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Tackling Nutrient TMDLs

Meeting the most stringent requirements with complex treatment

The implementation of total maximum daily loads (TMDLs) has increased considerably in recent years, especially those limiting nutrients such as phosphorus and nitrogen, both of which are difficult to remove from storm water flows. Although we have seen some success by targeting nutrients associated with the solids, this strategy essentially ignores the often substantial dissolved fraction of the total nutrient loads as well as the transformation of nutrients from solid to dissolved forms within best management practices (BMPs).

To address the soluble nutrients, more complex treatment processes are being deployed, including media that is formulated to adsorb dissolved forms. Some nutrient forms, particularly nitrates, are difficult to remove without a long residence time in a biologically active system such as a wetland.

When optimizing nutrient load reduction in a specific watershed, the obvious first step is to assess the various source contributions and the relative cost of controlling them. Common sources include input from commercial or agricultural fertilizers, wastewater effluent and animal feedlots. Urban storm water runoff is a contributor of nutrients, but it may be difficult to meet TMDL load allocations because of the diffuse nature and low concentrations of nutrients compared with other sources.

As very low effluent concentrations are targeted, a point of diminishing returns quickly is reached where the cost of removal becomes high in relation to the added load reduction provided. Source control efforts, especially changing fertilizer types and application rates and containing runoff from agricultural fields and feedlots, are likely to be more effective per dollar spent in reducing load inputs.

For phosphorous, the percentage of dissolved compared to particulate-bound phosphorous is the most important predictor of removal performance. The literature varies on this subject, but it is not uncommon for 50% or more of the phosphorus load to be in particulate form. Where the phosphorus load is predominately particulate-bound, installation of an end-of-pipe BMP that effectively retains fine particles is common to remove more than 50% of the total phosphorus load. TMDLs calling for greater reductions warrant the use of specialized media to sequester soluble phosphorus. Oxide-coated media is available that is able to consistently achieve 65%-plus total phosphorus load reduction and reduce low total phosphorus concentration to near the detection limit.

Likely the most effective way to control nutrients in storm water is to keep runoff on site—good news, as regulations continue to evolve from end-of-pipe capture to runoff reduction (low-impact development) requirements. If a site has permeable soils, a wide range of infiltration systems can be installed either above ground or under paved surfaces when space is at a premium. Infiltrating runoff on site inherently allows one to meet the TMDL, as no flows will be discharged off site into receiving waters.

Unfortunately, infiltration is not always practical. If a site has high groundwater, soils with low permeability, bedrock, contaminated soils or other limiting conditions, infiltration alone may not provide enough runoff reduction or nutrient removal to meet regulations. In this case, harvesting and treating the rainwater for nonpotable use is a viable and cost-effective solution. Packaged rainwater harvesting systems can be designed to intercept runoff and store and treat it for irrigation or other uses. These options also eliminate bacteria, metals and other pollutants of concern, including phosphorus and nitrogen.

Between infiltration, rainwater harvesting and effective media filtration options, practitioners should have the flexibility to tackle the most stringent TMDLs and storm water criteria. SWS

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