U.S. House of Representatives
Committee on Transportation and Infrastructure
Washington, DC 20515

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May 9, 2008

SUMMARY OF SUBJECT MATTER

TO: Members of the Subcommittee on Water Resources and Environment

FROM: Subcommittee on Water Resources and Environment Staff

SUBJECT: Field Hearing on the Impacts of Nutrients on Water Quality in the Great Lakes

PURPOSE OF HEARING

On Monday, May 12, 2008, at 12:00 p.m., at the Board of Commissioner's Room of the St. Clair County Commission, 200 Grand River Avenue, Port Huron, Michigan, the Subcommittee on Water Resources and Environment will receive testimony from representatives from the National Oceanic and Atmospheric Administration ("NOAA"), academia, and other interested stakeholders on the impact of nutrients on water quality in the Great Lakes.

BACKGROUND

Nutrients, such as nitrogen and phosphorous, in appropriate amounts, are essential to the health of aquatic systems. Excessive nutrients, however, can result in harmful or nuisance algal blooms, reduced spawning grounds and nursery habitat for fin fish and shell fish, fish kills, oxygen-starved hypoxic or "dead" zones, and public health concerns related to impaired drinking water sources and increase exposure to toxic microbes.[1] Nutrient problems can exhibit themselves locally or much further downstream, leading to degraded estuaries, lakes, reservoirs, and to hypoxic zones where fish and aquatic life can no longer survive.[2]

Recent reports on water quality conditions provided by the states indicate that nutrients are the leading cause of impairment in lakes, ponds, and reservoirs, and the second leading cause of impairment to bays and estuaries. In the National Water Quality Inventory: Report to Congress for

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[1] *See* Letter from Assistant Administrator of EPA's Office of Water, Ben Grumbles, to State water program directors, dated May 25, 2007 (hereafter referred to as "Grumbles letter").
[2] *See* Grumbles letter.

the 2002 Reporting Cycle,[3] states reported that excessive nutrients were key causes of water quality impairment for streams, rivers, lakes, bays, and estuaries. For example, states reported that roughly 40 percent of assessed lakes, 22 percent of assessed bays and estuaries, and 15 percent of assessed rivers and streams identified excessive nutrients as a causing the waterbody to fail to meet its designated uses. In the Great Lakes, states have identified nutrient contamination as a major cause of water quality impairment.

Similarly, the U.S. Department of the Interior's U.S. Geological Survey has determined that only about 40 percent of U.S. stream miles meet EPA's recommended goal for phosphorous (0.1 milligrams per liter) to control excessive growth of algae and other nuisance plants. For example, about 20 percent of stream miles in the Upper Mississippi River basin meet EPA's goal for phosphorous versus 56 percent in the Great Lakes basin, and nearly 85 percent in New England.

Impacts of Nutrient Pollution:

Nutrient pollution in the Great Lakes:

Excessive nutrient problems can have significant impacts over large areas, and within entire watersheds.

In the 1960s, Lake Erie was famously declared "dead" when excessive nutrients in the Lake fostered excessive algae that became the dominant plant species, covering beaches in slimy moss and killing off native aquatic species by soaking up all of the oxygen. Prior to the enactment of the Clean Water Act, pollution filled Lake Erie with far more nutrients than the lake could handle, with phosphorous being the main culprit.

Phosphorous is a fertilizer that induces plant growth and algae. At the time, phosphorous was also found in many commercial detergents. Plants began growing, dying and decomposing in Lake Erie, creating anoxia[4] (severe deficiency of oxygen) at the bottom of the lake and covering the surface with algal growth. This lack of oxygen killed fish and other aquatic species.

With the enactment of the Clean Water Act, and the signing of the Great Lakes Water Quality Agreement in 1972, a concerted effort was made to reduce the pollutant loadings into the Lakes, including a reduction in phosphorous. This effort has improved the overall health of the Lakes.

In recent years, there has been attention to the continuing problems of excessive nutrients in the Great Lakes, including the reemergence of a "dead" zone within Lake Erie. According to EPA, the bottom waters in the central basin of Lake Erie are again becoming anoxic in the late summer, in part, due to a concern about excessive nutrient loadings to the Lakes.

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[3] In this report, the Environmental Protection Agency ("EPA") summarizes water quality assessments submitted to the agency by states under section 305(b) of the Clean Water Act.

[4] Hypoxia is a condition where the lack of oxygen in a system results in impacts to aquatic species that depend on oxygen for their survival (e.g., finfish and shell fish). Anoxia is hypoxic condition of such severity as to cause permanent damage to the surrounding ecosystem.

Similarly, widespread outbreaks of harmful algal blooms have occurred throughout the Lakes, but most notably at Bear Lake, Michigan; Muskegon Lake, Michigan, Saginaw Bay, Michigan; and in Western Lake Erie. Although the controlling factors for growth of many harmful algal bloom species are not entirely understood, according to NOAA, harmful algal blooms may be linked to over-enrichment of nutrients when runoff from lawns, roads, and farmland accumulate at a rate that "overfeeds" the algae that exist normally in the environment.

