

1. Describe the environmental conditions or standards being prescribed.

The proposed rule includes methods to determine numeric nutrient criteria based on certain lake characteristics. These criteria will apply to all classified lakes with the exception of lakes located in the big river floodplains. Criteria for these lakes, as well as streams, will be addressed in a future rulemaking.

2. A report on the peer-reviewed scientific data used to commence the rulemaking process.

The proposed rule has been developed consistent with federal rule 40 CFR 131.12, Section 304(a) of the Clean Water Act and EPA's published guidance. Decisions on specific criteria were based on analysis of data from over 140 lakes and reservoirs throughout the state. Dr. Jack Jones and his colleagues at the University of Missouri have been collecting the data since 1976. (See "[Limnology Data Set](#)" in [Attachment A - Supporting Documents](#).)

The Regional Technical Assistance Group (RTAG) for EPA's Region VII (IA, KS, MO, NE) also provided data (See "[RTAG Data Set](#)" in [Attachment A - Supporting Documents](#)), technical advice, and assistance.

Development of the rule followed a series of nineteen meetings, beginning in October, 2005, with a stakeholders' advisory group. This group consisted of representatives of a variety of interested parties, including municipalities, agriculture, and environmental advocacy groups, as well as the Missouri Department of Natural Resources (the Department), the Missouri Department of Conservation, U.S. Environmental Protection Agency (EPA), and staff from the Department of Fisheries and Wildlife Sciences at the University of Missouri - Columbia. In December 2006, after a review of the draft rule and rationale by EPA, the group made the decision to form a technical subcommittee to look more closely at the data. The technical subcommittee met eight times since January 2007. A list of the peer-reviewed science and rationale used in the development of the proposed nutrient criteria for lakes can be found in [Attachment A - Supporting Documents](#).

3. A description of the persons who will most likely be affected by the proposed rule, including persons that will bear the costs of the proposed rule and persons that will benefit from the proposed rule.

Persons Affected - Point Sources:

There are about 2,000 permitted facilities producing a nutrient load from wastewater that are located within the watersheds of classified lakes and reservoirs. Of these, about 25 percent have stormwater permits, 25 percent have general permits, and the

remaining 50 percent of permits are site specific. More than 85 percent of these facilities are within the watersheds of the ten largest reservoirs in the state. (See Figure 3.1). Nutrients are a common element in domestic wastewater. There are about 140 Publicly Owned Treatment Works (POTW) and over 360 subdivisions that may be affected by the rule. Of these, 235 of the subdivisions are within the Lake of the Ozarks watershed, and 60 are in the Table Rock Lake watershed.

Other facilities that have domestic wastewater and therefore may be affected by the rule include 82 mobile home parks, 56 campgrounds 54 resorts, 30 motels, 20 restaurants, and 27 schools. The probability of any of these facilities receiving new limits on nutrients will depend on the trophic condition of the lakes within their watersheds, and the distance between their outfalls and the receiving lake..

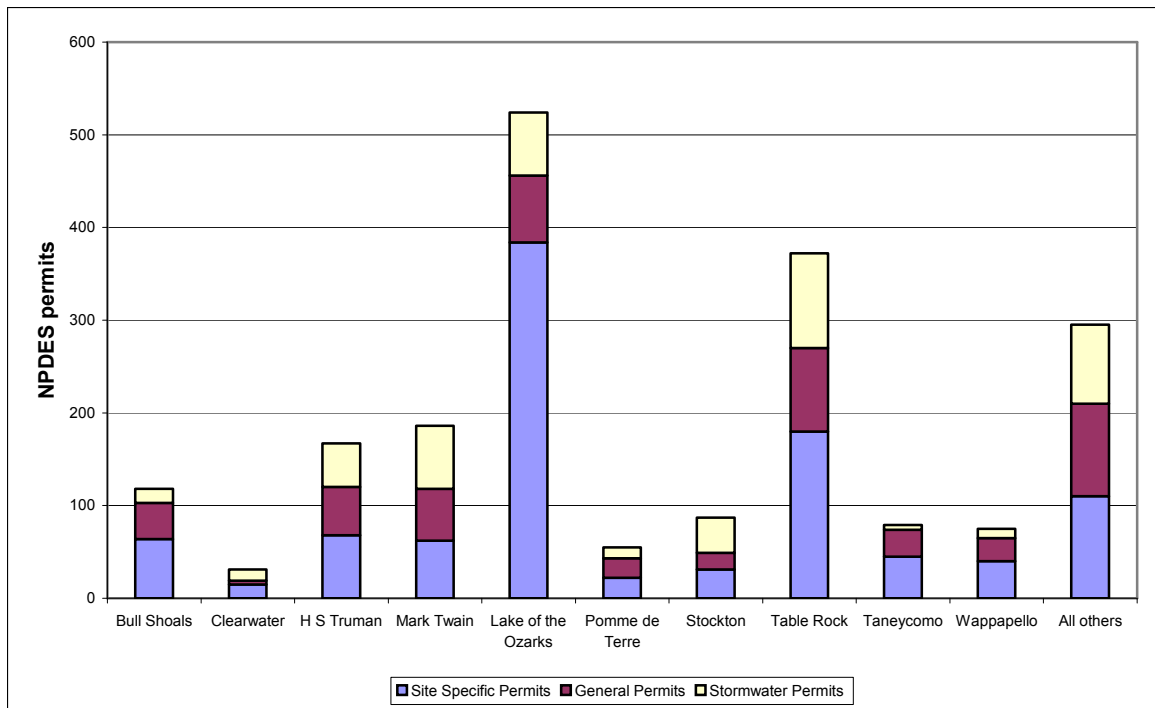


Figure 3.1 Distribution of permitted wastewater facilities within lake watersheds.

