DRAFT

PERFORMANCE-BASED CONTROLS FROM STATE NUTRIENT STRATEGIES (EXCERPTS AND LINKS)

Summary			
State	**TP Limit mg/L**	**TN Limit mg/L**	**Notes (more details below and via the links)**
Delaware River Basin Commission (DE, PA, NJ, NY)	2	10	30-day averages. Limits apply to new and expanded direct municipal discharges to Outstanding Basin Waters or Significant Resource Waters. Limits for direct industrial discharges developed case-by-case.
Tennessee	1	8	Averaging period? Limits apply to discharges with a "medium" nutrient impact level. Assumes conventional biological nutrient removal and tertiary filtration. More stringent limits/technologies apply to discharges with a "high" nutrient impact level.
Iowa	1	10	Annual average limits will not be lower than these values where biological treatment is the primary means of reducing nutrients. Limits are developed case-by-case considering the effect of the pollutant and the feasibility and reasonableness of treating the pollutant.
Kansas	1.5	8	Annual average limits for large municipals (> 1 MGD). Assumes BNR technology. Nutrient reduction at industrial facilities evaluated case-by-case.

Delaware, Pennsylvania, New Jersey, New York:

Administrative Manual - Part III (Water Quality Regulations)

The minimum level of wastewater treatment for the following categories of projects will be "Best Demonstrable Technology" as defined below: all new wastewater treatment facilities and all projects involving substantial alterations or additions to existing wastewater treatment facilities when the new or expanding facility discharges directly to Outstanding Basin Waters or Significant Resource Waters. Equivalent effluent criteria for industrial facilities and seasonal limits, if any, will be developed on a case-by-case basis. The following 30-day average effluent criteria define Best Demonstrable Technology*:

5-day CBOD: 10 mg/l or less
Dissolved oxygen: 6.0 mg/l or greater
Total suspended solids: 10 mg/l or less
Ammonia-nitrogen: 1.5 mg/l or less
Total nitrogen: 10.0 mg/l or less
Total phosphorus: 2.0 mg/l or less
Fecal coliform: 50/100 ml or less

* The effluent criteria that define Best Demonstrable Technology (BDT) were established by these Regulations in 1992 when DRBC originally promulgated the Special Protection Waters regulations for point source discharges. Although treatment technologies have advanced since that year, these "BDT"

criteria have been retained for the limited purposes of the SPW program. BDT as defined herein may be superseded, however, by applicable federal, state or DRBC criteria that are more stringent.

Tennessee:

Tennessee Nutrient Reduction Framework

Nutrient impact levels in each HUC-10 watershed is evaluated as high, medium, and low based on a combined analysis of EF [enrichment factor] and percentage of WWTP contribution, as follows: The cumulative frequency distributions of EF (Figures A6 and A8) and percentage of WWTP contribution (Figures A10 and A11) were each bracketed into three zones: bottom, middle, and top. For each HUC-10 watershed, if the scores of EF and percentage of WWTP contribution both exceed the top bracket, the nutrient impact from WWTP is considered the high level. When both the EF and percentage of WWTP contribution are below the bottom bracket, the nutrient impact from WWTP is at the low level. In the first stage of implementation, EFs have been bracketed at the 33rd and 67th percentiles and the percent of WWTP contributions have been bracketed at the 50th and 80th percentiles. The decision-making matrices for the Upper Tennessee River Basin based on these brackets are presented in Tables A3 and A4 for total nitrogen and total phosphorus, respectively. Tables A5 and A6 show the same decision-making matrices for the Lower Tennessee River Basin for total nitrogen and total phosphorus, respectively. The partitioning of the EF and percent of WWTP contribution will be periodically assessed and adjusted during the implementation phase to evaluate their impact and effectiveness.
In each HUC-10 watershed, the resulting nutrient impact level indicates the appropriate level of nutrient reduction for WWTPs to achieve the PAWL. For both nitrogen and phosphorus, effluent limits (Table A7) will be assigned to WWTPs according to the impact levels determined. The effluent target limits (8 mg/l TN and 1 mg/l TP) assigned to HUC-10s with medium impact represent nutrient concentrations corresponding to conventional biological nitrogen and phosphorus removal and tertiary filtration. The effluent limits (5 mg/l TN and 0.3 mg/l TP) assigned to HUC-10s with high impact represent results of additional chemical treatment for phosphorus removal (WERF, 2010). For plants equipped with biological treatment systems, appropriately modifying and optimizing the operation of existing systems for nitrogen and phosphorus removal may be capable of achieving the required effluent discharge limits. The Division strongly encourages that, if applicable, plant optimization be included as one of the first alternatives in the plant's nutrient removal/reduction plan.

