

Chapter 583**Nutrient Criteria for Fresh Surface Waters**

SUMMARY: This Chapter establishes nutrient criteria for Class AA, A, B, C, and GPA surface waters of the State. Nutrient enrichment can cause negative environmental impacts to fresh surface waters, such as algal blooms, low dissolved oxygen concentrations, and excessive growths of filamentous algae or bacteria. Methods described in this Chapter will be used to make decisions about attainment of classification and water quality standards.

1. Definitions. The following terms are defined for use in this Chapter.

- A. “Algal bloom” means a planktonic growth of algae which causes Secchi disk transparency to be less than 2.0 meters.
- B. “Chlorophyll *a*” means a particular kind of photosynthetic pigment of algae and plants.
- C. “Colored” means having a mean apparent color >25 standard platinum units or equivalent value of true color or dissolved organic carbon.
- D. “Diatoms” means algae in the class Bacillariophyceae.
- E. “Impounded waters” means riverine waters upstream of a dam and not classified as GPA where the surface elevation is essentially the same as found at the dam.
- F. “Ppb” means parts per billion, which is equivalent to micrograms per liter.
- G. “Ppm” means parts per million, which is equivalent to milligrams per liter.
- H. “Periphyton” means a layer of microscopic algae, bacteria, and fungi growing on a substrate within a waterbody.
- I. “Phytoplankton” means algae suspended in the water column.
- J. “Stressor” means an environmental condition of anthropogenic or natural origin that causes a detrimental change to aquatic life.

2. Purpose and applicability. The purpose of this Chapter is to describe environmental response criteria used to determine impairment of a designated or existing use as described in 38 M.R.S.A. §§ 464(4), 465, and 465-A due to phosphorus or another nutrient. The nutrient criteria and decision framework established by this Chapter are applicable to Class AA, A, B, C, and GPA surface waters of the State. Surface waters may be divided into segments that are evaluated independently.

NOTE: Class GPA waters shall have stable or decreasing trophic state (less nutrient enrichment) as described in 38 M.R.S.A. § 465-A(1)(B). In addition, no change in land use in a watershed of a Class GPA water may result in a water quality impairment or increase in trophic state of the GPA water as described in 38 M.R.S.A. § 465-A(1)(C). These two provisions are addressed in part by DEP under the Chapter 500 Stormwater Management Rules and by many local ordinances, both of which require certain new developments to incorporate stormwater phosphorus mitigation measures based on lake specific watershed phosphorus budgets and other provisions in “Volume II of the Maine Stormwater Best Practices Manual - Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development”.

- 3. Nutrient criteria and decision framework.** The Department uses the following decision framework (Figure 1) to determine whether phosphorus or another nutrient has caused or contributed to the impairment of a designated use. The decision framework uses a variety of nutrient indicators, including total phosphorus concentrations and environmental responses of nutrient enrichment. The Department will use the decision framework to determine (1) if there is an impaired use and (2) if phosphorus or another nutrient caused or contributed to the impairment. The total phosphorus limits for each class are described in Section 3(A) of this Chapter. Limits of environmental response criteria for each class are described in Section 3(B) of this Chapter. Application of the decision framework is described in Section 3(C) of this Chapter. The criteria and decision framework are also used in evaluations of existing uses for antidegradation purposes pursuant Section 464(4)(F)(1).
- A. Total phosphorus concentrations (ppb).** The limits for total phosphorus, measured as the mean of an established set of samples, are set forth in Table 1 for each statutory class.
- B. Environmental response criteria.** The following environmental responses of nutrient enrichment indicate an impairment of a use described in 38 M.R.S.A. §§ 464(4), 465, and 465-A. A variety of environmental responses are necessary because of the variety of fresh surface waters in Maine. One or more environmental response criteria must be measured and independently evaluated depending on the type of surface water being sampled as described in Table 2.
- (1) **Secchi disk transparency depth (meters).** This variable is an indicator of phytoplankton blooms and relates to designated uses and criteria in 38 M.R.S.A. § 464-A(1)(B) and the recreation and aquatic life components of § 465-A. Summer (June 1 – September 30) algal blooms usually are dominated by cyanobacteria, however may be dominated by other types of algae. This variable is met if the Secchi disk depth is greater than or equal to 2.0 meters for all samples taken during the open water season (Table 3). This variable is applicable to GPA waters and impounded Class A, B, and C waters greater than 2 meters deep.
- (2) **Water column chlorophyll *a* (ppb).** This variable is an indicator of phytoplankton blooms and relates to designated uses and criteria in 38 M.R.S.A. § 464-A(1)(B) and the habitat, recreation, and aquatic components of §§ 464(4) and 465. This variable is met if the water column chlorophyll *a* concentration is less than or equal to the limit set forth in Table 3 for the statutory class of the waterbody. The maximum limit for Class A waters is 3.5 ppb. The Department has the discretion to use 5.0 ppb as the maximum limit for Class A waters with water velocity less than 5 centimeters per second.
- (3) **Diatom total phosphorus index.** This variable is a measure of the trophic state of streams and rivers and relates to the designated use and narrative criteria associated with aquatic life in

