

IMPACT OF TMDLS ON NPDES PERMITS

What is a TMDL?

A Total Maximum Daily Load or TMDL is the amount of pollutant loading (typically in Lbs/Day) that a water body can assimilate or allow and still meet established water quality standards. In simple terms, a TMDL is a watershed budget for pollutants.

Pollutants are anything that prevents a water body from attaining or maintaining the federal goal of being "fishable and swimmable." Common pollutants include fecal coliform bacteria, excessive nutrients, metals, pH, sediment and toxic chemicals.

Section 303(d) of the Clean Water Act and federal regulations found at 40 CFR Part 130.7 require states to identify and prioritize impaired waters in which applicable water quality standards cannot be attained. TMDLs must be established for these water bodies to ensure attainment of water quality standards. EPA has final approval on TMDLs.

What are Water Quality Standards?

Water quality standards are state regulations. Pennsylvania's water quality standards are found in PA Code Chapter 93. The main components of water quality standards consist of designated uses, numeric criteria and narrative criteria. Pennsylvania regulations define 26 drainage lists, under which the streams are further subdivided and the protected water uses are defined.

Stream Assessment

The Department of Environmental Protection (DEP) is in the process of assessing every stream in Pennsylvania to determine if a stream is impaired. The assessment process involves a biological survey, which consists of a macro-invertebrate count; a chemical analysis of the water; and an evaluation of the surrounding habitat and watershed landscape.

Stream Impairment

Primary causes of stream impairment include the following parameters, in order of prevalence, as identified in Pennsylvania:

- ❖ Sediment Accumulation
- ❖ Metals
- ❖ Nitrogen & Phosphorus
- ❖ pH
- ❖ Low Dissolved Oxygen
- ❖ Flow and Habitat Alterations

According to DEP's 2002 305(b) Report, more than 90 percent of the stream impairments identified in Pennsylvania are derived from the following sources:

- ❖ Agriculture
- ❖ Acid Mine Drainage
- ❖ Urban Runoff

This means that less than 10 percent of the stream impairments are caused by point source discharges, such as municipal and industrial wastewater treatment facilities. Yet, these sources bear the brunt of the TMDL reductions currently being implemented and enforced.

TMDL Categories

TMDLs are currently under development in Pennsylvania for the following categories:

- ❖ Acid Mine Drainage
- ❖ Fish Consumption Advisories
- ❖ Lakes
- ❖ Nonpoint Source Impairments
- ❖ Point Source Only Impairments

How are TMDLs Derived?

Point source only impairments are evaluated using steady-state mass balance models, such as those used for NPDES permit evaluations. Point sources are also part of other TMDL categories.

The nonpoint source reference watershed approach uses the stream loading rate from the bioassessment protocol as a basis to establish loading reductions for an impaired watershed.

This watershed approach focuses on implementation of remedial efforts to restore and maintain healthy waterways. Allocations are distributed to all of the land use categories as well as the point sources with NPDES permits.

TMDLs are the sum of wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, natural background levels, and a margin of safety (MOS) to maintain the integrity of the water sources and to account for uncertainty in the loading calculations.

How are TMDLs Implemented?

The point source component of a TMDL is implemented through the NPDES permit program.

The nonpoint source component of a TMDL is implemented through Best Management Practices (BMPs), via a combination of federal, state and local programs such as land use requirements; erosion and sediment pollution control for earth disturbance activities; Phase II Storm Water regulations and Act 167 Storm Water Management Plans for urban runoff; and nutrient management plans for agricultural runoff.

Nutrient TMDLs

One of the primary impacts of TMDLs on municipal and industrial wastewater treatment facilities are the Nutrient TMDLs for Nitrogen and Phosphorus. Coupled with DEP's Chesapeake Bay Tributary Strategy and impending statewide instream water quality standards for Phosphorus, the challenge of achieving reductions of Nitrogen and Phosphorus in a wastewater treatment process is on every operator's mind.

Nitrogen Cycle

Nitrogen is plentiful in the environment. Approximately 80 percent of the atmosphere consists of nitrogen gas. However, nitrogen

must be converted to other forms of nitrogen, such as nitrate, before most plants and animals can use it. The nitrogen cycle consists of four processes:

- ❖ **Nitrogen Fixation:** Conversion of gaseous nitrogen to ammonia by nitrogen-fixing organisms such as blue-green algae and the bacteria *Rhizobium* and *Azobacter*.
- ❖ **Ammonification:** Breakdown of wastes and nonliving organic tissues to amino acids, which are then oxidized to carbon dioxide, water and ammonia ions by decomposer organisms.
- ❖ **Nitrification:** Two-step process in which ammonia is oxidized first to nitrite and water by *Nitrosomonas* bacteria, and then the nitrite is oxidized to nitrate by *Nitrobacter*.
- ❖ **Denitrification:** Nitrate is reduced to gaseous nitrogen by facultative anaerobes such as fungi.

The most important forms of nitrogen in terms of their immediate impact on water quality are the readily available ammonia ions, nitrites and nitrates. Total nitrogen (TN) is a measurement of all forms of nitrogen and is measured in an environmental laboratory by the sum of the following test parameters: Ammonia Nitrogen, Organic Nitrogen (Total Kjeldahl Nitrogen - Ammonia Nitrogen), Nitrate Nitrogen and Nitrite Nitrogen.

Phosphorus Cycle

Phosphorus is less abundant in the aquatic environment under normal conditions. It does not exist as a gas like nitrogen. Phosphorus exists in water as either an organic or inorganic form, which are defined as follows:

- ❖ **Organic Phosphorus:** Includes living and dead particulate matter such as plankton and detritus and nonparticulate phosphorus in the form of dissolved organic phosphorus excreted by organisms and colloidal phosphorus compounds.
- ❖ **Inorganic Phosphorus:** Soluble inorganic phosphates are readily available to plants. Some condensed phosphates, such as those found in detergents, are inorganic but are not available for plant uptake. Inorganic particulate phosphorus is also present in the environment.

Total Phosphorus is a combination of all inorganic and organic, and soluble and particulate forms of phosphorus. Phosphorus undergoes continual transformations in a freshwater environment.

Human activities have resulted in excessive loadings of phosphorus in freshwater environments. Overloads result in an imbalance of the natural cycling processes. Excess available phosphorus in a water body can result in accelerated plant growth if other nutrients and limiting factors are available.

Example Nutrient TMDL

The following information is part of an EPA-approved TMDL for a watershed tributary to the Delaware River Basin, which is designated for trout stocking. The watershed is deemed to be heavily impacted by urbanization and is listed as impaired due to problems associated with chlorine, low dissolved oxygen (DO) concentrations, elevated nutrient levels, oil and grease, pathogens, siltation, and water/flow variability.

Several municipal point source dischargers in this watershed formed a consortium and hired a consultant with watershed modeling experience to review and comment on the TMDL as it was in process.

This TMDL was developed to address impairments due to low DO, nutrients and siltation. Future TMDLs will be developed to address chlorine and oil and grease impairments.

Wasteload allocations are detailed in the TMDL for each stream segment impaired as a result of excess nutrients and siltation (sediment accumulation). To address the nutrient impairments, TMDLs were established for Carbonaceous Biochemical Oxygen Demand, Ammonia Nitrogen, Nitrate-Nitrite Nitrogen and Orthophosphate. To achieve the recommended TMDLs for the above named parameters, the minimum DO concentration was increased to 7.0 mg/L, which is the most stringent applicable DO criteria necessary for aquatic life use protection during trout stocking periods.

Once the TMDL was approved by EPA, DEP proceeded to issue the NPDES permits for the affected municipal dischargers. As an example, one of the municipal dischargers has

the following *final* summer permit limits in its NPDES permit, the compliance of which must be achieved within 36 months of the permit effective date:

CBOD ₅	7.5 mg/L
NH ₃ -N	0.72 mg/L
NO ₃ +NO ₂ -N	Monitor & Report
Ortho-PO ₄	1.82 mg/L

The above limits are much more stringent than those limits contained in their previous NPDES permit. It also doesn't help this discharger that its plant flow essentially makes up more than 90 percent of the receiving stream during low flow conditions.

Public Comment

Public participation is not only required as part of the TMDL process, it is essential to the program's success. A minimum 30-day review period is provided to the public prior to submission of a TMDL to EPA for approval. A summary of all public comments and responses to those comments must be part of the TMDL submission.

Public meetings are typically held during various stages of the TMDL development process. In addition, EPA encourages the public to participate in data collection efforts. During the TMDL development process mentioned in the above example, there were eight public meetings as well as numerous mailings to all stakeholders.

Therefore, it is crucial to take a proactive role in the TMDL development process to ensure the most representative data and most accurate modeling criteria are available.

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