Biology Strengthens Water Quality Management Programs

This website provides information to states and tribes for the incorporation of biological information into water quality standards and its application in water quality management.

The primary objective of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." This objective is the foundation of all water quality programs and the ultimate measure of their success.

Because biological condition is a comprehensive and direct measure of the ability of a waterbody to support aquatic life, state and tribal water quality programs can better equip themselves to meet these challenges by directly measuring biological condition and incorporating that information into management decisions.

Biological condition is assessed through the response of the biota (aquatic organisms such as fish, invertebrates, and algae) to the cumulative, and often synergistic, effects of stressors. In partnership with state and tribal scientists, the U.S. EPA has developed a scientific model, the **Biological Condition Gradient (BCG)**, for interpreting the effects of stressors on aquatic ecosystems.

Using the BCG model as a framework for assessments, you not only measure the condition of the biota but you gather data on the severity and categories of stressors impacting the biota. This integrated information provides the basis for using biological information to more precisely define , or tier, aquatic life uses , establish biological criteria, and support diagnosis and treatment .

How does this information make a difference?

Biological response and stressor information better enables water quality managers to work across program lines to:

- **integrate decision-making**
- **achieve environmental results**
- **communicate those results to the public**

States have used bioresponse and stressor information to refine, or tier, their aquatic life uses and adopt biological criteria in their WQS. As a result, they have been better able to:

- Identify and protect high quality waters
- Establish attainable restoration goals for degraded waters
- Lock in incremental improvements
- Communicate more effectively with the public

(Link to state case examples illustrating main points of this statement_ 1/26 SJ).

Most states have bioassessment programs and, depending on the level of rigor of their program, are able to use the information to assess attainment, set realistic biological goals and help diagnose cause of degradation. **(Link to case examples supporting main points of this statement, including relationship between level of technical program rigor and ability to support management needs _1/26 SJ).**

Video under construction

Lee Dunbar
Assistant Director, Planning and Standards Division,
Bureau of Water Management and Land Reuse, CT DEP

Video presents his viewpoint on why CT is moving ahead on incorporating biological monitoring information into their program and how the biological, chemical, and physical data are more integrated

"Trying to run a water quality management program without biological monitoring information is like trying to drive a car at night without the headlights on. And if you do monitor but you don't look at the data, it's like driving the car with the headlights on but with your eyes closed!"

Next: How Do I Build on Current Programs?

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Biological Condition Gradient: summary in revision

Integrated Program Management and Decision-making

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Integrated program management means

- chemical, physical, and biological information are brought together to provide a more complete picture of waterbody health
- decision-makers use this information to set water quality goals and collaboratively set priorities and target resources
- progress is measured using real environmental results that can be easily communicated to the public.

In many ways, EPA and state water quality agencies are like physicians charged with improving the health of their "patients," the Nation's waterbodies. Just as physicians measure the effectiveness of diagnosis and treatment by the overall condition of the patient, water quality managers can use biological condition to measure the effectiveness of management actions designed to protect aquatic life.

Comprehensively integrated water quality programs use stressor and biological response information as the central driver for decision making and as the basis for setting appropriate aquatic life use goals and water quality criteria. This enables water quality managers and staff to share data and strategically collaborate across programs using the same ultimate measure of program success – the condition of the biology.

Information on biological condition and stressor-response relationships allows for better communication across program areas and supports more efficient and effective decision-making.

Add: case ex, video or state quote to illustrate the statements on this page_ SJ 1/26.