Persons Affected - Non-point sources

The most widespread non-point source contributor to nutrient loading of lakes and reservoirs is row-crop agriculture. Row cropping occurs primarily in the glaciated and Osage plains regions of the state. Processes of nutrient loading include overland flow and soil erosion. Other forms of agriculture, particularly livestock production, are also significant contributors.

Non-point source contribution may be controlled through incentive programs that promote Best Management Practices (BMP) and environmental awareness. The US

Department of Agriculture's Natural Resource Conservation Service (NRCS) and the Department's Soil and Water Conservation Program (SWCP) are the major sponsors of this effort.

“Best management practices are methods that have been determined to be the most effective and practical means of preventing or reducing pollution. These practices are often employed in agriculture, forestry, mining and construction. The EPA, working with partners in industry and the academic community have established and published best management practices for soil erosion, wastewater treatment, fuel storage, pesticide and fertilizer handling and the management of livestock yards. The ultimate goal of these practices is to increase efficiency while reducing pollution.”

(<http://www.epa.gov/rgytgrnj/economics/pdf/epa-r7wwpd-06-002.pdf>)

Examples of BMP include nutrient management plans, reduced tillage, buffer strips along streams, and crop rotations. NRCS programs include the Environmental Quality Incentives Program (EQIP), and the Conservation Security Program (CSP). SWCP offers cost-share for specific conservation practices, and the Agriculture Non-Point Source Special Area Land Treatment (AgNPS SALT) program targets selected watershed areas for land treatment. For lakes and reservoirs that are in non-compliance with the rule, coordination with these agencies will be essential to addressing the problem. Implementation will, in many cases, be a long-term process. Landowners who participate in these programs can benefit from the BMP by protecting the soil's productive capacity and using fewer costly chemicals

The other principle source of non-point source nutrient loading is urban run-off. As with agriculture, runoff from certain urban activities is not regulated except in metropolitan municipalities covered by MS4 permits. Educational and outreach programs work to improve lawn care management and reduce nutrient loading.

Stormwater runoff from urban areas is regulated by the municipal separate storm sewer system (MS4) permit. Urban stormwater may contain significant amounts of nutrients from fertilizers. There are 152 municipalities in Missouri that are required to manage their stormwater runoff under Phase II of the NPDES. MDNR staff have determined that runoff from 38 of these communities may affect the water quality of some lakes.

Persons Benefited - Both Point and Non-point Sources

In direct economic terms, the greatest beneficiaries from the proposed rule may be owners of lake front property. Several studies have indicated that increased water clarity associated with nutrient reduction is a significant factor in raising the value of such property. (Michael et al., 1996; Wilson and Carpenter 1999). Steinnes (1992), found an average increased value of \$235 per lakeshore lot for each 1 meter increase in water transparency as measured with Secchi disk.

Other economic beneficiaries include businesses that are reliant on tourism related lake recreation, such as restaurants, hotels, and marinas, as well as gas stations both near to and on the way to or from resort areas. Several studies demonstrated

relationships between lake water clarity and levels of tourist recreation (Bouwes and Schneider, 1979; Ribaudo and Epp, 1984; Smith et al, 1986; Wilson and Carpenter, 1999).

In more tangential terms, the public at large will benefit. Drinking water systems that use reservoirs as a source would experience fewer episodes of taste and odor problems that can occur as a consequence of excessive nutrient loading (MDNR, 2006). Furthermore, improved water quality in drinking water reservoirs would lead to a reduction in the cost of treating the water. Protected and enhanced water clarity will maintain and improve opportunities for whole body contact recreation. And, while some sport fishing potential is enhanced with higher nutrient loading, the potential for greater aquatic biodiversity tends to increase with reduced nutrient loading (Egertson and Downing, 2004).

4. A description of the environmental and economic costs and benefits of the proposed rule.

The cost to control nutrient loading as a result of this rule varies considerably, depending on the current condition of lake quality, the source of pollution (point or a non-point source), and the types of additional nutrient management needed. The numbers of classified lakes that appear to exceed the proposed criteria are summarized in [Table 4.5](#) below.

Table 4.5 Numbers of classified lakes exceeding the proposed criteria based on current data.

