Nutrients in Michigan - Overview

STATE OF MICHIGAN, DEPARTMENT OF ENVIRONMENTAL QUALITY

Nutrient Framework to Reduce Phosphorus and Nitrogen Pollution

Michigan and Nutrients

Michigan is known as the Great Lakes state, a "peninsula surrounded by water." Almost all of Michigan waters drain to the Great Lakes Basin System (link to map showing drainage to Great Lakes). Nutrients, such as phosphorus, nitrogen and silica are essential and necessary for the growth of plants. When excess amounts of nutrients (mainly phosphorus) enter surface waters beyond an ecosystem's ability to naturally incorporate the excess into biogeochemical cycles (link to hydrologic and phosphorus cycles), the results can be harmful to aquatic life and cause taste and odor problems in drinking water supplies.

Excess nutrients enter surface waters from point source discharges (a discrete pipe) and non-point sources (overland runoff). Nutrients can come from natural sources such as fertile soils, decomposing plant material, and wildlife wastes. In Michigan, nutrient control has focused on phosphorus since the majority of surface waters are limited in this nutrient. Nitrogen reductions have been necessary when this nutrient was considered the limiting factor for plant productivity or has been the direct cause of water quality impairment.

Michigan has a variety of soil types and a broad range of soil fertility that affects the contribution of phosphorus to surface waters. Sandy soils with low to moderate phosphorus concentrations dominate the western and northern portions of the Lower Peninsula. Surface waters in these portions of the state generally contain low to moderate levels of phosphorus. Clays and loamy soils dominate the southern Lower Peninsula and contain moderate to high concentrations of phosphorus resulting in higher levels of nutrients in surface waters in this portion of the state. The western Upper Peninsula is comprised of relatively nutrient-poor, rocky, acidic soils, while soils in the eastern Upper Peninsula tend to be dominated by sand and clay lake plain derived soils, which are poorly drained and have low to moderate phosphorus concentrations. In general, higher populations of

humans found in the southern Lower Peninsula accelerate the rate at which nutrients enter a water body.

Historical efforts to control phosphorus in Michigan

Efforts to reduce nutrient enrichment in Michigan began early. In the late 1960's areas of the Great Lakes, such as the Western potion of Lake Erie and Saginaw Bay in Lake Huron, suffered from adverse effects of excess phosphorus (e.g., blue-green algal blooms, decomposing algae on beaches, taste and odor problems at public water supply intakes). In 1968, Michigan formally adopted the state's first set of Water Quality Standards

which included a narrative standard to control excess phosphorus entering the Great Lakes. Nutrients originating from industrial, municipal, or domestic animal sources were to be limited to the extent necessary so as to prevent adverse effects on water treatment processes, or the stimulation of nuisance growths of aquatic plants and algae that might become injurious to designated water uses (link to an introduction to designated uses).

In 1972, and again by renewal in 1978, the Great Lakes Water Quality Agreement (GLWQA) between the United States and Canada established programs and measures to reduce and control inputs of phosphorus and other nutrients into the Great Lakes Basin System (link to GLWQA info). Specific to Michigan, wastewater treatment facilities discharging more than 1 million gallons per day (mgd) were to be constructed and maintained so as to achieve a phosphorus effluent concentration of 1 milligram per liter (mg/l) in discharges to Lakes Superior, Michigan and Huron, and 0.5 mg/l in discharges to Lake Erie. Phosphorus load reduction targets were established for the Great Lakes Basins, select channels, and bays to alleviate drinking water taste and odor problems, minimize eutrophication problems, and prevent degradation of waters in the Great Lakes Basin System.

Phosphorus inputs from industrial discharges were to be regulated to the maximum extent practicable, and phosphorus in household detergents was to be reduced to 0.5 percent. Phosphorus from non-point sources (agricultural and urban) were to be reduced to the maximum extent practicable into Lakes Superior, Michigan and Huron, and by 30 percent into Lake Erie.

In 1973, Michigan revised state Water Quality Standards to include requirements that be controlled from point source discharges using best practicable waste treatment technology with the goal of achieving a monthly average effluent concentration of 1 mg/l. In 1977, Michigan banned the use of laundry detergents containing phosphates to further reduce the input of nutrients that entered surface waters.

The Great Lakes responded well to phosphorus reduction efforts. Phosphorus concentrations in the open waters of the Great Lakes decreased below target goals that were set in the GLWQA (as shown in Table 1 from the Phosphorus Management Strategies Task Force document). In 1983, WWTP upgrades were made and further phosphorus reductions were obtained through the implementation of the 1 mg/l phosphorus goal.

Table 1. Water Quality Objectives used to establish target phosphorus loads for eutrophication control in the Great Lakes.

Lake Basin	Total Phosphorus (µg/L)	Chlorophyll a (µg/L)	Secchi Depth (m)	Trophic State
Superior	5	1.3	8	Oligotrophic
Michigan	7	1.8	6.7	Oligotrophic
Huron	5	1.3	8	Oligotrophic
Saginaw Bay	15	3.6	3.9	Mesotrophic
Western Erie	15	3.6	3.9	Mesotrophic
Central Erie	10	2.6	5.3	Oligomesotrophic
Eastern Erie	10	2.6	5.3	Oligomesotrophic
Ontario	10	2.6	5.3	Oligomesotrophic

Nutrients in Michigan - Overview

STATE OF MICHIGAN, DEPARTMENT OF ENVIRONMENTAL QUALITY

Nutrient Framework to Reduce Phosphorus and Nitrogen Pollution

By 1986, the 1 mg/l goal became an effluent standard in Michigan's Water Quality Standards and a requirement in NPDES permits for WWTP and many industrial discharges. In addition, Michigan's narrative nutrient standard was revised to provide protection to inland waters. The narrative

standard provided the flexibility to limit to the extent necessary, nutrients that stimulated growths of aquatic plants and algae that became, or that might become, injurious to designated uses (see presentation on nutrient limits in NPDES permits).

Throughout the 1990s to the present, phosphorus limitations below the 1 mg/l effluent standard for point sources have been routinely included in NPDES permits using the narrative rule in the Part 4 Water Quality Standards. The narrative rule states…… "nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the surface waters of the state (link to Part 4 WQS).

Recent efforts to further control phosphorus in Michigan

Early efforts to implement the Federal Clean Water Act of 1972 focused primarily on regulating discharges from traditional point source facilities, such as municipal sewage treatment and industrial plants. Because of those efforts, point source pollution has been greatly reduced. Until the late 1980s, little attention was paid to storm water runoff from urban areas, construction sites, farms, and other wet weather pollution discharges. Since that time, work to address wet weather pollution has increased significantly (link to Wet Weather Document), but phosphorus contributions from these types of discharges continue to impair surface waters and cause accelerated eutrophication issues. Today, the major surface water quality issues in Michigan regarding nutrients can generally be attributed to discharges associated with wet weather pollution. Such discharges include sewer overflows, storm water, animal feeding operations, biosolids, septage, soil erosion, and farming operations. Recent efforts to control and reduce phosphorus through various Water programs are outlined in the links off of the Nutrient Framework website.