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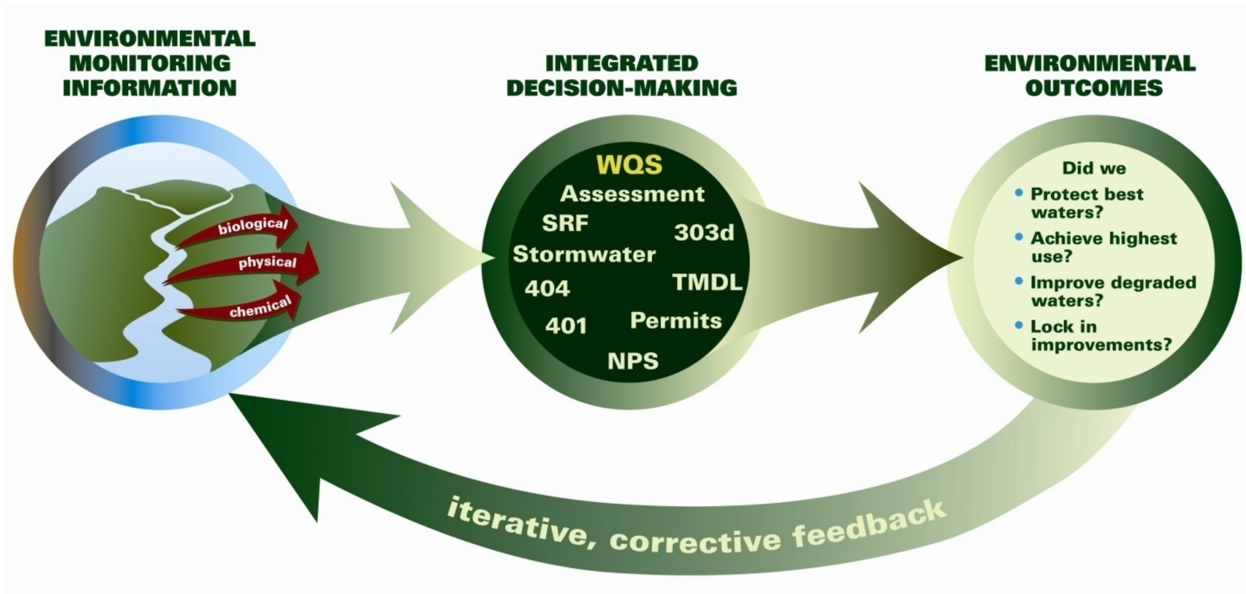
Achieve Environmental Results

How does program integration work to achieve environmental results?



Based on data and information relating biological condition to the level and type of stress, results of individual program actions can be related to a common measure of success – the condition of the aquatic biota.

This information helps Program Managers collaboratively prioritize actions and target resources based on the potential to achieve environmental results and improve condition.

We can measure these results and communicate our progress to the public about things they care about.

Case Study: Measuring and Communicating Results

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Case Study: Measuring Program Results and Improvements with Biocriteria

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Many states rely on water chemistry data to assess aquatic life use attainment for 305(b) reporting and 303(d) listing. What are the implications of relying solely on water chemistry information? Chemical assessments, based on water quality criteria for specific pollutants, measure individual stressors at a specific point in time. Are there significant environmental and program benefits when using both water chemistry and biological assessments? Biological assessments can measure the cumulative effects of all stressors on the biological community residing in the waterbody, for example fish, benthic macroinvertebrates, periphyton, amphibians. Chemical assessments measure specific stressors while biological assessments measure the response. To address questions on the benefits of using each type of indicator, the Ohio Environmental Protection Agency (Ohio EPA) evaluated 20 years of biological and chemical data to compare aquatic use attainment decisions where both data sets were used together.

The Ohio study showed that 35% of the time, biological assessments indicated impairment when chemical criteria did not. Ohio EPA scientists evaluated the possible reasons for these differences. For example, the biological impairment could be caused by pollutants that did not have water quality criteria and were not being measured, or by nonchemical stressors such as loss of habitat. The biological assessment information provided Ohio EPA with a scientifically sound and defensible basis to identify impairment that would otherwise be missed as well gather information on the probable stressors and their source s – enabling program managers to strategically target their resources and implement the most effective management actions. Also, they were better able to identify and document impairment situations that were not caused by pollutants and that would not require a TMDL but would need other management actions.

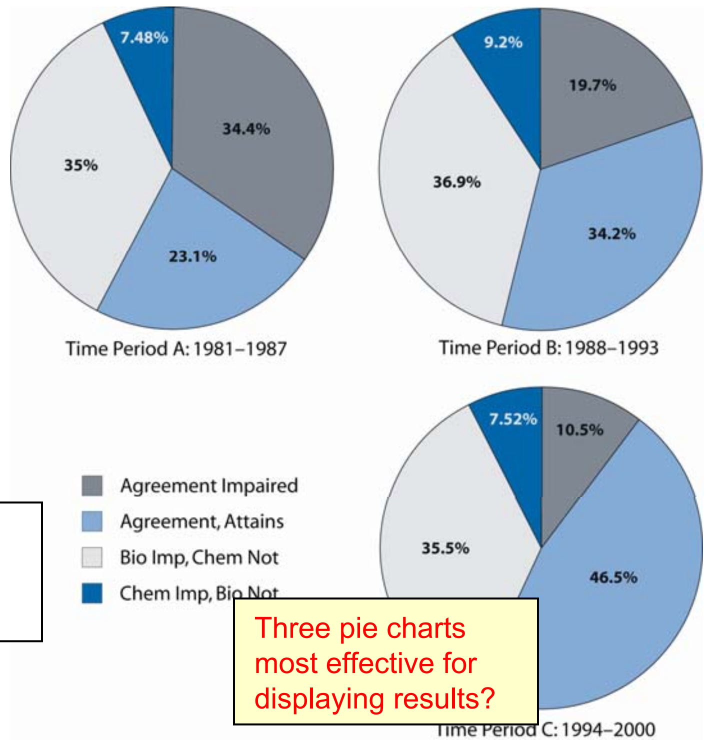
Approximately 56% of the time the chemical and biological assessments were in agreement on water quality standards attainment decisions. The complementary information provided compelling support and documentation for management actions. Additionally, by being able to explain very clearly to the public and to stakeholders the impact of the stressors on the aquatic community, Ohio EPA was able to gain public support for management actions to improve and maintain water quality. Ohio EPA also communicated the success of management actions, and justified use of public resources.

