DISCLAIMER

This manual provides technical guidance to States, Tribes, and other authorized jurisdictions to establish water quality criteria and standards under the Clean Water Act (CWA), in order to protect aquatic life from acute and chronic effects of nutrient overenrichment. Under the CWA, States and Tribes are required to establish water quality criteria to protect designated uses. State and Tribal decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance when appropriate and scientifically defensible. While this manual constitutes EPA's scientific recommendations regarding ambient concentrations of nutrients that protect resource quality and aquatic life, it does not substitute for the CWA or EPA's regulations; nor is it a regulation itself. Thus, it cannot impose legally binding requirements on EPA, States, Tribes, or the regulated community, and might not apply to a particular situation or circumstance. EPA may change this guidance in the future.

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Cover Photograph: South Umpqua River, Oregon. Photograph courtesy of Dr. E. B. Welch, University of Washington.

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EXECUTIVE SUMMARY

The purpose of this document is to provide scientifically defensible technical guidance to assist States and Tribes in developing regionally-based numeric nutrient and algal criteria for river and stream systems. The Clean Water Action Plan, a presidential initiative released in February 1998, includes an initiative to address the nutrient enrichment problem. Building on this initiative, the EPA developed a report entitled *National Strategy for the Development of Regional Nutrient Criteria* (USEPA 1998). The report outlines a framework for development of waterbody-specific technical guidance that can be used to assess nutrient status and develop regional-specific numeric nutrient criteria. This technical guidance manual builds on the strategy and provides specific guidance for rivers and streams. Similar documents are being prepared for lakes and reservoirs, estuaries and coastal marine waters, and wetlands.

A directly prescriptive approach to nutrient criteria development is not appropriate due to regional differences that exist and the lack of a clear technical understanding of the relationship between nutrients, algal growth, and other factors (e.g., flow, light, substrata). The approach chosen for criteria development must be tailored to meet the specific needs of each State or Tribe. The criteria development process described in this guidance can be divided into the following iterative steps.

1. Identify water quality needs and goals with regard to managing nutrient enrichment problems.
2. Classify rivers and streams first by type, and then by trophic status.
3. Select variables for monitoring nutrients, algae, macrophytes, and their impacts.
4. Design sampling program for monitoring nutrients and algal biomass in rivers and streams.
5. Collect data and build database.
6. Analyze data.
7. Develop criteria based on reference condition and data analyses.
8. Implement nutrient control strategies.
9. Monitor effectiveness of nutrient control strategies and reassess the validity of nutrient criteria.

The components of each step is explained in detail in succeeding chapters of the document.

Chapter 1 addresses the necessity of defining water quality needs and goals for rivers and streams, and gives a general overview of nutrient criteria development. Well-defined needs and goals help to assess the applicability of the criteria development process and identify attainable water quality goals. This step will be revisited throughout the criteria development process to assure defined needs and goals are met.

Chapter 2 discusses classification of streams for water quality assessment and nutrient criteria development. The intent of classification is to identify groups of rivers or streams that have comparable characteristics (i.e., similar biological, ecological, physical, and/or chemical features). Classifying rivers and streams reduces the variability of river-related measures (e.g., physical, biological, or water quality attributes) within classes, maximizes variability among classes, and allows criteria to be identified on a broader rather than site-specific scale. Hence, classification of stream systems will assist in setting appropriate criteria for specific regions and stream system types and provide information used in developing management and restoration strategies.

Chapter 3 describes the candidate variables that can be used to evaluate or predict the condition or degree of eutrophication in a water body. Variables that are required for nutrient criteria development are water column nutrient concentrations (total nitrogen [TN] and total phosphorus [TP]), algal biomass (measured

as chlorophyll *a* [chl *a*]), and a measure of turbidity. Measurement of these variables provides a means to evaluate nutrient enrichment and can form the basis for establishing regional and waterbody-specific nutrient criteria. This chapter provides an overview of the required variables and additional variables that can be considered when setting criteria.

Chapter 4 provides technical guidance on designing effective sampling programs. Appropriate data describing stream nutrient and algal conditions are lacking in many areas. Where available data are not sufficient to derive criteria, it will be necessary to collect new data through existing or new monitoring programs. New monitoring programs should be designed to assess nutrient and algal conditions with statistical rigor while maximizing available management resources.

Chapter 5 describes how to build a database of nutrient and algal information. A database of relevant water quality information can be an invaluable tool to States and Tribes as they develop nutrient criteria. Databases can be used to organize existing information, store newly gathered monitoring data, and manipulate data as criteria are being developed. This chapter discusses the role of databases in nutrient criteria development and provides a brief review of existing data sources for nutrient-related water quality information.

Data analysis, described in Chapter 6, is critical to nutrient criteria development. Proper analysis and interpretation of data determines the scientific defensibility and effectiveness of the criteria. The purpose of this chapter is to explore methods for analyzing data that can be used to derive nutrient criteria. Included in this chapter are techniques that link cause and effect relationships between nutrient loading and algal growth, statistical analyses to evaluate compiled data, and use of computer models. Methods of statistical analyses and a review of relevant computer simulation models are provided in appendices.

Chapter 7 presents several approaches that water quality managers can use to select numeric criteria for the rivers and streams in their State/Tribal ecoregions. The approaches that are presented include: the use of reference streams, applying predictive relationships to select nutrient concentrations that will result in desirable levels of aquatic growth, and deriving criteria from thresholds established in the literature. Considerations are also presented for those situations in which development of applicable river and stream nutrient criteria might be driven by conditions that are deemed acceptable for downstream receiving waters (i.e., the lake, reservoir, or estuary to which the river drains).

Chapter 8 provides information on regulatory and non-regulatory programs that may be affected by or utilize nutrient criteria. This chapter is intended to serve as an informational resource for water quality managers and foster potential links among regulatory and non-regulatory watershed programs. Information on other agency programs that may assist in implementing criteria and maintaining water quality is included.

Chapter 9 discusses the continued monitoring of river and stream systems to reassess goals and established nutrient criteria. This step should (1) evaluate the appropriateness of the nutrient criteria, (2) ensure that river and stream systems are responding to management action, and (3) assess whether water quality goals established by the resource manager are being met.

Appended to the guidance document are case studies; technical discussions of analytical methods, statistical analyses, and computer modeling; a list of acronyms; and a glossary.