APPENDIX R

Policy on the Use of Biological Assessments and Criteria in the Water Quality Program

WATER QUALITY STANDARDS HANDBOOK

SECOND EDITION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

MEMORANDUM

SUBJECT: Transmittal of Final Policy on Biological Assessments and Criteria

FROM: Tudor T. Davies, Director
Office of Science and Technology (WH-551)

TO: Water Management Division Directors
Regions I-X

Attached is EPA's "Policy on the Use of Biological Assessments and Criteria in the Water Quality Program" (Attachment A). This policy is a significant step toward addressing all pollution problems within a watershed. It is a natural outgrowth of our greater understanding of the range of problems affecting watersheds from toxic chemicals to physical habitat alteration, and reflects the need to consider the whole picture in developing watershed pollution control strategies.

This policy is the product of a broad-based workgroup chaired by Jim Plafkin and Chris Faulkner of the Office of Wetlands, Oceans and Watersheds. The workgroup was composed of representatives from seven EPA Headquarters offices, four EPA Research Laboratories, all 10 EPA Regions, U.S. Fish and Wildlife Service, U.S. Forest Service, and the States of New York and North Carolina (see Attachment B). This policy also reflects review comments to the draft policy statement issued in March of 1990. Comments were received from three EPA Headquarters offices, three EPA Research Laboratories, five EPA Regions and two States. The following sections of this memorandum provide a brief history of the policy development and additional information on relevant guidance.

Background

The Ecopolicy Workgroup was formed in response to several converging initiatives in EPA's national water program. In September 1987, a major management study entitled "Surface Water Monitoring: A Framework for Change" strongly emphasized the need to "accelerate development and application of promising biological monitoring techniques" in State and EPA monitoring programs. Soon thereafter, in December 1987, a National Workshop on Instream Biological Monitoring and Criteria reiterated this

recommendation but also pointed out the importance of integrating the biological criteria and assessment methods with traditional chemical/physical methods (see Final Proceedings, EPA-905/9-89/003). Finally, at the June 1988 National Symposium on Water Quality Assessment, a workgroup of State and Federal representatives unanimously recommended the development of a national bioassessment policy that encouraged the expanded use of the new biological tools and directed their implementation across the water quality program.

Guided by these recommendations, the workgroup held three workshop-style meetings between July and December 1988. Two major questions emerged from the lengthy discussions as issues of general concern:

ISSUE 1 - How hard should EPA push for formal adoption of biological criteria (biocriteria) in State water quality standards?

ISSUE 2 - Despite the many beneficial uses of biomonitoring information, how do we guard against potentially inappropriate uses of such data in the permitting process?

Issue 1 turns on the means and relative priority of having biological criteria formally incorporated in State water quality standards. Because biological criteria must be related to local conditions, the development of quantitative national biological criteria is not ecologically appropriate. Therefore, the primary concern is how biological criteria should be promoted and integrated into State water quality standards.

Issue 2 addresses the question of how to reconcile potential apparent conflicts in the results obtained from different assessment methods (i.e., chemical-specific analyses, toxicity testing, and biosurveys) in a permitting situation. Should the relevance of each be judged strictly on a case-by-case basis? Should each method be applied independently?

These issues were discussed at the policy workgroup's last meeting in November 1988, and consensus recommendations were then presented to the Acting Assistant Administrator of Water on December 16, 1988. For Issue 1, it was determined that adapting biological criteria to State standards has significant advantages, and adoption of biological criteria should be strongly encouraged. Therefore, the current Agency Operating Guidance establishes the State adaptation of basic narrative biological criteria as a program priority.

With respect to Issue 2, the policy reflects a position of "independent application." Independent application means that any one of the three types of assessment information (i.e., chemistry, toxicity testing results, and ecological assessment) provides conclusive evidence of nonattainment of water quality

standards regardless of the results from other types of assessment information. Each type of assessment is sensitive to different types of water quality impact. Although rare, apparent conflicts in the results from different approaches can occur. These apparent conflicts occur when one assessment approach detects a problem to which the other approaches are not sensitive. This policy establishes that a demonstration of water quality standards nonattainment using one assessment method does not require confirmation with a second method and that the failure of a second method to confirm impact does not negate the results of the initial assessment.