Summary

The Ohio study supports use of both chemical and biological monitoring information where each indicator tool is used in its proper role. Using water chemistry data without biological data can result in large errors of omission by failing to detect impacts from 1) non-chemical stressors (e.g., habitat), 2) ephemeral chemical stressors (e.g., spills or runoff) or 3) misclassifying the nature of the impact (coincidental impairments). Similarly, biological data by itself can be used to identify stressor categories, but it may be insufficient alone to determine the specific stressor or appropriate abatement strategies. Finally, biological data directly demonstrates the severity of impairments resulting from stressors. There are predictable changes in number and types of aquatic organisms associated with different levels and types of stress. Incremental improvements can be documented since an aquatic system make take time to fully recover.

The Ohio study suggests that state monitoring programs that use only chemical data and criteria to assess attainment could have error rates of 35% or more, and may be prone to incorrect or incomplete characterization of responsible stressors. This could result in resources wasted in addressing the wrong solutions, as well as accusations that agencies with error rates of 35% are not accountable to their State and public.

The good news for Ohio was that over the course of 20 years the percent of waters attaining water quality standards doubled, from 23.1 % to 46.5% as measured by both chemical and biological data. More accurate aquatic life use designations were established based on the potential for a waterbody to achieve higher level of water quality. Additionally, water quality improvements were "locked in" through the Ohio's tiered aquatic life use classifications and therefore protected. For some waters, the improvement in water quality was sufficient to redesignate them to a higher aquatic life use category.



Pie charts summarize agreement between biocriteria-based vs. water chemistry-based measures of aquatic life use attainament in three different periods: 1981-1987, 1988-1993, and 1994-2000.

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Communicate Results to the Public

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Which of these statements will resonate more with the public of your state?

a. "This year, State XYZ issued 73 discharge permits under the NPDES Program."

b. "This year, State XYZ upgraded 73 stream miles from Class B (good condition) to Class A (excellent condition) as a result of improvements in the biological communities. Native mussel and cold water trout populations were re-established."

Water programs need public support. They must be transparent and accountable to citizens. Biological monitoring and assessment enables us to demonstrate program effectiveness in ways that can be readily and clearly communicated to the public. **People intuitively understand that healthy aquatic ecosystems are typically ones where an abundance and diversity of life exists.** Good biological information helps us set meaningful, progressive goals for improving seemingly hopelessly degraded waters, protecting healthy waters by giving us a complete picture of what "high quality" means in terms of aquatic life, and helping us determine the restoration potential of degraded waters. This information helps the public better understand what is being protected or could potentially be restored and serves to motivate and engage them in setting goals for improvement and designing solutions that work. Of equal importance, the regulated community should know that their investments resulted in improved biological condition in addition to meeting compliance with permit conditions.

Video under construction

Mike Sandusky
Director, Environmental Analysis and Outcomes Division, Minnesota Pollution Control Agency

Video presents MN's perspective on the power of biology as a communication tool

Video or case example write up

Guilford-Sangerville / Interface Inc, Maine case example: PR benefits to company

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Integrating biological information into water quality management includes 3 basic areas: 1) developing a sound biological monitoring program and integrating with chemical and physical monitoring programs, 2) incorporating the biological and other related environmental data and information into water quality standards, and, 3) using the water quality standards and on-site monitoring information to manage water quality. This website shows how to incorporate biological information into each of these steps and provides case examples.

The steps in this process are designed to build on your current program, not replace or duplicate.

Where are you now?

The **first step** is to evaluate your program so you will know where you can build on current program strengths and what areas you need to focus on to achieve environmental results. The tool for this evaluation is The Critical Elements of an Effective Bioassessment Program: Assessing Program Quality and Technical Rigor (EPA/XXX/R - XX/XXX). This document describes technical and programmatic elements required to discriminate multiple levels of biological condition, develop biological criteria, help identify causes of degraded condition, and incorporate biological information into water quality standards, criteria, and water quality management programs.

This first step includes answering the question: What Type of Information Do I Need? Quality data, including biological information, is critical for a strong water quality program. This step shows what constitutes a sound biological monitoring program and how to link the biological information with chemical, physical, and landscape data and information for use in water quality standards.

What was the experience of states and tribes that took the first step?
To learn more about the experiences of state managers whose programs have gone through the bioassessment technical evaluation review, click HERE.

Ready to take the first step?
If you are a state or tribe interested in taking the first step to evaluate how to build on your existing technical program, click HERE for contact information in your region

Step Two: Using This Information in Water Quality Standards
Once information is in hand, it needs to be interpreted into a form that decision makers can incorporate into water quality standards and apply in their water quality programs. This step includes detailed information on how to interpret biological monitoring data and use that information to more precisely define designated aquatic life uses and develop biological criteria, relate the biological criteria with other applicable water quality criteria, and apply it in state and tribal water quality standards (designation of aquatic life uses, water quality criteria development and modification, implementation of antidegradation policies and assessment of WQS attainment).

Step Three: Use in Decision-Making
Biological and stressor information incorporated into water quality standards can provide managers with a framework to more comprehensively assess attainment of WQS and more effectively target management actions through sharing of data and information across different water programs (e.g., listings, TMDLs, permits, nonpoint source, etc). Sharing information can improve program integration by promoting mutual identification of causes of biological impairment and targeting of program resources to achieve optimal environmental results.

What is the experience of other states?

Several states have started down the road to incorporate biological information into their water quality standards and to apply in water quality management. Some are further along than others. They have taken different approaches, and there have been various catalysts that caused managers to move in this direction. Click HERE to hear and read what other states and tribes are doing to incorporate biologically-based decision making into their programs, and for contacts in each state for further information.

top of page

EPA United States Environmental Protection Agency | Office of Science and Technology | Washington, DC 20460 | January 2009 | EPA/XXX/R-XX/XXX

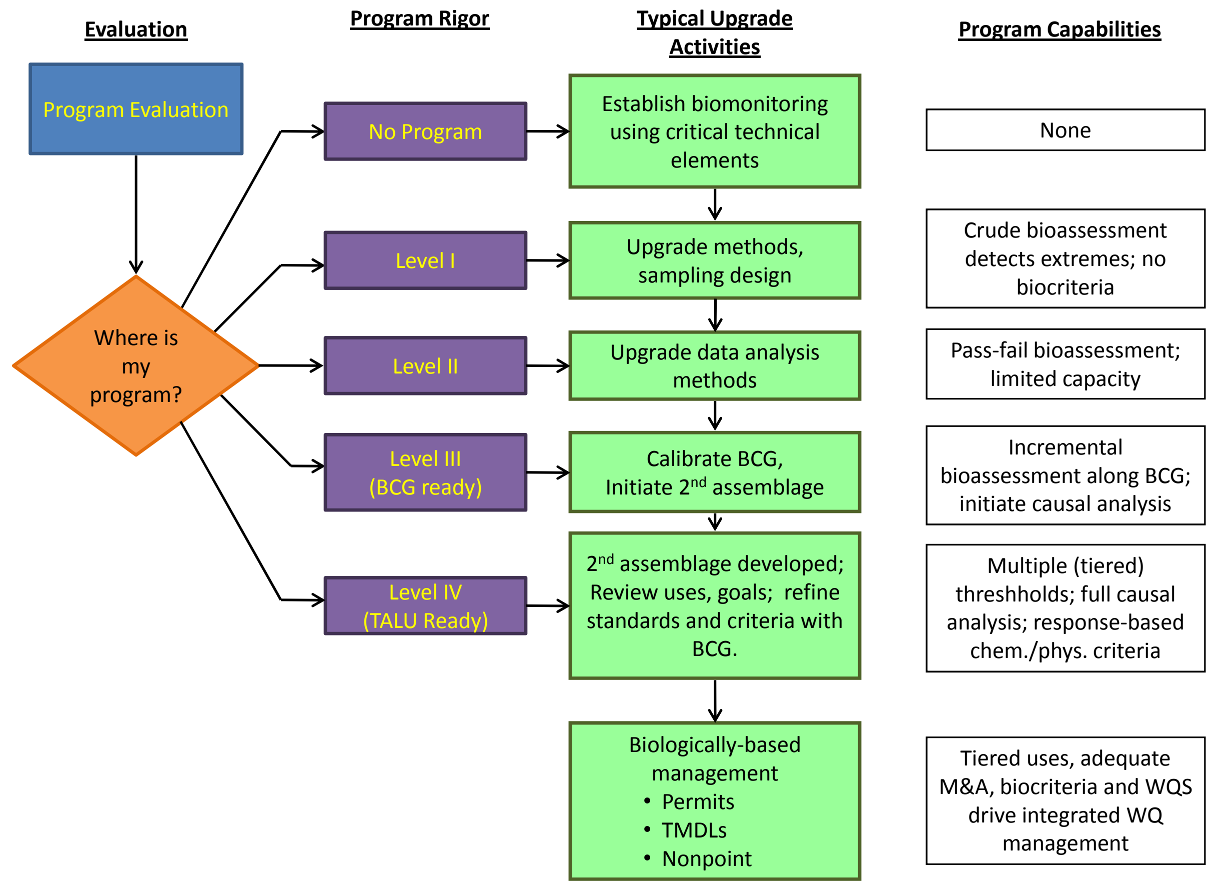
The Critical Elements of an Effective Bioassessment Program:
Assessing Program Quality and Technical Rigor