In addition to the nutrient impact level, additional factors can be considered in determining the required nutrient load reductions. Those include current effluent concentrations, proximity (less than 10 miles upstream) to other nutrient or dissolved oxygen (DO) impaired water bodies, and, for total phosphorus, proximity (less than 20 miles) to downstream reservoir segments. Additionally, a facility's operation and maintenance will be taken into consideration. In the first stage of implementation, this strategy will be applied to major municipal as well as permitted industrial WWTPs.

Required Effluent Limits			
	Low Impact	**Medium Impact**	**High Impact**
Total Nitrogen	Cap @ current level	8 mg/l	5 mg/l
Total Phosphorus	Cap @ current level	1 mg/l	0.3 mg/l

Table A7. Required Effluent Limits for Total Nitrogen and Total Phosphorus

Iowa:

Iowa Nutrient Reduction Strategy

Technology Based Limits for POTWs Technology-based limits for POTWs have been established by EPA in 40 §CFR 133 under authority of Section 304(d) of the Clean Water Act and represent the degree of reduction attainable through the application of secondary wastewater treatment technology. Technology-based effluent limits for a pollutant not covered by federal effluent standards may be imposed on a case-by-case basis (IAC 567- 62.8(5)). Such limitation must be based on the effect of the pollutant in water and the feasibility and reasonableness of treating such pollutant. Although continuously evolving, many nutrient removal technologies in wastewater treatment are already proven and well-established. Thus, nutrient removal for Iowa's wastewater treatment facilities is technologically feasible. The primary mechanism IDNR will use in assessing the "reasonableness" of nutrient removal for individual facilities is the estimated costs for improvements and the ability of end users to afford those costs. Affordability of wastewater treatment improvements is dependent upon a number of factors including capital costs, existing and projected debt service, and operation and maintenance costs. Without detailed financial information from a facility it is not possible to determine affordability. Screening criteria are available to indicate the likelihood that a project will be affordable with minimal information. EPA economic guidance (U.S. EPA 1995) and proposed rules to implement the new disadvantaged communities' law (455B.199B) suggest that if the ratio of projected total wastewater costs to a community's Median Household Income (MHI) is less than one percent, then a project is affordable barring very weak community economic indicators. If the ratio is greater than two percent then a project is not affordable unless economic indicators are strong. Projects resulting in a ratio between one and two percent may or may not be considered affordable dependent upon the strength of secondary economic indicators such as comparison of county MHI to statewide MHI, bond rating, etc. Section 3.2 shows that nutrient reduction costs are generally affordable for most of Iowa's major municipal facilities based on the ratio of estimated project cost to Median Household Income (MHI). These same facilities also have the largest design flows and, in general, the greatest point source nutrient contribution. If the communities served by major municipal facilities can afford a project cost/MHI ratio of 0.5%, the design flow treated by those facilities for which nutrient reduction is affordable is over 550 MGD, or roughly 86% of the total design flow for all major municipal facilities. This relationship is shown in Figure 3-1 below.