Review of Draft Policy

The draft was circulated to the Regions and States on March 23, 1990. The comments were mostly supportive and most of the suggested changes have been incorporated. Objections were raised by one State that using ecological measures would increase the magnitude of the pollution control workload. We expect that this will be one result of this policy but that our mandate under the Clean Water Act to ensure physical, chemical, and biological integrity requires that we adopt this policy. Another State objected to the independent application policy. EPA has carefully considered the merits of various approaches to integrating data in light of the available data, and we have concluded that independent application is the most appropriate policy at this time. Where there are concerns that the results from one approach are inaccurate, there may be opportunities to develop more refined information that would provide a more accurate conclusion (e.g., better monitoring or more sophisticated wasteload allocation modelling).

Additional discussion on this policy occurred at the Water Quality Standards for the 21st Century Symposium in December, 1990.

What Actions Should States Take

This policy does not require specific actions on the part of the States or the regulated community. As indicated under the Fiscal Year 1991 Agency Operating Guidance, States are required to adopt narrative biocriteria at a minimum during the 1991 to 1993 triennial review. More specific program guidance on developing biological criteria is scheduled to be issued within the next few months. Technical guidance documents on developing narrative and numerical biological criteria for different types of aquatic systems are also under development.

Relevant Guidance

There are several existing EPA documents which pertain to biological assessments and several others that are currently under development. Selected references that are likely to be important in implementing this policy are listed in Attachment C.

Please share this policy statement with your States and work with them to institute its provisions. If you have any questions, please call me at (FTS) 382-5400 or have your staff contact Geoffrey Grubbs of the Office of Wetlands, Oceans and Watersheds at (FTS) 382-7040 or Bill Diamond of the Office of Science and Technology at (FTS) 475-7301.

Attachments

cc: OW Office Directors
Environmental Services Division Directors, Regions I-X

Attachment A

Policy on the Use of Biological Assessments and Criteria in the Water Quality Program

May 1991

Contents

Statement of Policy

To help restore and maintain the biological integrity of the Nation's waters, it is the policy of the Environmental Protection Agency (EPA) that biological surveys shall be fully integrated with toxicity and chemical-specific assessment methods in State water quality programs. EPA recognizes that biological surveys should be used together with whole-effluent and ambient toxicity testing, and chemical-specific analyses to assess attainment/nonattainment of designated aquatic life uses in State water quality standards. EPA also recognizes that each of these three methods can provide a valid assessment of designated aquatic life use impairment. Thus, if any one of the three assessment methods demonstrate that water quality standards are not attained, it is EPA's policy that appropriate action should be taken to achieve attainment, including use of regulatory authority.

It is also EPA's policy that States should designate aquatic life uses that appropriately address biological integrity and adopt biological criteria necessary to protect those uses. Information concerning attainment/nonattainment of standards should be used to establish priorities, evaluate the effectiveness of controls, and make regulatory decisions.

Close cooperation among the States and EPA will be needed to carry out this policy. EPA will provide national guidance and technical assistance to the States; however, specific assessment methods and biological criteria should be adopted on a State-by-State basis. EPA, in its oversight role, will work with the States to ensure that assessment procedures and biological criteria reflect important ecological and geographical differences among the Nation's waters yet retain national consistency with the Clean Water Act.

Definitions

Ambient Toxicity: Is measured by a toxicity test on a sample collected from a waterbody.

Aquatic Community: An association of interacting populations of aquatic organisms in a given waterbody or habitat.

Aquatic Life Use: Is the water quality objective assigned to a waterbody to ensure the protection and propagation of a balanced, indigenous aquatic community.