Finally, there is growing concern on a relationship between excessive nutrients in the Great Lakes and the presence of two aquatic invasive species – the zebra mussel and quagga mussels. NOAA's Great Lakes Environmental Research Laboratory ("GLERL") is currently studying this relationship, which hypothesizes that, as nutrient laden waters flow into the Lakes, the near-shore microalgae flourish as they feed on the nutrients. The zebra and quagga mussels then feed on the abundance of microalgae, and deposit what they cannot digest or the byproducts of what they can on the bottom of the Lakes. This tends to concentrate nutrients in particular hotspots that often coincide where zebra and quagga mussels are found in abundance. These concentrations of nutrients, in turn, accelerate the growth of harmful algal blooms. In addition, because zebra and quagga mussels are filter feeders, they can quickly turn murky water into clear water, which allows sunlight to penetrate into deeper depths. This expands the depth of water in which algal blooms can grow.

Other Regional Nutrient Pollution Concerns:

Two additional widely known examples of nutrient impacts include the Gulf of Mexico and the Chesapeake Bay. Within these two areas, 35 states contribute to the nutrient loadings that have resulted in large scale water quality and habitat impacts.

In the Gulf of Mexico, each spring, the oxygen levels near the bottom become too low to allow most fish and crustaceans to live in an area that can stretch from the Mississippi River westward along the Louisiana and Texas coasts. According to the National Research Council, the causes of the Gulf of Mexico "dead zone" are "complex, but clearly related to nutrient over-enrichment" from nutrients carried down the waters of the Mississippi River to the Gulf.[5]

Excessive nutrients have also been identified as the primary cause of water quality degradation within the Chesapeake Bay.[6] Excess nutrients fuel large algal blooms that block sunlight and deplete oxygen as the algae decompose. Without sunlight, underwater bay grasses cannot grow, and without sufficient oxygen blue crabs and fish cannot live. In the Chesapeake Bay watershed, the nutrients of concern (phosphorous and nitrogen) come from many sources, such as lawn fertilizer, wastewater treatment plants, septic systems, cropland, livestock, and the air.

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[5] *See* National Research Council. "Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution" (2000).

[6] *See* Report of the Environmental Protection Agency's Office of the Inspector General, "Despite Progress, EPA Needs to Improve Oversight of Wastewater Upgrades in the Chesapeake Bay Watershed" (Report No. 08-P-0049, January 8, 2008).

Sources of Nutrient Pollution:

While natural sources of nutrients are essential to sustain life in the environment, human activities can greatly accelerate eutrophication, or the process of increasing organic enrichment of an ecosystem where the increased supply of organic matter causes changes to the system, such as excessive or toxic production of algal biomass (including red and brown tides), loss of near shore habitat such as sea grass beds, changes in marine biodiversity and species distribution, increased sedimentation of organic particles, and depletion of dissolved oxygen (hypoxia and anoxia).[7]

In general, nutrients predominantly reach surface waters in one of three ways: pipes, runoff from the land, and air pollution deposition.

In heavily populated, urban areas, wastewater discharges from sewage treatment plants and industrial dischargers can be significant contributors of excessive nutrients to local waterbodies. These point sources of nutrients tend to be continuous over time, and enter waterbodies at specific locations, such as specific point sources, combined sewer overflows, or sanitary sewer overflows. Accordingly, point sources of nutrients tend to be the easiest to identify, and monitor, and can often be rectified by constructing additional treatment capacity, or implementing tertiary treatment technologies that can remove excessive nutrients from the wastewater before it is discharged.

Nonpoint sources of nutrient pollution, including failing septic systems, agricultural runoff of fertilizers and animal wastes, urban runoff of pet wastes and lawn fertilizers, atmospheric deposition, and construction runoff, tend to be diffuse, episodic, and more closely linked to seasonal activities such as agriculture growing seasons or construction seasons, or occur only during weather events, such as rainfall. Accordingly, nonpoint sources of nutrient pollution are more challenging to measure and to mitigate.

For example, septic systems may be a significant source of nutrients in suburban environments. Nutrient concentrations and loads entering and leaving septic systems may be well known, but it is less clear what extent these pollutants actually reach waterbodies.

Similarly, since World War II, there has been an expanded use of inorganic fertilizers, such as commercially purchased nitrogen and phosphorous, on agricultural lands, in response to the demand for increased agricultural output. This has more than doubled overall agricultural production (on less agricultural lands), but has resulted in increased concentrations of nutrients in certain watersheds, as well as increased loadings of nitrogen and phosphorous to the surrounding surface waters.

According to EPA, manure and wastewater from animal feeding operations also have the potential to contribute pollutants such as nitrogen and phosphorus, organic matter, sediments, pathogens, heavy metals, hormones, antibiotics, and ammonia to the environment. Decomposing organic matter (e.g., animal waste) can also reduce oxygen levels and cause fish kills. Pathogens, such as Cryptosporidium, have been linked to impairments in drinking water supplies and threats to human health. Pathogens in manure can also create a food safety concern if manure is applied directly to crops at inappropriate times. In addition, pathogens are responsible for some shellfish

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[7] *See* National Research Council. "Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution" (2000).

bed closures. Nitrogen in the form of nitrate, can contaminate drinking water supplies drawn from ground water.