Lakes exceeding TP, TN, and Chl of the proposed criteria	8
Lakes exceeding only TP and TN of the proposed criteria	2
Lakes exceeding only TP of the proposed criteria	13
Lakes exceeding only TN of the proposed criteria	8
Lakes exceeding only TP and Chl of the proposed criteria	13
Lakes exceeding only TN and Chl of the proposed criteria	4
Lakes exceeding only Chl of the proposed criteria	7
Total lakes that exceed the proposed criteria	55

Cost of nutrient removal from point source discharges:

Total Phosphorus (TP) removal from wastewater discharges has costs that are dependent on a number of factors, the most significant being the size of the facility. Generally, the larger the facility, the lower the cost per unit mass of phosphorus removed. A study of wastewater treatment plants (WWTP) in six small communities in Texas illustrates the point (Keplinger et al., 2004). [Figure 4.1](#) is a log transformed linear regression of the cost to remove a kilogram per day of TP from the effluent as it relates to quantity of WWTP discharge. Costs ranged from \$33.65 to \$799 per kg of TP removed. This translated to a monthly cost of \$1.19 per house in a town of about 15,000 people, and a cost of \$25.43 per house in a village of 360 people.

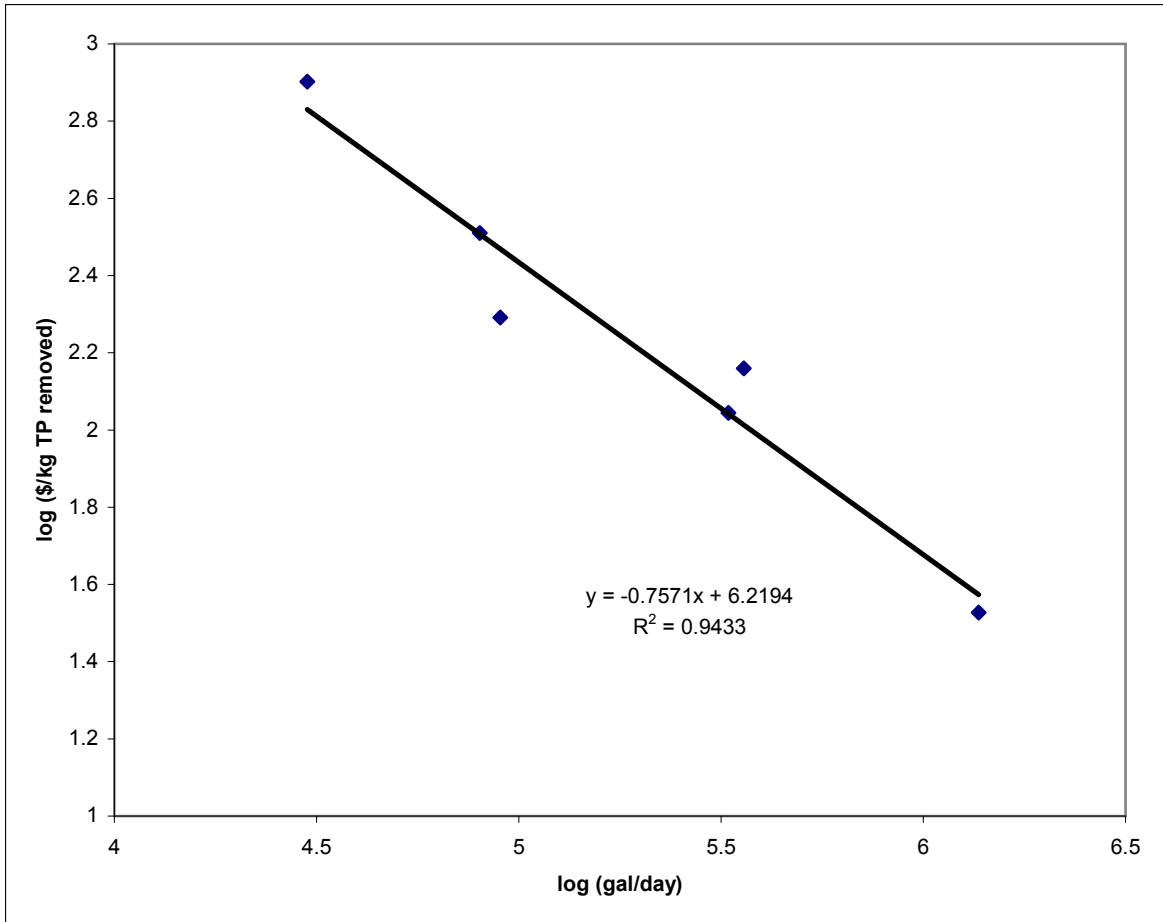


Figure 4.1 Cost of TP removal as a function of WWTP daily discharge in six communities in Texas (from Keplinger et al. 2004).

The higher cost per unit for smaller systems may be mitigated by a few factors. In several parts of the state, maintenance of smaller systems is contracted to operators. These parties often have the resources and the expertise to apply TP controls that otherwise may not be affordable to a small system owner. (Neher, 2007).

It is possible that waste load allocations developed from the proposed nutrient criteria for lakes would be less restrictive for facilities within lake watersheds but that do not directly discharge to a lake. This is because of the potential for effective nutrient reduction through instream processes and uptake by riparian vegetation. For example, phosphorus can be bound by organic matter which can then settle in stream sediments. Denitrification, the transformation of nitrate to nitrogen gas, can effectively remove nitrogen from the aquatic environment.

Under these circumstances, many facilities, particularly smaller ones, may qualify for relaxed limitations or no limitations at all. About 67 percent of wastewater outfalls in the lake watersheds have design flows of less than 22,500 gallons per day (gpd) and 18 percent have design flows greater than 100,000 gpd.