Biological Assessment: An evaluation of the biological condition of a waterbody using biological surveys and other direct measurements of resident biota in surface waters.

Biological Criteria (or Biocriteria): Numerical values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.

Biological Integrity: Functionally defined as the condition of the aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by community structure and function.

Biological Monitoring: Use of a biological entity as a detector and its response as a measure to determine environmental conditions. Toxicity tests and biosurveys are common biomonitoring methods.

Biological Survey (or Biosurvey): Consists of collecting, processing, and analyzing a representative portion of the resident aquatic community to determine the community structure and function.

Community Component: Any portion of a biological community. The community component may pertain to the taxonomic group (fish, invertebrates, algae), the taxonomic category (phylum, order, family, genus, species), the feeding strategy (herbivore, omnivore, carnivore), or organizational level (individual, population, community association) of a biological entity within the aquatic community.

Habitat Assessment: An evaluation of the physical characteristics and condition of a waterbody (example parameters include the variety and quality of substrate, hydrological regime, key environmental parameters and surrounding land use.)

Toxicity Test: Is a procedure to determine the toxicity of a chemical or an effluent using living organisms. A toxicity test measures the degree of response of exposed test organisms to a specific chemical or effluent.

Whole-effluent Toxicity: Is the total toxic effect of an effluent measured directly with a toxicity test.

Background

Policy context

Monitoring data are applied toward water quality program needs such as identifying water quality problems, assessing their severity, and setting planning and management priorities for remediation. Monitoring data should also be used to help make regulatory decisions, develop appropriate controls, and evaluate the effectiveness of controls once they are implemented. This policy focuses on the use of a particular type of monitoring information that is derived from ambient biosurveys, and its proper integration with chemical-specific analyses, toxicity testing methods, and biological criteria in State water quality programs.

The distinction between biological surveys, assessments and criteria is an important one. Biological surveys, as stated in the section above, consist of the collection and analysis of the resident aquatic community data and the subsequent determination of the aquatic community's structure and function. A biological assessment is an evaluation of the biological condition of a waterbody using data gathered from biological surveys or other direct measures of the biota. Finally, biological criteria are the numerical values or narrative expressions used to describe the expected structure and function of the aquatic community.

Rationale for Conducting Biological Assessments

To more fully protect aquatic habitats and provide more comprehensive assessments of aquatic life use attainment/nonattainment, EPA expects States to fully integrate chemical-specific techniques, toxicity testing, biological surveys and biological criteria into their water quality programs. To date, EPA's activities have focused on the interim goal of the Clean Water Act (the Act), stated in Section 101(a)(2): To achieve; "...wherever attainable, an interim goal of water quality which provides for protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water...." However, the ultimate objective of the Act, stated in Section 101(a), goes further. Section 101(a) states: "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Taken together, chemical, physical, and biological integrity define the overall ecological integrity of an aquatic ecosystem. Because biological integrity is a strong indicator of overall ecological integrity, it can serve as both a meaningful goal and a useful measure of environmental status that relates directly to the comprehensive objective of the Act.

Deviations from, and threats to, biological integrity can be estimated indirectly or directly. Traditional measures, such as chemical-specific analyses and toxicity tests, are indirect estimators of biological conditions. They assess the suitability of the waters to support a healthy community, but they do not directly assess the community itself. Biosurveys are used to directly evaluate the overall structural and/or functional characteristics of the aquatic community. Water quality programs should use both direct and indirect methods to assess biological conditions and to determine attainment/nonattainment of designated aquatic life uses.