Three Tiers of Nutrient Removal: The three most commonly cited "tiers" of nutrient removal are Biological Nutrient Removal (BNR), Enhanced Nutrient Removal (ENR) and the Limit of Technology (LOT). Biological Nutrient Removal is commonly associated with sequenced combinations of aerobic, anoxic and anaerobic processes which facilitate biological denitrification via conversion of nitrate to nitrogen gas and "luxury" uptake of phosphorus by biomass with subsequent removal through wasting of sludge (biomass). Effluent limits achievable using BNR at wastewater treatment facilities that treat primarily domestic wastewater are 10 mg/L of total nitrogen (TN) and 1.0 mg/L of total phosphorus (TP). Enhanced Nutrient Removal typically uses BNR with chemical precipitation and granular media filtration to achieve lower effluent nitrogen and phosphorus concentrations than can be achieved through BNR alone. ENR systems are capable of producing effluent with nitrogen and phosphorus values of about 6 mg/L of total nitrogen and 0.2 mg/L of total phosphorus (Falk et al. 2011). The term "Limit of Technology" (LOT) is generally associated with the lowest effluent concentrations that can be achieved using any treatment technology or suite of technologies. It is commonly referenced as an upper bound

in nutrient removal performance. However, there is no consensus or regulatory definition establishing specific treatment requirements for the LOT. As such, effluent values associated with the LOT are debatable. Some have proposed statistical approaches that define the LOT as the minimum effluent concentrations that can be expected to be reliably met over a specific averaging period using widely available and proven treatment processes (Neethling et al. 2009, Bott et al. 2009). Commonly referenced thresholds for the LOT for BNR are 3 mg/L for total nitrogen and 0.1 mg/L for total phosphorus (U.S. EPA 2007, Jeyanayagam 2005). Lower effluent values are possible using tertiary chemical addition & filtration, 3 advanced effluent membrane filtration, ion exchange and/or adsorption processes but may not be practical.

Technology Based Limits for Industries

Technology -based limits for industrial discharges are established by federal effluent guidelines adopted in 40 CFR subchapter N, under the authority of CWA Sections 304 and 306, and are adopted in the state of Iowa by reference in IAC 567 -62.4. Where EPA has not promulgated a federal standard for a particular industrial category, technology -based limits must be developed on a case -by -case basis at the time of permit issuance (CWA section 402(a)(1)(B) and IAC 567 -62.6(3)(a)). In developing case -by - case technology - based limits for industries, the limits must conform to 40 CFR Part 125 Subpart A – Criteria and Standards for Imposing Technology -Based Treatment Requirements. EPA has promulgated federal effluent guidelines for 57 classes of industries but, with few exceptions, such effluent standards do not establish technology -based requirements for total nitrogen or total phosphorus. Where there are promulgated federal guidelines for TN or TP, the NPDES permit will contain effluent limits consistent with those guidelines. Data on the amounts of nitrogen and phosphorus discharged by industries is not readily available but likely varies significantly based on the type of industry. For example, process wastewater discharged by a meat processing facility will likely contain significantly higher nutrient concentrations than the discharge from a steam electric power plant. Most industries do not operate biological wastewater treatment plants because the characteristics of their wastewater makes biological treatment unnecessary so requiring all industries to install BNR is not reasonable. All major industries and minor industries with existing biological treatment systems will be required to collect data on the source, concentration and mass of total nitrogen and total phosphorus in their effluent and to evaluate alternatives for reducing the amounts of both pollutants in their discharge. IDNR will use the results of these evaluations to establish case -by -case technology-based effluent limits in NPDES permits except in cases where the industry is subject to a federal effluent standard for total nitrogen or total phosphorus. The nitrogen and phosphorus effluent limits for industries and for POTWs with significant industrial loads will be determined consistent with 40 CFR Part 125 Subpart A and IAC 567 -62.8(5).

Implementation Plan

All major municipal and industrial facilities, and minor industrial facilities that treat process wastewater using biological treatment, will be required to evaluate the economic and technical feasibility for reducing nutrient discharges. This evaluation, or “Feasibility Study,” will be based on a goal of achieving annual average mass limits equivalent to effluent concentrations of 10 mg/L TN and 1 mg/L TP. These concentrations are consistent with the minimum levels considered achievable using biological nutrient removal at a wastewater treatment facility that treats primarily domestic sewage. Technology-based effluent limits for nutrients for facilities addressed in this strategy must be developed on a case-by-case basis consistent with IAC 567 -62.8(5) and will be developed using the procedures specified in 40 CFR