Besides the discharge capacity of the facility, other factors affecting the cost of nutrient removal include the type of wastewater treatment system, whether nutrient removal is being adapted to an existing system or installed as a part of a new system, and the target nutrient concentration in the effluent.

As the nutrient limit becomes more restrictive, cost of treatment tends to rise exponentially, as is illustrated in Figure 4.2 (Jiang et al. 2005; Waitman, 2007). Total annual economic cost in this study includes annualized capital costs, as well as annual costs for energy, labor, chemicals, sludge disposal, maintenance, and insurance.

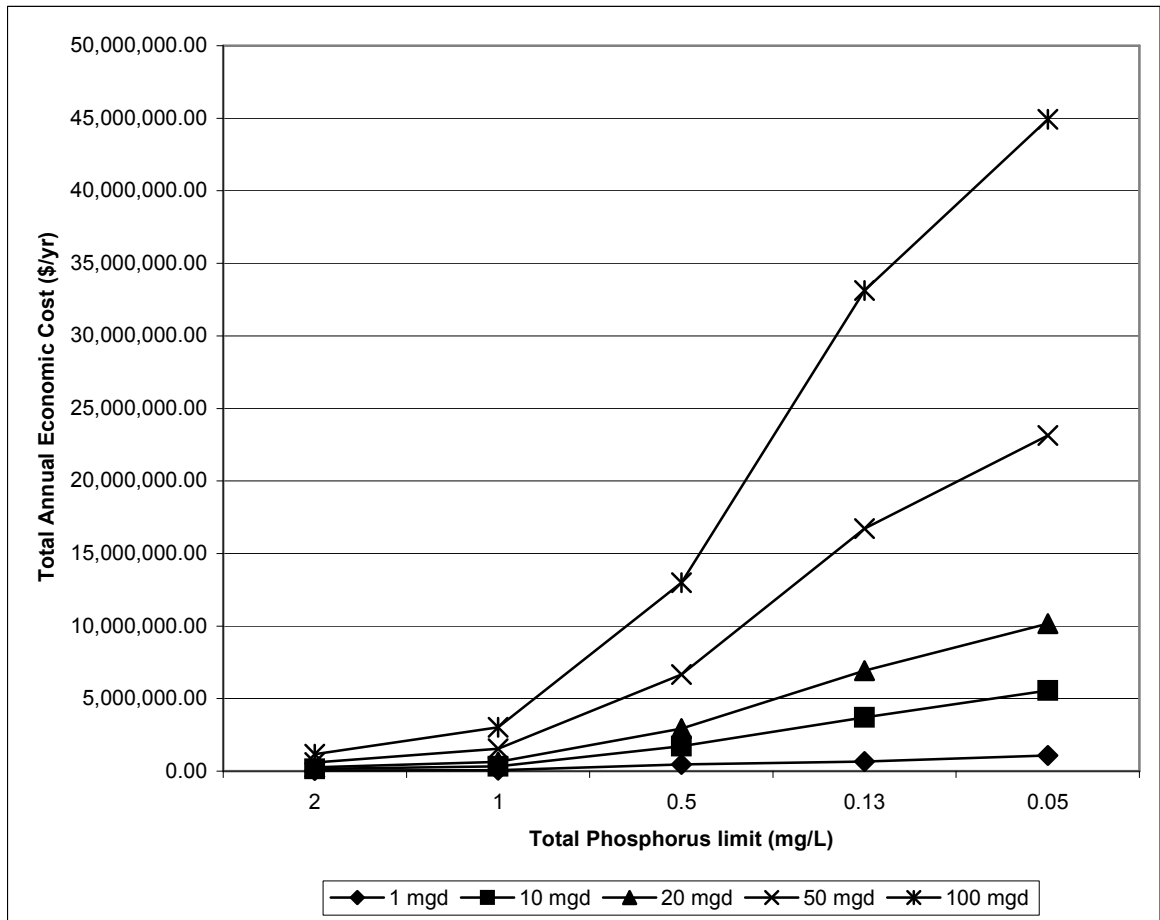


Figure 4.2: Total Annual Economic Costs for reducing Total Phosphorus in Activated Sludge treatment plants of varying design flow capacities (from Jiang et al, 2005)

Effluent rules 10CSR 20-7.015(3)(F) & (G) set an effluent limit of 0.5 mg/L total phosphorus as a monthly average and a schedule of compliance for facilities discharging in the Table Rock Lake and Lake Taneycomo watersheds. Facilities discharging one million gallons per day (1 MGD) or more complied with this rule by November 30, 2003. Some operators of small facilities (less than 1 MGD) have

voluntarily installed phosphorus removal systems, out of concern that nutrient impairment of Table Rock Lake was affecting the resort business that they served. Capital and operating costs data for TP removal were obtained from several of these facilities in the Table Rock Lake watershed and are shown in Table 4.6.