38 M.R.S.A. § 465. This variable is calculated using the protocols described in “Protocols for Calculating the Diatom Total Phosphorus Index (DTPI) and Diatom Total Nitrogen Index (DTNI) for Wadeable Streams and Rivers” (DEPLW-0970) dated April 10, 2009. This variable is met if the Diatom Total Phosphorus Index is less than or equal to the limit set forth in Table 3 for the statutory class of the waterbody. This response variable is applicable to Class AA, A, B, and C waters less than 1 meter deep at the time of sampling, including segments of large rivers.

- (4) **Percent cover of algae.** This variable indicates the amount of algae growing on substrates on the bottom of a stream or river and relates to the designated uses and narrative criteria associated with habitat, recreation, and aquatic life in 38 M.R.S.A. §§ 464(4) and 465. This variable is met if the percent of substrate covered by periphyton mats greater than 1 millimeter thick and filamentous algae is less than or equal to the limit set forth in Table 3 for the statutory class of the waterbody. This response variable is applicable to Class AA, A, B, and C waters less than 1 meter deep at the time of sampling, including segments of large rivers.
- (5) **Patches of fungi and filamentous bacteria.** This variable indicates major shifts in trophic state and relates to the designated uses and narrative criteria associated with habitat, recreation, and aquatic life in 38 M.R.S.A. §§ 464(4) and 465. This variable is met if there are no macroscopically observable patches of fungi and filamentous bacteria on the substrate, excluding iron and manganese bacteria.
- (6) **Dissolved oxygen concentrations (ppm).** This variable protects fish and other aquatic life. This variable is met if the waterbody attains the dissolved oxygen criteria as described in 38 M.R.S.A. §§ 465 and 465-A or as naturally occurs.
- (7) **pH.** This variable protects fish and other aquatic life and relates to designated uses and criteria associated with aquatic life as described in 38 M.R.S.A. §§ 465 and 465-A. Very low and very high pH values can be harmful to aquatic life and can be caused by nutrient enrichment. This variable is met if the waterbody is within the range of pH, 6.0 – 8.5, or as naturally occurs.
- (8) **Aquatic life use attainment.** This variable is an indicator of the condition of aquatic biological communities. This variable is met if the waterbody attains the narrative and numeric aquatic life use criteria as described in 38 M.R.S.A. §§ 465 and 465-A, and Department of Environmental Protection 06-096 Chapter 579.

C. Nutrient decision framework outcomes (Figure 1)

- (1) **Not impaired - all nutrient criteria are attained.** If the mean total phosphorus concentration is less than or equal to the limit of the assigned class from Table 1 and all environmental response criteria from Table 2 that are measured in a waterbody meet the limits of the assigned class of Table 3, then the Department will conclude that phosphorus did not cause an impairment of a use (top-left box in Figure 1).
- (2) **Not impaired - total phosphorus exceeds the limit but environmental response criteria are attained.** If the mean total phosphorus concentration is greater than the limit of the assigned class from Table 1, but all environmental response criteria from Table 2 that are

measured in a waterbody meet the limits of the assigned class of Table 3, then the Department will conclude that phosphorus did not cause an impairment of a use (top-right box in Figure 1). The Department subsequently may examine downstream waterbodies to determine if there are any adverse effects downstream.