Adopting an integrated approach to assessing aquatic life use attainment/nonattainment represents the next logical step in the evolution of the water quality program. Historically, water quality programs have focused on evaluating the impacts of specific chemicals discharged from discreet point sources. In 1984, the program scope was significantly broadened to include a combination of chemical-specific and whole-effluent toxicity testing methods to evaluate and predict the biological impacts of potentially toxic mixtures in wastewater and surface waters. Integration of these two indirect measures of biological impact into a unified assessment approach has been discussed in detail in national policy (49 FR 9016) and guidance (EPA-440/4-85-032). This approach has proven to be an effective means of assessing and controlling toxic pollutants and whole-effluent toxicity originating from point sources. Additionally, direct measures of biological impacts, such as biosurvey and bioassessment techniques, can be useful for regulating point sources. However, where pollutants and pollutant sources are difficult to characterize or aggregate impacts are difficult to assess (e.g., where discharges are multiple, complex, and variable; where point and nonpoint sources are both potentially important; where physical habitat is potentially limiting), direct measures of ambient biological conditions are also needed.

Biosurveys and biological criteria add this needed dimension to assessment programs because they focus on the resident community. The effects of multiple stresses and pollution sources on the numerous biological components of resident communities are integrated over a relatively long period of time. The community thus provides a useful indicator of both aggregate ecological impact and overall temporal trends in the condition of an aquatic ecosystem. Furthermore, biosurveys can detect aquatic life impacts that other available assessment methods may miss. Biosurveys detect impacts caused by: (1) pollutants that are difficult to identify chemically or characterize toxicologically (e.g., rare or unusual toxics [although biosurveys cannot themselves identify specific toxicants causing toxic impact], "clean" sediment, or nutrients); (2) complex or unanticipated exposures (e.g., combined point and non-point source loadings, storm events, spills); and perhaps most importantly, (3) habitat degradation (e.g., channelization, sedimentation, historical contamination), which disrupt the interactive balance among community components.

Biosurveys and biological criteria provide important information for a wide variety of water quality program needs. This data could be used to:

- o Refine use classifications among different types of aquatic ecosystems (e.g., rivers, streams, wetlands, lakes, estuaries, coastal and marine waters) and within a given type of use category such as warmwater fisheries;
- o Define and protect existing aquatic life uses and classify Outstanding National Resource Waters under State antidegradation policies as required by the Water Quality Standards Regulation (40 CFR 131.12);
- o Identify where site-specific criteria modifications may be needed to effectively protect a waterbody;
- o Improve use-attainability studies;
- o Fulfill requirements under Clean Water Act Sections 303(c), 303(d), 304(l), 305(b), 314, and 319;
- o Assess impacts of certain nonpoint sources and, together with chemical-specific and toxicity methods, evaluate the effectiveness of nonpoint source controls;
- o Develop management plans and conduct monitoring in estuaries of national significance under Section 320;
- o Monitor the overall ecological effects of regulatory actions under Sections 401, 402, and 301(h);
- o Identify acceptable sites for disposal of dredge and fill material under Section 404 and determine the effects of that disposal;
- o Conduct assessments mandated by other statutes (e.g., CERCLA/RCRA) that pertain to the integrity of surface waters; and
- o Evaluate the effectiveness and document the instream biological benefits of pollution controls.

Conduct of Biological Surveys

As is the case with all types of water quality monitoring programs, biosurveys should have clear data quality objectives, use standardized, validated

laboratory and field methods, and include appropriate quality assurance and quality control practices. Biosurveys should be tailored to the particular type of waterbody being assessed (e.g., wetland, lake, stream, river, estuary, coastal or marine water) and should focus on community components and attributes that are both representative of the larger community and are practical to measure. Biosurveys should be routinely coupled with basic physicochemical measurements and an objective assessment of habitat quality. Due to the importance of the monitoring design and the intricate relationship between the biosurvey and the habitat assessment, well-trained and experienced biologists are essential to conducting an effective biosurvey program.