Table 4.6 Installation and operating costs for TP removal at individual WWTFs

Facility	Design Flow (MGD)	Installation Cost	Annual Operation & Maintenance Costs	Annual Lab Sample Costs	Total Annual Operating Costs
1	0.002	\$25,000	\$600	\$417	\$1,017
2	0.00462	\$2,000	\$567	\$80	\$647
3	0.00592		\$760	\$600	\$1,360
4	0.007	\$12,000	\$600	\$620	\$1,220
5	0.008	\$1,800	\$300	\$320	\$620
6	0.009	\$4,000			
7	0.009		\$760	\$600	\$1,360
8	0.009375		\$580	\$500	\$1,080
9	0.014		\$760	\$600	\$1,360
10	0.018	\$237,000			
11	0.045		\$12,480	\$216	\$12,696
12	0.12	\$100,000	\$18,600	\$1,800	\$20,400
13	0.3	\$2,428	\$13,136	\$180	\$13,316
14	42.5	\$1,600,000	\$700,000		\$700,000

Note: Regressions were calculated from the above data, yielding the following results:

$$\text{Log [installation costs (\$)]} = 0.5252 * \text{log [design flow (gal/day)]} + 1.7338 (R^2 = 0.5284)$$

$$\text{Log [total annual operating costs (\$)]} = 0.7745 * \text{log [design flow (gal/day)]} + 0.111 (R^2 = 0.8087)$$

The estimates, as calculated from the above regression equations are based on the median design flow within each range.

The number and size of facilities that may be affected by the proposed criteria for total phosphorus are presented in Table 4.7.

Table 4.7 Number and size of wastewater facilities possibly affected for total phosphorus statewide

Design Flow (MGD)	Public	Private	Totals
<0.005	0	17	17
0.005-0.05	5	11	16
0.05-0.5	6	2	8
0.5+	3	1	4
Totals	14	31	45

Tables 4.8 and 4.9 present statewide cost estimates for achieving compliance with the proposed phosphorus criteria.

Table 4.8 Estimate of total installation cost for phosphorus removal by facility type and design flow range:

Design Flow (MGD)	Public	Private	Totals	Yearly Cost* Based on 20-Year Loan
<0.005	\$0	\$16,979	\$16,979	\$1,362
0.005-0.05	\$61,527	\$135,359	\$196,886	\$14,271
0.05-0.5	\$279,365	\$93,122	\$372,487	\$22,953
0.5+	\$230,320	\$76,773	\$307,093	\$18,924
Totals	\$571,212	\$322,233	\$893,445	\$57,511

*yearly cost is based on interest rate (5% for private and 1% for public entities), amount of the loan (estimated cost), and a zero future value.

Table 4.9 Estimate of total yearly operation and maintenance cost for phosphorus removal:

Design Flow (MGD)	Public	Private	Total O&M Cost	Total O&M plus Amortization Costs
<0.005	\$1,177	\$18,834	\$20,011	\$21,373
0.005-0.05	\$8,021	\$44,115	\$52,136	\$66,407
0.05-0.5	\$113,779	\$37,926	\$151,705	\$174,658
0.5+	\$113,822	\$37,940	\$151,762	\$170,686
Totals	\$236,798	\$138,815	\$375,614	\$433,125

Assumptions;

- 1) Estimates are derived from regressions of treatment cost as a function of design flow. Regressions are as follows:
 - a) Capital Costs: $x = -1/\sqrt{[MGD]}$, $y = \log_{10}(\text{cost})$; $y = 0.102x + 4.983$; $R^2 = 0.755$; Robust Regression (least median squares).
 - b) Operation & Maintenance – Design flow < 0.01 MGD: $x = \text{gallons per day}$; $y = \text{annual cost}$; $y = 0.009x + 1154.63$; $R^2 = 0.753$; Robust Regression (least median squares).
 - c) Operation & Maintenance – Design flow ≥ 0.01 MGD: $x = \log_{10}(\text{gpd})$; $y = \text{annual cost}$; $y = 18650.925x - 75029.92$; $R^2 = 0.994$; Robust Regression (least median squares).
- 2) Capital and operation and maintenance cost data developed from interviews with managers of facilities that already treat for a total phosphorus limit of 0.5 mg/L.
- 3) Operation and maintenance includes chemical input, repairs, and lab analyses.
- 4) Estimates do not account for specific waste load allocations. Calculating those will not be accomplished in a short time.

Cost of nitrogen removal from point source discharges:

Biological Nutrient Removal (BNR) may be used to reduce total nitrogen in wastewater facilities. This technology has been implemented in the Chesapeake Bay area since 1983 and achieved total nitrogen limits of 8 mg/L and total phosphorus of 3 mg/L. Activated sludge enhanced nutrient removal system achieved a 3 and 0.3 mg/L of TN and TP respectively. The estimated total cost of planning, design, and construction of new activated sludge Enhanced Nutrient Removal (ENR) or upgrade

of existing traditional system of 7 wastewater treatment systems in the Chesapeake Bay is summarized in **Table 4.10** below.

