Minnesota Pollution Control Agency

Understanding Biotic Impairments and Associated Pollutants

The Minnesota Pollution Control Agency (MPCA) uses biological monitoring to track the health of river and wetland environments. Because the health of a biological system is a direct measure of environmental stress, biological monitoring is often preferred over chemical monitoring for assessing environmental health.

Researchers monitor the biological health of fish, plant, or macroinvertebrate communities. Monitoring data are used to conduct a bioassessment, which is an examination of attributes such as community composition, reproductive function, tolerance to human disturbance, abundance, and condition. Each attribute changes in a predictable way with human influence. Quantifying these attributes results in a score called an Index of Biological Integrity (IBI).

What is a biological impairment?

Streams or wetlands with IBI scores less than a certain value are considered impaired for Aquatic Life and placed on the U.S. Environmental Protection Agency (EPA) 303(d) List of Impaired Waters. Because IBI scores may be calculated for fish, macroinvertebrate, or plant assemblages, the pollutant or stressor for waters on the impaired water list may therefore include fish bioassessments, aquatic macroinvertebrate bioassessments, and/or aquatic plant bioassessments.

The 2008 303(d) list of impaired waters in Minnesota includes 41 stream stretches where the pollutant or stressor is fish bioassessments, 19 for aquatic macroinvertebrate bioassessments, and 22 for both (see figure on next page). The MPCA anticipates increased use of biological monitoring to assess water quality, so it is likely the number of assessed streams and wetlands having biological impairments will increase.

What is a Total Maximum Daily Load?

A biologically-impaired stream or wetland must be restored to a specific assemblage of fish, macroinvertebrates, or plants through the Total Maximum Daily Load (TMDL) process. A TMDL is the maximum amount of a pollutant that can be discharged to receiving water and still have the receiving water comply with water quality standards. During development of a TMDL, detailed analyses are conducted to determine reductions in pollutant loading needed to restore a stream or wetland to its intended use.

How does a TMDL address biological impairments?

Since the TMDL represents a quantity of pollutant, a surrogate chemical must be found for the biological impairment. For biological impairments, the pollutant may not be known. For example, a stream may not support a healthy fish assemblage because of elevated temperature, chloride, sediment, and so on. Suspended sediment is the most common surrogate for biotic impairments, although others, such as phosphorus, may be used.

The TMDL will be written in terms of the surrogate chemical. Models and data are used to estimate average chemical loads that can be discharged to a river or stream without exceeding the water quality standard for that chemical.

A TMDL may be estimated from several sources, such as agriculture, stormwater, and wastewater treatment plants. The portion of the TMDL assigned to regulated Municipal Separate Storm Sewer Systems (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.

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Which best management practices (BMPs) are most effective for reducing biotic impairments?

Since the WLA for biotic impairments is written for conventional pollutants, BMPs appropriate for those pollutants should be implemented. The MPCA has prepared fact sheets for addressing these conventional pollutants, such as phosphorus and suspended sediment (turbidity) in a Stormwater Pollution Prevention Program (http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-management/stormwater-programs-and-impaired-waters.html?menuid=&missing=0&redirect=1).

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. The MPCA recommends consulting the Minnesota Stormwater Manual (http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html) or MPCA staff for additional information.

Minnesota waters on the 2008 U.S. EPA Impaired Waters list for aquatic-life problems.