waste at animal feeding operations. Once in the atmosphere, ammonia can react with other chemicals to produce ammonium aerosol.

The uncertainty lies in the lack of quality data to establish emission estimating methods that account for the effect of type and class of animals, varying climate conditions, and differing farming practices. EPA plans to address this research need through the 2005 Animal Feeding Operations Consent Agreement and Final Order that will monitor emissions of air pollutants from these operations, including ammonia, for about 24 months. The monitoring program is expected to begin in the spring or early summer of this year. Data from the monitoring program will allow EPA to develop a process-based emission estimating model that considers the entire production process of livestock products. EPA can then input a more accurate emission inventory into air quality models that determine the fate of the ammonia emissions that include deposition onto sensitive ecosystems, such as the Bay.

3. What progress have States made in implementing voluntary measures and State-specific regulations to reduce nitrogen deposition to the Chesapeake Bay?

The current strategy for cleaning up the Bay relies on CAA-related reductions and does not call for any additional State-specific regulatory or voluntary actions. We spoke with State environmental managers and staff from Maryland, Virginia, and Pennsylvania. These managers and staff confirmed that their States have not implemented any air pollution control measures specifically designed to help clean up the Bay. However, they identified a number of ongoing activities designed to help States meet the ozone and $PM_{2.5}$ NAAQS that will have the co-benefit of reducing nitrogen deposition to the Bay. As discussed in the prior section that addressed our second question, some of these activities include programs that go beyond the requirements of EPA's air regulations in reducing NOx emissions. While not specifically designed to address the Bay's problem, these regulations will have the co-benefit of reducing nitrogen loads to the Bay.

Conclusion

EPA is relying on existing CAA regulations to reduce atmospheric nitrogen deposition to the Bay. Current and proposed Federal air regulations, as well as pollution control activities at the State level, are expected to have the co-benefit of reducing nitrogen deposition to the Bay. EPA modeling projects that these air regulations will decrease NOx emissions to the extent needed to meet the atmospheric deposition goals in the *Chesapeake 2000* agreement. While EPA expects to achieve the planned reductions from the air sector, meeting the non-air nitrogen reduction goals is proving difficult. Bay partners agree that there is much work to be done to reduce nitrogen loads to the Bay and, at the current rate of progress, the Bay and its tributaries will not be removed from EPA's impaired waters list by 2010. Consequently, additional opportunities for reducing nitrogen loads to the Bay may need to be identified. Airborne ammonia emissions from animal feeding operations may present one such opportunity, but more information is needed to determine the impact of these emissions on the Bay.

Recommendation

We recommend that the EPA Region 3 Regional Administrator:

1. Instruct CBPO to use the results of the animal feeding operations emissions monitoring studies to determine what actions and strategies are warranted to address animal feeding operations' nitrogen deposition to the Chesapeake Bay.

Agency Comments and OIG Evaluation

EPA concurred with our recommendation. The OIG expects to receive the Agency's response to this final report within 90 days with specifics for implementing this recommendation, including milestones.

Status of Recommendation and Potential Monetary Benefits

RECOMMENDATION						POTENTIAL MONETARY BENEFITS (in $000s)[2]	
Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Claimed Amount	Agreed To Amount
1	12	Instruct CBPO to use the results of the animal feeding operations emissions monitoring studies to determine what actions and strategies are warranted to address animal feeding operations' nitrogen deposition to the Chesapeake Bay.	O	EPA Region 3 Regional Administrator			

[1] O = recommendation is open with agreed-to corrective actions pending;
C = recommendation is closed with all agreed-to actions completed;
U = recommendation is undecided with resolution efforts in progress

[2] Assessing potential monetary benefits was not an objective of this evaluation.

Appendix A

Details on Scope and Methodology

Prior Coverage

The EPA OIG recently issued two reports on the Chesapeake Bay:

- *EPA Grants Supported Restoring the Chesapeake Bay* (Report No. 2006-P-00032), September 6, 2006 – We reported that EPA effectively awarded grant funds toward projects that should maximize environmental benefits in the Chesapeake Bay.

- *Saving the Chesapeake Bay Watershed Requires Better Coordination of Environmental and Agricultural Resources* (EPA OIG Report No. 2007-P-00004), November 20, 2006 – This report, jointly conducted by the EPA OIG and the U.S. Department of Agriculture Office of Inspector General, addresses the Chesapeake Bay Program's progress in reducing excess nutrients and sediment from the agricultural sector. The report noted that despite significant efforts directed at the agricultural community to improve water quality in the Bay watershed, such as agricultural best management practices, excess nutrients and sediment continue to impair the Bay's water quality.

The Government Accountability Office issued *Chesapeake Bay Program: Improved Strategies Are Needed to Better Assess, Report, and Manage Restoration Progress* (Report No. GAO-06-96) on October 28, 2005. This report noted that the Chesapeake Bay Program (1) had not yet developed and implemented an integrated assessment approach for measuring progress; (2) did not effectively communicate the status of the health of the Bay to the public; and (3) did not have a comprehensive, coordinated implementation strategy to meet the goals of the *Chesapeake 2000* Agreement.

