

# Nutrient Management Vol. I: Regulatory Approaches to Protect Water Quality – Review of Existing Practices

Utilities work with regulators to treat nitrogen (N) and phosphorus (P) in wastewater to levels that protect human health and ecosystems. Water quality criteria and permits are typically based on scientifically defensible and shared understanding of the sources of pollutants in a watershed, as well as treatment capabilities and costs to control these in the aquatic environment. In recent years in the U.S., there has been much discussion of nutrient impacts on water quality, with issues in high visibility waterbodies such as the Chesapeake Bay, Long Island Sound, and the Gulf of Mexico. As the lead regulatory agency, the U.S. Environmental Protection Agency's efforts to promulgate numeric nutrient standards in various eco-regions, raised questions about how these standards apply to wastewater dischargers. They questioned whether they are effective and how they affect stakeholders in the water quality arena. This report discusses current nutrient management issues that confront point source wastewater dischargers nationwide. It provides a better understanding of challenges that utilities and regulators face setting and meeting low nutrient effluent limits and it expands understanding of the practical capabilities of treatment technology.



**Duckett Dam in Prince George's County, MD forming the Rocky Gorge reservoir.**

The report is organized in six main chapters. Chapter 1.0 presents an introduction to key nutrient management issues that confront point source wastewater dischargers. All states in the U.S. have yet to adopt or develop numeric nutrient standards; although the effort to do so was started in 1998 by the EPA. The national discussion of nutrient impacts on water quality continues to evolve beyond national and local regulators and utilities to include public citizens and environmental organizations. Some proposals call for treatment technology standards for nitrogen and phosphorus.

Chapter 2.0 explores receiving water quality issues in greater detail. The issues include nutrient criteria and key regulatory requirements and mechanisms to protect receiving water quality (such as total maximum daily loads, use attainability analysis, variances, numeric criteria, and anti-degradation) that influence nutrient removal requirements. The chapter addresses how targeted nutrient levels in lakes, streams, and estuaries can be very low concentrations that are challenging to meet with treatment of point sources and application of best management practices (BMPs) to nonpoint sources. This chapter also presents a discussion of regulatory efforts to develop numeric nutrient standards, including key technical issues and a summary of progress in some key states including how a number of nutrient related legal issues have occurred in the past two years which may influence the approach to nutrient management in other areas of the nation.

Chapter 3.0 addresses key nutrient control challenges for dischargers. Waterbodies that receive effluent discharges have impoundments and reservoirs, irrigation diversions and returns, water supply withdrawals, and many other modifications that alter the aquatic environment. These conditions present challenging circumstances for the selection of appropriate in-stream nutrient targets that protect water quality and reflect realistically

## BENEFITS

- Provides background to discussions and legal challenges in the U.S. with regard to receiving water quality impacts from nutrients.
- Discusses historical and emerging regulatory drivers and mechanisms, including watershed-based approaches.
- Looks at advanced technologies currently used for N and P removal, as well as unique considerations related to permitting for low nutrient levels.

## RELATED PRODUCTS

*Variability of Low Phosphorus Analytical Measurement* (NUTR1R06f)

*Regulatory Issues for Low-level Effluent Nitrogen and Phosphorus Concentrations – Compendium* (NUTR1R06-LOT)

*Nutrient Management Vol. II: Removal Technology Performance & Reliability* (NUTR1R06k)

## RELATED ONGOING RESEARCH

Finding the Balance Between Wastewater Treatment Nutrient Removal and Sustainability (NUTR1R06n)

Nutrient Management Vol. III: Guidance on Permitting Strategies for Achievable and Sustainable N & P Removal (NUTR1R06x)

Bioavailability of Phosphorus in Treated Wastewater Effluent (NUTR4C09)

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attainable conditions. Nutrient removal treatment can substantially reduce point source discharges of nitrogen and phosphorus, however substantial investments are required to build and operate advanced wastewater treatment facilities. In some watersheds, nonpoint source nutrient loadings outweigh point sources to a degree that advanced treatment for nutrient removal, and even complete elimination of point sources, would have limited benefit to water quality. Nevertheless, point source NPDES permitted dischargers are the most directly regulated sources subject to nutrient control requirements resulting from numeric nutrient standards, TMDLs, and water quality based permit limits. The costs of advanced wastewater treatment are substantial and this chapter summarizes some of the cost and sustainability issues that should be balanced in order to make optimal decisions for nutrient management in watersheds.

Chapter 4.0 presents an overview of advanced wastewater treatment technology for N and P removal. Primary and secondary treatment processes only remove a limited fraction of nutrients from wastewater – a portion of the insoluble N and P taken out with primary solids and nutrient uptake required for biological growth. Nutrient removal also requires additional energy, chemicals, maintenance materials, and labor which increase the complexity of plant operations and costs. The current state-of-the-art for nutrient removal is summarized and the capabilities of treatment technology are described. At low effluent limits, some portion of the remaining N and P in treatment plant effluent may not be removable with current treatment technology. N and P speciation is an important area of nutrient research, both in terms of biodegradability in wastewater treatment and bioavailability in the water environment.

Chapter 5.0 presents a discussion of nutrient discharge permitting issues and some of the special considerations associated with appropriate limits for N and P. Surface water nutrient discharges should receive special considerations in discharge permitting for distinction from other effluent parameters, in particular toxic parameters, upon which much of the existing EPA permit writer's guidance is based. Appropriate NPDES discharge permit structures for nutrients should be based on long averaging periods, such as seasonal limits based on mean or median statistics. It is important that consideration be given to variability and reliability of effluent performance from advanced nutrient removal facilities.

Lastly, Chapter 6.0 presents a discussion of nutrient discharge permitting issues and some of the special considerations associated with appropriate limits for nitrogen and phosphorus. Example discharge permits with nutrient limits are summarized for reference use from 12 utilities. Since special considerations are required for appropriate surface water nutrient discharge limits, the summaries presented in this chapter illustrate the range of effluent limits and variety of permit structures in place for some key nutrient removal facilities.

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