Nutrient removal technology has been advancing rapidly in recent years. Less than 15 years ago, reduction of total nitrogen in effluent to 8mg/L cost about \$35 per pound of nitrogen removed. Now the costs are generally less than \$10 per pound, and \$4 per pound for those facilities with some form of nutrient control already in place (Chesapeake Bay Commission, 2004). The following web sites provide further information on these figures:

http://www.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf
<http://www.mde.state.md.us/Water/CBWRF/index.asp>
<http://www.chesapeakebay.net/status.cfm?sid=186>

Table 4.10 Cost estimate prepared for Maryland Department of the Environment:

Facility Name	Upgrade Description	Design Flow (MGD)		Capital Costs
		Old	New	
Celanese WWTP	Activated sludge replacing lagoon	1.25	1.66	\$15,833,000
Crisfield WWTP	Activated sludge upgrade with denitrification filters	1.0	1.0	\$10,100,000
Easton WWTP	Activated sludge replacing overland flow	2.35	4	\$38,913,000
Hurlock WWTP	Activated sludge replacing lagoon	1.65	1.65	\$7,285,000
Kent Island WWTP	Activated sludge replacing rotating biological contactor	2.0	3.0	\$33,200,000
Salisbury WWTP	Trickling filter modification, new denitrification filters	6.8	8.5	\$81,658,000
Talbot County Region II WWTP	Activated sludge replacing rotating biological contactor	0.5	0.66	\$13,747,000

The cost of upgrading a facility for nitrogen removal is dependent on a number of factors, including size of the facility and type of treatment. For systems with design flows of less than 0.5 MGD, there are two options for retrofitting; the addition of an anoxic tank or a deep bed denitrification filter (US-EPA 2007). The anoxic tank option is applicable to systems that use the Modified Ludzack-Ettinger (MLE) process, which is not common in Missouri, and particularly not in smaller systems. However, deep bed denitrification filters can be added to package plants. The

estimates in [Table 4.11](#) include pumps for secondary effluent to the filters and methanol feed equipment for nitrogen removal and chemical feed for phosphorus removal as well.

Table 4.11 Average costs for retrofits with deep bed denitrification filter. (US-EPA 2007).

Design Flow (gpd)	Construction	Operation and Maintenance
4,000	\$145,655	\$21,573
10,000	\$161,691	\$22,309
25,000	\$196,434	\$24,883
50,000	\$217,815	\$30,399
100,000	\$213,000	\$28,600

For facilities with greater flows, there is a wider range of system upgrade options for nitrogen control. Systems already in use in Missouri include Anaerobic/anoxic/Aerobic Process (A²/O), Activated Sludge, Methanol, Oxidation Ditch, Rotating Biological Contactor (RBC), and Sequencing Batch Reactor (SBR). [Table 4.12](#) is derived from a list of construction costs for facility upgrades in Maryland that operate in the aforementioned systems.

Table 4.12 Nutrient Reduction Upgrade Costs for Maryland Wastewater Treatment Plants (US-EPA 2007).

Facility	Design Flow (MGD)	Treatment Process	Total Capitol Cost (2006\$)
Aberdeen	2.8	MLE	\$3,177,679
Annapolis	10	Ringlace	\$14,687,326
Black River	180	MLE	\$138,305,987
Ballenger	2.0	Modified Bardenpho	\$2,891,906
Broadneck	6.0	Oxidation Ditch	\$3,165,193
Cambridge	8.1	Activated Sludge	\$7,424,068
Chesapeake Beach	0.75	Oxidation Ditch	\$2,158,215
Dorsey Run	2.0	Methanol	\$3,967,307
Freedom District	3.5	Activated Sludge	\$1,462,798
Fruitland	0.5	SBR	\$7,546,764
Little Patuxent	18	A ² /O	\$7,263,879
Mt. Airy	0.6	Activated Sludge	\$5,235,575
Northeast	2.0	Activated Sludge	\$4,225,029
Parkway	7.5	Methanol	\$15,869,228
Patuxent	6.0	Oxidation Ditch	\$2,106,763
Poolesville	0.625	SBR	\$1,593,640
Princess Anne	1.26	Activated Sludge	\$4,311,742
Taneytown	0.7	SBR	\$3,808,298
Western Branch	30	Methanol	\$47,132,782
Westminster	5.0	Activated Sludge	\$5,274,444

The number and size of facilities that may be affected by the proposed criteria for total nitrogen, and the possible costs, are presented in [Tables 4.13, 4.14 and 4.15](#). Many of these facilities are in the watersheds of lakes that also are high in total phosphorus. Nitrogen removal may not be necessary where phosphorus loading is found to be the most limiting nutrient to water quality impairment and where total nitrogen violation of the criteria is marginal.

Table 4.13 Number and size of wastewater facilities possibly affected for total nitrogen statewide

Design Flow (MGD)	Public	Private	Totals
<0.005	1	25	26
0.005-0.05	7	39	46
0.05-0.5	14	6	20
0.5+	11	2	13
Totals	33	72	105

Table 4.14 Total installation costs for affected facilities for nitrogen removal

Design Flow (MGD)	Public	Private	Totals	Yearly Cost Based on 20-Year Amortization
<0.005	\$278,635	\$6,965,889	\$7,244,525	\$574,401
0.005-0.05	\$2,504,215	\$13,952,054	\$16,456,268	\$1,258,321
0.05-0.5	\$7,924,705	\$3,396,302	\$11,321,007	\$711,678
0.5+	\$28,616,961	\$5,203,084	\$33,820,045	\$2,003,327
Totals	\$39,324,516	\$29,517,329	\$68,841,845	\$4,547,727

Table 4.15 Total yearly operation and maintenance costs for affected facilities for nitrogen removal