Internal Controls

Government Auditing Standards require that auditors obtain an understanding of internal controls significant to the audit objectives and consider whether specific internal control procedures have been properly designed and placed in operation. This evaluation was a limited-scope assessment of the role of atmospheric deposition in the Chesapeake Bay Program's efforts to reduce overall nitrogen loads in the Bay. The extent of atmospheric deposition's contribution to Bay nitrogen loads and the impact of NO_X emission reductions activities on atmospheric deposition is estimated using complex environmental models. The Chesapeake Bay Program, until recently, relied upon the ExtRADM model to track nitrogen emissions from all sources in the airshed. The ExtRADM has been peer-reviewed, a key internal control for ensuring the acceptability of scientific data and processes. During the course of our review, the Program switched its Airshed Model from the ExtRADM to the CMAQ model. However, EPA had not finalized any modeling runs using the new model at the time we completed our field work. The CMAQ model has also been peer-reviewed.

Limitations

The atmospheric deposition data presented in this report is based on estimates produced by EPA models. These models in turn rely upon numerous data collected from and generated by other sources and models. For example, a key input to the atmospheric deposition models (ExtRADM and CMAQ) are NO_X emission inventories and projected NO_X emissions for future years. Sources of the NO_X emission inventory include Continuous Emission Monitoring of point sources, such as utilities, and results from emission estimating methods and models for area and mobile sources. EPA uses NO_X emission data as inputs into models that take into account growth and other factors to estimate future NOx emissions inventories. In the case of utilities, estimates of future years' NO_X emissions are generated by the Integrated Planning Model, an economic model of the utility sector. We did not assess the accuracy of the inputs to the various models used in generating the atmospheric deposition estimates or assess the appropriateness of EPA's use of these models.

Air deposition data is one of many data sources for the Chesapeake Bay Program Watershed model. The Watershed model estimates the delivery of nutrients from all areas of the watershed to tidal waters under different management scenarios. We did not assess the accuracy of modeling data generated by the Chesapeake Bay Program Watershed model.

Appendix B

Chesapeake Bay Nitrogen Loads

The following table shows the relative contribution of atmospheric deposition to the Bay's overall nitrogen loads in 2000 and 2010 if land use patterns and land use nitrogen loads change as outlined in the State-tributary strategies. As noted earlier in the report, land use patterns greatly impact the percentage of atmospheric deposition that is delivered to the Bay. Accordingly, the difference in atmospheric deposition to the watershed between 2000 and 2010 represents the combined impact of reductions in atmospheric deposition and full implementation of the activities (best management practices, installation of riparian buffers, etc.) outlined in the most recent State-tributary strategies. However, as explained earlier in this report, the nitrogen load cap of 175 million tons will not be met by 2010. Thus, this table does not represent an estimate of Bay nitrogen loads for 2010, and only illustrates the potential impact of CAA regulations in combination with the State-tributary strategies. The difference in atmospheric deposition directly to tidal waters does represent the anticipated impact of CAA regulations, including CAIR, since this deposition is unaffected by land use.

Table B.1: Bay Nitrogen Loads for 2000 and 2010

Sources of Nitrogen	2000 Nitrogen Loads (million pounds)	2010 Projected Nitrogen Loads (million pounds)
Manure [a]	54.6	25.2
Chemical Fertilizers [a]	78.9	43.6
Point Sources (i.e., wastewater treatment plants) [a]	62.8	40.6
Septic systems [a]	11.9	9.4
Atmospheric Deposition to Watershed [b]	76.5	62.6
Total Nitrogen Load from Watershed Before CAIR	284.8 [c]	181.3 [c d]
Atmospheric Deposition Directly to Tidal Waters	20.5	15.9 [e]
Total Nitrogen Load	305.3	197.2

Source: Table based on modeling data provided by the CBPO.

[a] 2010 projected loads are the goals outlined in the respective State-tributary reductions and not an estimate of what is expected to occur in 2010. EPA has acknowledged that some of these reductions will not occur by 2010.

[b] Includes deposition from all emission sources, i.e., on-road and non-road mobile, utility, industry, and area sources (including agriculture).

[c] Totals do not add to exact number due to rounding.

[d] Includes reductions attributable to CAA implementation, i.e., "Tier II" tail pipe standards, Title IV (Acid Rain Program), and the NO_X SIP call. This total does not include expected reductions from implementation of CAIR since the impact of CAIR has not been modeled against expected watershed conditions for 2010. CAIR is estimated to provide an 8-million-pound reduction if watershed conditions did not change from 2000 to 2010.

[e] Includes reductions attributable to actions referenced in table note "d" plus reductions from CAIR. These reductions would be fully attributable to air regulations since land use patterns would not impact direct deposition to tidal waters.

Appendix C

Agency Response to Draft Report

February 5, 2007

MEMORANDUM

SUBJECT: EPA's Response to OIG Draft Assignment No. 2006-01045 dated January 9, 2007 entitled, "Evaluation Report: EPA Relying on Existing Clean Air Act Regulations to Reduce Atmospheric Deposition to the Chesapeake Bay and its Watershed"

FROM: Donald S. Welsh
Regional Administrator, Region III

TO: J. Rick Beusse, Director for Program Evaluation, Air Issues
Office of the Inspector General

We concur with the recommendation as described in the report.

If you or your staff has any questions related to our response to the draft report, please contact Rebecca Hanmer at 410-267-5709 or Richard Batiuk at 410-267-5731.

cc. Benjamin Grumbles, Assistant Administrator, Office of Water
William Wehrum, Acting Assistant Administrator, Office of Air and Radiation
Judith Katz, Director, Region 3 Air Protection Division
Jon Capacasa, Director, Region 3 Water Protection Division
Rebecca Hanmer, Director, Region 3 Chesapeake Bay Program Office
Richard Batiuk, Associate Director for Science, Chesapeake Bay Program Office
Lorraine Fleury, Audit Coordinator, Region 3
Michael Mason, Office of Water

Appendix D

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