Integration of Assessment Methods and Regulatory Application

Site-specific Considerations

Although biosurveys provide direct information for assessing biological integrity, they may not always provide the most accurate or practical measure of water quality standards attainment/nonattainment. For example, biosurveys and measures of biological integrity do not directly assess nonaquatic life uses, such as agricultural, industrial, or drinking water uses, and may not predict potential impacts from pollutants that accumulate in sediments or tissues. These pollutants may pose a significant long-term threat to aquatic organisms or to humans and wildlife that consume these organisms, but may only minimally alter the structure and function of the ambient community. Furthermore, biosurveys can only indicate the presence of an impact; they cannot directly identify the stress agents causing that impact. Because chemical-specific and toxicity methods are designed to detect specific stressors, they are particularly useful for diagnosing the causes of impact and for developing source controls. Where a specific chemical or toxicity is likely to impact standards attainment/nonattainment, assessment methods that measure these stresses directly are often needed.

Independent Application

Because biosurvey, chemical-specific, and toxicity testing methods have unique as well as overlapping attributes, sensitivities, and program applications, no single approach for detecting impact should be considered uniformly superior to any other approach. EPA recognizes that each method can provide valid and independently sufficient evidence of aquatic life use impairment, irrespective of any evidence, or lack of it, derived from the other two approaches. The failure of one method to confirm an impact identified by another method would not negate the results of the initial assessment. This policy, therefore, states that appropriate action should be taken when any one of the three types of assessment determines that the standard is not attained. States are encouraged to implement and integrate all three approaches into their water quality programs and apply them in combination or independently as site-specific conditions and

assessment objectives dictate.

In cases where an assessment result is suspected to be inaccurate, the assessment may be repeated using more intensive and/or accurate methods. Examples of more intensive assessment methods are dynamic modelling instead of steady state modelling, site specific criteria, dissolved metals analysis, and a more complete biosurvey protocol.

Biological Criteria

To better protect the integrity of aquatic communities, it is EPA's policy that States should develop and implement biological criteria in their water quality standards.

Biological criteria are numerical measures or narrative descriptions of biological integrity. Designated aquatic life use classifications can also function as narrative biological criteria. When formally adopted into State standards, biological criteria and aquatic life use designations serve as direct, legal endpoints for determining aquatic life use attainment/nonattainment. Per Section 131.11(b)(2) of the Water Quality Standards Regulation (40 CFR Part 131), biological criteria can supplement existing chemical-specific criteria and provide an alternative to chemical-specific criteria where such criteria cannot be established.

Biological criteria can be quantitatively developed by identifying unimpaired or least-impacted reference waters that operationally represent best attainable conditions. EPA recommends States use the ecoregion concept when establishing a list of reference waters. Once candidate references are identified, integrated assessments are conducted to substantiate the unimpaired nature of the reference and to characterize the resident community. Biosurveys cannot fully characterize the entire aquatic community and all its attributes. Therefore, State standards should contain biological criteria that consider various components (e.g., algae, invertebrates, fish) and attributes (measures of structure and/or function) of the larger aquatic community. In order to provide maximum protection of surface water quality, States should continue to develop water quality standards integrating all three assessment methods.

Statutory Basis

Section 303(c)

The primary statutory basis for this policy derives from Section 303 of the Clean Water Act. Section 303 requires that States adopt standards for their waters and review and revise these standards as appropriate, or at least once every three years. The Water Quality Standards Regulation (40 CFR 131)

requires that such standards consist of the designated uses of the waters involved, criteria based upon such uses, and an antidegradation policy.

Each State develops its own use classification system based on the generic uses cited in the Act (e.g., protection and propagation of fish, shellfish, and wildlife). States may also subcategorize types of uses within the Act's general use categories. For example, aquatic life uses may be subcategorized on the basis of attainable habitat (e.g., cold- versus warm-water habitat), innate differences in community structure and function (e.g., high versus low species richness or productivity), or fundamental differences in important community components (e.g., warm-water fish communities naturally dominated by bass versus catfish). Special uses may also be designated to protect particularly unique, sensitive or valuable aquatic species, communities, or habitats.