- (3) **Impaired - total phosphorus is less than or equal to the limit but one or more environmental response criteria are not attained.** If the mean total phosphorus concentration is less than or equal to the limit of the assigned class from Table 1, but one or more environmental response criteria from Table 2 that are measured in a waterbody do not meet the limits of the assigned class of Table 3, then the attainment result is indeterminate (bottom-left box in Figure 1). Indeterminate results require additional evaluation and best professional judgment to make the final determination. The Department will use a weight-of-evidence approach to determine if total phosphorus or another nutrient caused or contributed to an impairment of a use.
 - (a) The Department will conclude that total phosphorus caused or contributed to an impairment of a use if it is shown through weight-of-evidence that phosphorus is a plausible stressor.
 - (b) The Department will conclude that another nutrient, such as nitrogen or carbon, has caused or contributed to an impairment of a use if it is shown through weight-of-evidence that the nutrient is a plausible stressor responsible for the impairment.
 - (c) The Department will conclude that phosphorus has not caused an impairment if it is shown through weight-of-evidence that another non-nutrient stressor is the plausible stressor responsible for the impairment. This determination does not mean that the impairment of a use does not exist, rather that phosphorus is not the cause.
 - (d) The Department will conclude that the result is indeterminate if there is not enough information and more data collection is necessary to determine the source of impairment.
- (4) **Impaired - total phosphorus exceeds the limit and one or more environmental response criteria are not attained.** If the mean total phosphorus concentration is greater than the limit of the assigned class from Table 1, and one or more environmental response criteria from Table 2 that are measured in a waterbody do not meet the limits of the assigned class of Table 3, then the Department will conclude that phosphorus has caused or contributed to an impairment of a use (bottom-right box in Figure 1).
- (5) **Atypical situations.** The Department will use best professional judgment to determine if phosphorus or another nutrient has caused an impairment of a use when natural conditions have contributed to elevated nutrient levels or atypical environmental responses. Such natural conditions include, but are not limited to the proximity to unimpacted marshes, bogs, lake outlets, tidal areas, and naturally occurring concentrations of fish or wildlife. The Department may use other relevant chemical, physical, and biological data as supporting information.

4. Data requirements

- A. Responsibility for sampling.** In general, it is the responsibility of the Department, or its agents, to conduct sampling for the purpose of making decisions on the attainment of designated uses. Under certain conditions, sampling may be required of an applicant for a waste discharge license, water quality certification, or other Department issued permit. The decision by the Department to require monitoring is based on the classification of the water, existing water quality information, past performance of existing controls for point and nonpoint sources of pollution, and the nature, magnitude, and variability of the activity relative to the affected water. Sampling must be performed by qualified persons. Outside entities shall submit sampling plans to the Department and receive approval from the Department before collecting data.
- B. Routine sampling.** Routine sampling takes place during the summer months (June 1 – September 30) for streams and ice free months (May 1 – October 31) for lakes with exceptions for special circumstances. Routine samples will not be taken during or soon after storms or flood events. Department staff evaluates the data quality, ensure that data are representative of ambient conditions, and identify potential circumstances of atypical natural conditions. Department staff will use best professional judgment and accepted statistical practices to determine the amount of data necessary to make an attainment decision. Fewer data may be required if data are consistent and provide clear indications of condition. More data may be required if the data are variable, provide conflicting information, or are near phosphorus and environmental response criteria limits.
- C. Special circumstances.** The Department may conduct sampling or approve sampling plans when routine sampling procedures are not ecologically appropriate or when sampling is necessary outside of the routine sampling period. A quantitative sampling and analysis plan must be developed in accordance with methods established in the scientific literature that are appropriate for the habitat conditions of the sample site and the season sampled.
- D. Data quality.** The Department evaluates data quality and sufficiency before making classification attainment decisions. Data from outside sources may be used if the Department determines them to be of sufficient quantity and quality. Additional sampling may be required after Department staff review data quality and sufficiency.