Design Flow (MGD)	Public	Private	Total O&M Cost	Total O&M plus Amortization Costs
<0.005	\$26,992	\$674,812	\$701,804	\$1,276,205
0.005-0.05	\$245,480	\$1,367,676	\$1,613,156	\$2,871,477
0.05-0.5	\$750,508	\$321,646	\$1,072,154	\$1,783,832
0.5+	\$1,402,276	\$254,959	\$1,657,235	\$3,660,562
Totals	\$2,425,256	\$2,619,093	\$5,044,349	\$9,592,076

Assumptions;

- 1) Estimates are based on regressions of treatment cost as a function of design flow. Data are from Biological Nutrient Removal Processes and Costs, EPA-823-R-07-002 and Municipal Nutrient Removal Technologies Reference Document (draft by Tetra Tech for EPA under contract EP-C-05-046; WA 1-46). Regressions are as follows:
 - a) Capital Costs – Design flow < 0.1 MGD:

- i) Lagoons: Replacement by sequencing batch reactors. $x = \text{MGD}$; $y = \text{cost}/\$1,000$. $y = -28306x^2 + 11847x + 392.01$.
- ii) All other facilities: Retrofit with deep bed denitrification filter. $x = \text{MGD}$; $y = \text{total installation cost}$. $y = 207529x^3 - 49577x^2 + 3704.3x + 130.8$.
- b) Operation & Maintenance – Design flow $< 0.1 \text{ MGD}$.
 - i) SBR (converted lagoon); $x = \text{MGD}$; $y = \text{cost}/\$1,000$. $y = -3044.5x^2 + 1229.3x + 29.943$.
 - ii) All other facilities: $x = \text{MGD}$; $y = \text{cost}/\$1,000$. $y = -49343x^3 + 5236.4x^2 + 42.236x + 21.356$.
- c) Capital Costs and Operation and Maintenance costs – Design flow $\geq 0.1 \text{ MGD}$. Estimated from CAPDEWorks models developed by Tetrattech. The following scenarios were used:
 - i) Oxidation Ditches retrofitted with phased isolation ditch;
 - ii) Extended aeration and activated sludge systems retrofitted with step-feed system;
 - iii) Lagoon expanded with denitrifying filter system.
 - iv) For O&M expenses, actual flow is assumed to be 50 percent of design flow.
- 2) Capital and operation and maintenance cost data derived from literature, mainly from EPA, the State of Maryland, and the Chesapeake Bay Program
- 3) Operation and maintenance includes chemical input, repairs, and lab analyses.
- 4) Estimates do not account for specific waste load allocations. Calculating those will not be accomplished in a short time.
- 5) For most affected lakes, phosphorus is the limiting nutrient. Phosphorus control by itself may be sufficient to protect water quality. This analysis does not account for that.

Cost of Combined Nitrogen and Phosphorus Removal from point source facilities

There are only three point source facilities that have been identified in the watersheds of lakes that would exceed proposed criteria for both nitrogen and phosphorus. In some instances, combining treatment technologies for removal of both nutrient types may be less costly than treating them separately. However, because of the small number of facilities affected, they were included in the preceding analyses for both phosphorus and nitrogen removal.

5. The probable costs to the agency and to any other agency of the implementation and enforcement of the proposed rule and any anticipated effect on state revenue.

The rule will likely lead to an increased workload for the department as it administers the new criteria. An estimated 150 facilities (Tables 4.7 and 4.13) may need to implement additional treatment to achieve compliance. The department will be required to conduct a review of these permits for "reasonable potential" for exceeding the new criteria and evaluate treatment plans to ensure compliance. Increased monitoring by the department may be necessary to perform a complete assessment of water quality in lakes predicted to exceed the standards.

6. A comparison of the probable costs and benefits of the proposed rule to the probable costs and benefits of inaction, which includes both economic and environmental costs and benefits.

The costs and benefits of the proposed rule are explained in response to item 4. The following consequences of inaction are specified in EPA's June 1998 National Strategy for the Development of Regional Nutrient Criteria:

“...if EPA determines that a new or revised nutrient standard is necessary for a State or Tribe (because EPA determines that the State or Tribe has not demonstrated reasonable progress toward developing numerical nutrient standards), EPA will initiate will initiate rulemaking to promulgate nutrient criteria values...”

If, due to inaction, EPA has to promulgate nutrient criteria, it is probable that criteria set by EPA would be more restrictive and less site-specific than what are in the proposed rule. These could result in reduced regulatory flexibility for both the department and the regulated community, which could result in higher costs for compliance due to the more restrictive standard.

7. A determination of whether there are less costly or less intrusive methods for achieving the proposed rule.

States are required to develop numeric nutrient criteria instead of relying on general criteria, as is done currently in Missouri, to identify and quantify water quality problems associated with nutrients. As described in response to item 2 of this report, the development of the proposed criteria involved discussions with a workgroup representing various interests. Because of the mix of the participants in this group, its work was aimed at finding the most effective criteria. The proposed criteria reflect the natural variations in reactions to nutrient loads by taking into account eco-regional differences, lake depths and hydraulic residence time. The proposed criteria also uses reference data to ensure the criteria properly reflect the levels of nutrient restrictions that are attainable.

Development of nutrient criteria has been a complex undertaking, with a large number of variables to take into account. We believe that, following consultation with a variety of experts in the field, the criteria proposed are the most effective that can be developed at this time.

8. A description of any alternative method for achieving the purpose of the proposed rule that were seriously considered by the department and the reasons why they were rejected in favor of the proposed rule.

The specific effects of nutrient loading on designated uses for waters of the state are difficult to quantify and calibrate because of uncertainties associated with the relationships between causal and response variables. The tolerance of a waterbody for nutrient loading varies with a number of factors including local hydrology, geology, land cover and climate. Overall, however, excessive nutrient loading has been amply demonstrated to degrade the beneficial uses of surface waters.

Several earlier drafts of the rule segmented the state in the same fashion as the current one. They derived predicted values for total phosphorus based largely on hydrologic factors in the plains region and regional factors in the Ozarks. They also established a

range between advisory and action levels to account for the uncertainty associated with the extent of nutrient loading that would lead to environmental degradation.

This approach lacked specific links to beneficial uses of water bodies, and it also lacked the identification of reference bodies to use as bench marks as allowed for in section 304(a) of the Clean Water Act. The current draft corrects that, and refines the hydrologic approach.

9. An analysis of both short-term and long-term consequences of the proposed rule.

Implementation of nutrient criteria will be through development of TMDL's for lakes that are identified as exceeding the criteria. The earliest probable listing will be in 2010, and calculation of load and wasteload allocations for those lakes that are listed will take a period of time after that. Therefore, negligible expense is anticipated in the short term.

However, we recognize that implementations through the TMDL process can be time consuming. It potentially places new discharges in these watersheds in limbo while waste load allocations are derived for the watershed. The department is committed to developing an implementation strategy that minimizes delays on new discharges in watersheds of impaired lakes and reservoirs.

Long term expenses will include point source upgrades as described in Section 4 of this report as well as staff time in bringing discharge permits into conformance with wasteload allocations. The other significant long term expenditure will be information and education efforts and the installation of best management practices in those areas where the principle nutrient dischargers are non-point sources. As previously mentioned, these expenditures can be substantially reimbursed to landowners through state and federal conservation incentive programs.

Long term cost effectiveness and environmental benefits will support increased and sustainable quality of life for all, including, individuals and community businesses, agricultural facilities and other utilities in the watershed.

10. An explanation of the risks to human health, public welfare or the environment addressed by the proposed rule.

- Aquatic life is impacted by nutrient loading at several levels. It can increase the probability of fish kills due to oxygen depletion that results from excessive algae growth. It can also undermine aquatic diversity by creating conditions favorable to certain fast growing species, such as carp and benthivores, at the expense of other species (Edgertson and Downing, 2004).
- Drinking water problems are frequently attributed to specific species of algae that produce a range of toxicities. The consequences can include taste and odor

- problems and risks to human health as well as to livestock and wildlife. (Downing et al. 2001).
- Whole body contact recreation can be impaired because of reduced water clarity associated with algae growth. This can affect the attractiveness of a water body for recreation, as well as safety concerns due to reduced water clarity.

11. The identification of the sources of scientific information used in evaluating the risk and a summary of such information

Rationale for the criteria is provided in Attachment A - Supporting Documents.

12. A description and impact statement of any uncertainties and assumptions made in conducting the analysis on the resulting risk estimate.

The central paradigm on which the rule is based comes from research that has been going on since the 1920's. That is that the most commonly occurring water quality impairments in lakes and reservoirs result from loading of nitrogen and phosphorus in quantities that are significantly in excess of natural loading levels. These impairments include but are not limited to: frequent nuisance algal blooms, fish kills, overabundance or decline of macrophytes, and loss of top predators from the food chain (Gibson et al, 2000).

While the paradigm is well established, there is uncertainty about the degree of nutrient loading that will lead to impairment. A certain amount of nutrient concentration is desirable and necessary for the support of healthy aquatic ecosystems. There is no single nutrient concentration level that is appropriate for all lakes and reservoirs. Factors that affect threshold levels include the type of aquatic ecosystem in question, local geology, lake hydrology, turbidity resulting from sedimentation, and land cover.

The rule addresses these uncertainties with the delineation of nutrient criteria by reference values within ecoregions, incorporation of hydrologic factors, and identification of those water bodies that merit more stringent protections than the others within each ecoregion.

13. A description of any significant countervailing risks that may be caused by the proposed rule.

Because of the complexity of the nutrient issue, there may be some risk that, in a given water body, the proposed criteria may be too stringent to adequately support a desired aquatic ecosystem, or not stringent enough to protection for all of the lake's designated uses. The criteria were developed following months of analysis of long-term data. The expertise and experience behind this effort will serve to minimize this type of risk.

The addition or alteration of phosphorus removal systems to point source facilities will result in increased production of sludge, due to the flocculation that results from the addition of alum to the wastewater stream. It is expected that this will only be a significant problem in larger facilities.

The proposed rule is likely to result in some point source facilities being required to add phosphorus control to their systems. It is possible that nitrogen control may be required in a few instances as well.

14. The identification of at least one, if any, alternative regulatory approaches that will produce comparable human health, public welfare or environmental outcomes.

The only viable alternative regulatory approach would be the adoption of EPA's national nutrient criteria. These are generally more stringent than what is in the proposed rule and they employ a different regional delineation. They do not account for the hydrologic factors that affect nutrient levels in lakes and reservoirs.