Finally, as noted by USGS, nutrient transport is not limited to runoff into surface waters, but also may occur through subsurface flows and groundwater flows. For example, agricultural best management practices ("BMPs") may focus on minimizing runoff while not reducing nutrient applications to land surfaces. The result of this is that nutrient transport may simply be transferred from surface waters to ground water.[8]

Potential Responses to Nutrient Pollution:

Increased monitoring:

In its 2000 report, the National Research Council recommended increased monitoring and modeling of nutrients as a first step towards addressing nutrient pollution throughout the nation. According to this report, before an effective strategy for nutrient management can be implemented, more information on the sources and impacts of nutrient contamination was necessary.

There is great variation in the amount of water quality sampling taking place with the waterbodies around the United States, and, due to Federal and state budgetary constraints, there has been a shift away from actual monitoring through water quality samples towards predictive monitoring based on comprehensive modeling. However, the utility of predictive modeling is diminished by a lack of data to validate predictive monitoring models. As a result, there may be an incomplete picture as to the nature and extent of the actual condition of the nation's waters.

For example, in 1973, the U.S. Department of the Interior's United States Geological Survey ("USGS") established the National Stream Quality Accounting Network ("NASQAN") to provide nationally comparable information on water quality, including nutrient loadings in the Great Lakes. NASQAN data were used by state agencies to document ambient water quality (in 305(b) reports required by the Clean Water Act) and by the U.S. Environmental Protection Agency for the first National Water Indicators report. However, due to Federal budgetary cuts, the number of monitoring sites, and the frequency of monitoring samples have been reduced, and the scope of the program has been limited to 4 major U.S. river systems (Mississippi, Rio Grande, Colorado, and Columbia).

To fill the gaps in actual monitoring, USGS developed the SPARROW (SPAtially Referenced Regression On Watershed attributes) model to better understand the linkages between monitoring data collected at a large network of sampling stations and the watershed factors that determine water quality.

Similarly, there has been a trend in shifting responsibility for actual monitoring from the Federal government to the states. This shift has produced mixed results, with certain states investing significant resources into comprehensive water quality monitoring, and other states cutting back on water quality monitoring.

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[8] *See* U.S. Geological Survey, "Review of Phosphorous Control Measures in the United States and Their Effect on Water Quality (1999). This report notes studies have found groundwater transport of phosphorous to be a substantial source phosphorous pollution. For example, in the Chesapeake Bay, it has been estimated that between 10 to 20 percent of the phosphorous entering the Bay travels through groundwater.

Without comprehensive and consistent water quality monitoring programs in place, it is difficult to develop an effective strategy to control pollutant loadings.

Water quality criteria for nutrients:

In 1998, the Environmental Protection Agency issued a national strategy for developing regional nutrient water quality criteria. According to EPA, numeric water quality criteria will drive water quality assessments and watershed protection management, and will support improved development of nutrient Total Maximum Daily Loads ("TMDLs"). Perhaps most importantly, they will create state and community developed environmental baselines to manage watersheds more effectively, measure progress, and support broader partnerships based on nutrient trading, Best Management Practices ("BMPs"), land stewardship, wetlands protection, voluntary collaboration, and urban storm water runoff control strategies.

In November 2001, EPA published a guidance document to states (and authorized tribes) on developing nutrient criteria plans, which would later be incorporated into state water quality criteria and standards for nutrients. EPA also published technical guidance for developing nutrient water quality criteria for lakes and reservoirs in May 2000, rivers and streams in June 2000, and estuaries and coastal waters in October 2001.

As of 2007, only 5 states (and territories) have approved complete nutrient water quality criteria, 6 states (including Michigan) are in the process of finalizing nutrient water quality criteria, and 42 states (and territories) are either collecting data or just starting this process.

Source Reduction and Control:

In its 2000 report,[9] the National Academy of Sciences recommended several management options for reducing the nutrient supply to coastal environments. These recommendations were:

(1) Reduce the overall nutrient loads to coastal areas through a variety of means, including improvements in agricultural practices, reductions in atmospheric sources of nitrogen, improvements in the treatment of municipal wastewater (including, in some cases, tertiary treatment), and better control of stormwater runoff from urban areas (streets and storm sewers) through both structural and non-structural controls.

(2) Minimize nutrient export from agricultural areas, including manure management strategies, careful estimation of native nutrient availability and crop requirements, and supplemental fertilizer application timed to meet crop demand.

(3) Long-term reductions of nutrient export from agricultural areas through consumer-driven (incentive based) programs and education.

(4) Factoring in reductions of nutrients to coastal waters in air pollution control strategies.

(5) Expanded use of "natural options" (such as the enhancement of coastal wetlands) for the management of nutrients.

[9] *See* National Research Council. "Clean Coastal Waters: Understanding and Reducing the Effects of Nutrient Pollution" (2000).

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