NOTE: All data collection will follow Department standard operating protocols and quality assurance procedures.

Figure 1. Decision framework.

<p>All measured environmental response criteria from Table 2 that are measured in a waterbody meet the limits of Table 3</p> <p>One or more environmental response criteria from Table 2 that are measured in a waterbody do not meet limits of Table 3</p>	<p>Mean total phosphorus concentration is less than or equal to the limit of the assigned class from Table 1</p>	<p>Mean total phosphorus concentration is greater than the limit of the assigned class from Table 1</p>
	<p>1. Not Impaired. Phosphorus did not cause an impairment of a use.</p>	<p>2. Not Impaired. Phosphorus did not cause an impairment of a use.</p>
	<p>3. Impaired. Indeterminate cause.</p>	<p>4. Impaired. Phosphorus did cause or contribute to an impairment of a use.</p>

Table 1. Total phosphorus limits.

Statutory Class	Total Phosphorus Limit (ppb)
AA and A	≤ 20.0
B	≤ 32.0
C	≤ 37.0
GPA	≤ 15.0

Table 2. Environmental response criteria for different waterbody types. One or more of the environmental response criteria shown for the waterbody type must be measured.

Waterbody Type	Environmental Response Criteria
GPA (Not Colored)	Secchi disk depth Water column chlorophyll <i>a</i> pH Aquatic life
GPA (Colored)	Secchi disk depth ¹ Water column chlorophyll <i>a</i> ¹ pH Aquatic life
A, B, or C (waterbodies or segments <1 meter deep at time of sampling)	Water column chlorophyll <i>a</i> Percent algal cover Dissolved oxygen Aquatic life Diatom total phosphorus index pH Patches of bacteria and fungi
A, B, or C (waterbodies or segments ≥1 meter deep at time of sampling)	Water column chlorophyll <i>a</i> Aquatic life Dissolved oxygen pH Patches of bacteria and fungi
Impounded Class A, B, or C waters	Secchi disk depth ¹ Water column chlorophyll <i>a</i> ¹ Dissolved oxygen pH Aquatic life

¹ – Secchi disk depth and water column chlorophyll *a* should be sampled together in colored GPA, impounded Class B, and impounded Class C waters.

Table 3: Environmental response criteria.

Statutory Class	AA/A	B	C	Impounded A	Impounded B	Impounded C	GPA Not colored	GPA colored
Secchi Disk Depth (meters) ^a	--	--	--	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0
Water Column Chl <i>a</i> (µg/L, parts per billion)	no single value > 3.5 (5.0 ^b)	no single value > 8.0	no single value > 8.0	OR spatial mean of 3.5 ^c and no single value > 5.0 ^c	AND spatial mean of 8.0 ^c and no single value > 10.0 ^c	AND spatial mean of 8.0 ^c and no single value > 10.0 ^c	OR no single value > 8.0 ^d	AND no single value > 8.0 ^d
Diatom Total Phosphorus Index ^a	≤ 20.0	≤ 32.0	≤ 37.0	--	--	--	--	--
Percent of Substrate Covered by Algal Growth ^a	≤ 20.0	≤ 30.0	≤ 40.0	--	--	--	--	--
Patches of Bacteria and Fungi ^a	None observed	None observed	None observed	None observed	None observed	None observed	--	--
Dissolved Oxygen (mg/L, parts per million) ^a	See 38 M.R.S.A. § 465						--	--
pH ^a	6.0 – 8.5							
Aquatic Life ^a	See 38 M.R.S.A. § 465 and Department of Environmental Protection 06 096 Chapter 579					See 38 M.R.S.A. § 465-A		

a - Instantaneous reading at any time

b - Applicable to waterbodies with water velocity less than 5.0 centimeters per second

c - Chlorophyll *a* samples from impoundments are based on depth-integrated, photic-zone averages

d - GPA chlorophyll *a* samples are based on depth-integrated, epilimnetic averages

AUTHORITY: 38 M.R.S.A §§ 341-D(1-B) and 464(5)

EFFECTIVE DATE: