

Addressing Dissolved Oxygen in a Stormwater Pollution Prevention Program

This fact sheet provides information to assist Municipal Separate Storm Sewer Systems (MS4s) addressing a Dissolved Oxygen Total Maximum Daily Load (TMDL) requirement. TMDLs are required under Section 303(d) of the federal Clean Water Act when a water body is impaired and not meeting its designated use.

How do we know if a water is impaired for dissolved oxygen?

Dissolved oxygen is required for nearly all aquatic organisms to live. When dissolved oxygen drops below acceptable levels, organisms are killed or harmed.

Measurements of dissolved oxygen are typically taken with an electronic probe, or meter. Measurements are taken around sunrise, when dissolved oxygen concentrations are lowest. Concentrations are compared to standards, which represent the amount of dissolved oxygen needed for organisms to survive and prosper.

Dissolved oxygen standards differ depending on the use class of the water. For most warm water streams, the standard is “not less than 5 mg/L as a daily minimum”. The standard for cold water streams is “not less than 7 mg/L as a daily average.” If the standard is not met, a river or stream is placed on the U.S. Environmental Protection Agency’s 303(d) List of Impaired Waters. Once on the Impaired Waters List, a TMDL must be completed for the impaired water.

How do TMDLs address dissolved oxygen impairments caused by runoff of urban stormwater?

Stormwater runoff can contribute to dissolved oxygen impairments in a number of ways. Sediment and organic material that is discharged to a lake or stream can make water turbid (cloudy). Turbid water prevents light from reaching plants that produce dissolved oxygen.

Also, organic material in stormwater, like fecal material, grass clippings, and leaves, contains the nutrients phosphorus and nitrogen. Excess nutrients encourage algal growth. When algae die, they are consumed by microbes. This further depletes the level of dissolved oxygen.

Perhaps the most important cause of low dissolved oxygen in urban streams is altered hydrology. Urban streams often have very low flow in summer, resulting in oxygen depletion.

The first challenge with a dissolved oxygen TMDL is to determine an appropriate surrogate pollutant, since dissolved oxygen is not a pollutant. Phosphorus, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and carbonaceous BOD (CBOD) are common surrogates for dissolved oxygen.

Models and data are used to estimate average phosphorus, BOD, COD, or CBOD loads that can be discharged to a river or stream without exceeding the water quality criteria for dissolved oxygen. This load is the TMDL and it is most often expressed as a mass per unit time (kg/day, for example).

A TMDL may be estimated from several sources, such as agriculture, stormwater, and wastewater treatment plants. The portion of the TMDL assigned to regulated MS4s, those MS4s covered under a National Pollutant Discharge Elimination System (NPDES) permit, is part of the TMDL wasteload allocation (WLA). NPDES permits must be consistent with the WLA. MS4s regulated under an NPDES permit must therefore comply with any TMDL requirements in the permit.

Which best management practices (BMPs) are most effective for reducing pollutants that contribute to Dissolved Oxygen impairments?

It can be difficult to determine specific BMPs that will address a dissolved oxygen impairment, since there are many diverse sources of pollutants that create an oxygen demand. The most successful strategies are likely to be those that reduce organic pollutants in runoff. Organic pollutants include leaves, grass clippings, animal waste, and human waste. The following BMPs are, therefore, recommended.

- prevention and education programs related to lawn and turf management
- ordinances to clean up pet waste
- elimination of illicit discharges and combined sewer overflows
- where applicable, control of wildlife (goose control, for example)

Beyond these BMPs, any strategy that reduces phosphorus and sediment loading will decrease oxygen demand in a stream or river. MPCA has prepared fact sheets for each of these pollutants.

For more information, see the Minnesota Stormwater Manual (www.pca.state.mn.us/water/stormwater/stormwater-manual.html), particularly Chapter 12, which includes BMP fact sheets.

How do I comply with the permit requirement?

The Phase 2 MS4 General Permit will be re-issued in 2011. There will be significant changes from the 2006 permit. Specific guidance has not been developed yet as the permit language for the 2011 permit is not finalized. Following is a list of items MS4s can consider addressing until the permit is re-issued.

- Develop a list of TMDL WLAs that apply to the MS4, including baselines. MPCA can provide this information.
- Develop a list of BMPs that apply toward the WLA(s).
- Develop a list of BMPs to be implemented and applied toward the WLA(s) and schedules for those BMPs.

Where can I learn more?

There are several excellent sources of information in the literature. MPCA recommends consulting the Minnesota Stormwater Manual (<http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html>) or MPCA staff for additional information.