Each State is required to "specify appropriate water uses to be achieved and protected" (40 CFR 131.10). If an aquatic life use is formally adopted for a waterbody, that designation becomes a formal component of the water quality standards. Furthermore, nonattainment of the use, as determined with either biomonitoring or chemical-specific assessment methods, legally constitutes nonattainment of the standard. Therefore, the more refined the use designation, the more precise the biological criteria (i.e., the more detailed the description of desired biological attributes), and the more complete the chemical-specific criteria for aquatic life, the more objective the assessment of standards attainment/nonattainment.

Section 304(a)

Section 304(a) requires EPA to develop and publish criteria and other scientific information regarding a number of water-quality-related matters, including:

- Effects of pollutants on aquatic community components ("Plankton, fish, shellfish, wildlife, plant life...") and community attributes ("diversity, productivity, and stability...");
- Factors necessary "to restore and maintain the chemical, physical, biological integrity of all navigable waters...", and "for protection and propagation of shellfish, fish, and wildlife for classes and categories of receiving waters...";
- Appropriate "methods for establishing and measuring water quality criteria for toxic pollutants on other bases than pollutant-by-pollutant criteria, including biological monitoring and assessment methods."

This section of the Act has been historically cited as the basis for

publishing national guidance on chemical-specific criteria for aquatic life, but is equally applicable to the development and use of biological monitoring and assessment methods and biological criteria.

State/EPA Roles in Policy Implementation

State Implementation

Because there are important qualitative differences among aquatic ecosystems (streams, rivers, lakes, wetlands, estuaries, coastal and marine waters), and there is significant geographical variation even among systems of a given type, no single set of assessment methods or numeric biological criteria is fully applicable nationwide. Therefore, States must take the primary responsibility for adopting their own standard biosurvey methods, integrating them with other techniques at the program level, and applying them in appropriate combinations on a case-by-case basis. Similarly, States should develop their own biological criteria and implement them appropriately in their water quality standards.

EPA Guidance and Technical Support

EPA will provide the States with national guidance on performing technically sound biosurveys, and developing and integrating biological criteria into a comprehensive water quality program. EPA will also supply guidance to the States on how to apply ecoregional concepts to reference site selection. In addition, EPA Regional Administrators will ensure that each Region has the capability to conduct fully integrated assessments and to provide technical assistance to the States.

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Attachment C

Relevant Guidance

Existing documents

- Chemical-specific evaluations

  Guidance for Deriving National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses (45 FR 79342, November 28, 1990, as amended at 50 FR 30784, July 29, 1985)

  Quality Criteria for Water 1986 (EPA 440/5-86-001, May 1, 1987)

- Toxicity testing

  Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Second Edition (EPA/600-4-89-001), March 1989)

  Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms (EPA/600-4-87/028, May 1988)

  Methods for Measuring Acute Toxicity of Effluents to Freshwater and Marine Organisms (EPA/600-4-85-013, March 1985)

- Biosurveys and integrated assessments

  Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses: Volumes I-III (Office of Water Regulations and Standards, November 1983-1984)

  Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90/001, March 1991)

  Rapid Bioassessment Protocols for Streams and Rivers: Benthic Macro-invertebrates and Fish (EPA/444-4-89-001, May 1989)

  Hughes, Robert M. and David P. Larsen. 1988. Ecoregions: An Approach to Surface Water Protection. Journal of the Water Pollution Control Federation 60, No. 4: 486-93.

  Omerik, J.M. 1987. Ecoregions of the Coterminous United States. Annals of the Association of American Geographers 77, No. 1: 118-25.

Regionalization as a Tool for Managing Environmental Resources (EPA/600-3-89-060, July 1989)

EPA Biological Criteria - National Program Guidance for Surface Waters (EPA/440-5-90-004, April 1990)

Documents being developed

Technical Guidance on the Development of Biological Criteria

State Development of Biological Criteria (case studies of State implementation)

Monitoring Program Guidance

Sediment Classification Methods Compendium

Macroinvertebrate Field and Laboratory Manual for Evaluating the Biological Integrity of Surface Waters

Fish Field and Laboratory Manual for Determining the Biological Integrity of Surface Waters