Part 125 Subpart A. Such limits will be based on the effect of the pollutant in water and the feasibility and reasonableness of treating the pollutant. Based on information available to IDNR today it is anticipated that permits will not specify limits more stringent than 10 mg/L TN and 1 mg/L TP where biological treatment is the primary means of achieving the nutrient reduction goals. Biological treatment processes are more efficient at reducing nutrients at higher water temperatures and higher quality wastewater effluent is typically produced in the spring, summer, and fall than in the winter. Thus, while properly designed and operated biological treatment systems may not achieve levels of 10 mg/L TN and 1 mg/L TP at all times, monitoring results averaged over the entire year should result in effluent concentrations at or below these levels {See page 2}. The IDNR realizes that some treatment facilities may not be able to achieve these limits due to higher concentrations of TN or TP in the raw wastewater than are typically found in domestic sewage. In these cases the goal is to achieve equivalent annual percentage reductions in raw wastewater of 66% TN and 75% TP. If a permitted discharger installs nutrient reduction processes and technology -based TN and TP limits are included in the NPDES permit, then it is the position of the IDNR that the TN and TP discharge limits will not be made more restrictive for a period of at least 10 years after the completion of the nutrient reduction process construction unless it is determined that more restrictive limits are necessary to ensure the stream or lake will meet Iowa water quality standards. Iowa Code section 455B.173(3C) establishes the moratorium on more restrictive limits for municipal dischargers. For non -municipal discharges, this prohibition can be enforced through the permitting process or as a part of the adoption of any future nutrient limitation. A report of nutrient removal performance will be submitted to IDNR once facilities are constructed and have operated for a period of five years.

Kansas:

Surface Water Nutrient Reduction Plan

In order to enhance nutrient removal at larger WWTFs, biological nutrient removal (BNR) has been used with good success in the United States. BNR is a modification of traditional biological treatment processes utilized by the majority of large WWTFs in Kansas. Studies have indicated that BNR processes in municipal wastewater treatment can typically achieve TN and TP reduction of around 65%. The US Army Corp of Engineers estimates BNR will typically reduce TN to approximately 6 mg/L, and phosphorus to 1.5 mg/L (COE, 2001). Information provided by Bond and others indicates TN concentrations of 8 to 10 mg/L are more realistic (D.M. Bond, personal communication, December 1, 2004). In addition, some industries can utilize BNR to reduce nutrient discharges. However, due to the varying nature of industrial wastewaters, nutrient reduction levels would have to be ascertained on a case-by-case basis. The addition of chemicals and filtration to the end of the BNR process can be used to achieve higher nutrient removal efficiencies – particularly for phosphorus. This plan does not propose chemical addition and filtration for several reasons: 1) chemical addition adds additional metal salt pollutants to the discharged wastewater, 2) chemical handling presents a number of safety issues to WWTF operators, and 3) chemical addition and filtration is an expensive addition in relation to the benefits provided. Studies have indicated chemical addition and filtration for phosphorus reduction can increase initial capital costs by over 300% and double annual operation and maintenance costs compared to BNR alone (Faeth, 2000). Based on expected removal efficiencies for BNR, it is feasible for the large WWTFs in Kansas to meet effluent limitations of 8 mg/L for TN (~67% reduction) and 1.5 mg/L for TP (~65% reduction) on an ANNUAL AVERAGE basis

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As indicated in the previous section, it is expected most large (>1 MGD average design flow) municipal wastewater treatment facilities (WWTFs) can meet TN limits of 8 mg/L and TP limits of 1.5 mg/L on an annual average basis with biological nutrient removal (BNR) technology. These are referred to as technology-based BNR limits. Nutrient reduction at industrial facilities would have to be evaluated on a case-by-case basis due to the varying nature of their wastewater streams. While it is not anticipated a single technology-based limit would apply to all industrial discharges, nutrient reduction would be required where it is technologically feasible.

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It is proposed that technology-based nutrient limitations be phased into municipal WWTF permits over the next 15 years, or three permit cycles. Small facilities (<1 MGD average design flow) would be required to optimize treatment for nutrient removal and evaluate the cost of incorporating technology-based biological nutrient removal if the WWTF is proposed for expansion.