DRAFT IN REVIEW

This document describes technical and programmatic aspects of biological monitoring, assessment, and water quality management. It helps program managers understand what steps they need to take to upgrade the technical abilities of their program so they can reliably discriminate multiple levels of biological condition, develop biological criteria, and help identify causes of degraded condition.

The evaluation assesses 13 technical elements and classifies programs into 4 levels of scientific rigor, where a Level I program is able to distinguish impaired from unimpaired conditions, while a Level IV program is able to discriminate up to 5 levels of biological condition, can develop unbiased statewide estimates of conditions, and is equipped to help diagnose causes of observed declines or loss of biological condition.

The figure below illustrates the evaluation and upgrade process, starting with the technical evaluation which determines your current program level. The flow chart shows which elements typically need to be upgraded to be ready to calibrate a BCG model. Once a calibrated BCG is in place, it is possible to move toward tiered uses based on biology, developing biocriteria, and integrating watershed management.



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What Type of Information Do I Need?

Integration of biological monitoring information with water quality standards and water quality management requires quality data collection, analysis, and interpretation.

Collecting Quality Data

Quality biological data are integral to effectively and accurately answering questions about condition, protection, restoration, or other management decisions regarding surface water resources. If data are unreliable or uncertain, then conclusions and decisions made from them will likewise be unreliable.

Good monitoring data, biological, chemical, and physical, are more than just quality-controlled laboratory values. In addition to standard field and laboratory QC, good data also require sampling and monitoring design (including level of effort) adequate for a monitoring program's purposes, data management, data analysis, and interpretation. There are 13 critical technical elements of good data collection and analysis described in the document Critical Elements of an Effective Bioassessment Program: Assessing Program Quality and Technical Rigor (EPA/XXX/R - XX/XXX). Monitoring and assessment programs can be classified into 4 levels of scientific rigor, where a level 1 program is able to distinguish impaired from unimpaired conditions, while a level 4 program is able to discriminate up to 5 levels of biological condition, can develop unbiased statewide estimates of conditions, and is equipped to help diagnose causes of observed declines or loss of biological condition.

Developing the Relationship Between Biological Condition and Stressor Data

The Biological Condition Gradient (BCG) is a conceptual model that describes how biological attributes of aquatic ecosystems change along a gradient of increasing anthropogenic stress. The national BCG model can be quantified and calibrated to local conditions for state and tribal use in monitoring and assessment. Click HERE to find out how.

Diagnosing Biological Impairment

The BCG, as well as many other biological indicators, are biological responses to the effects of anthropogenic stress on aquatic systems. These responses, along with information on stressors and sources, can be used to identify the causes of biological degradation. Identifying the causes of degradation are clearly important to water quality management, whether for permits, TMDLs, or watershed management. U.S. EPA has developed a step by step methodology for identifying causes of biological degradation, which can be found HERE.

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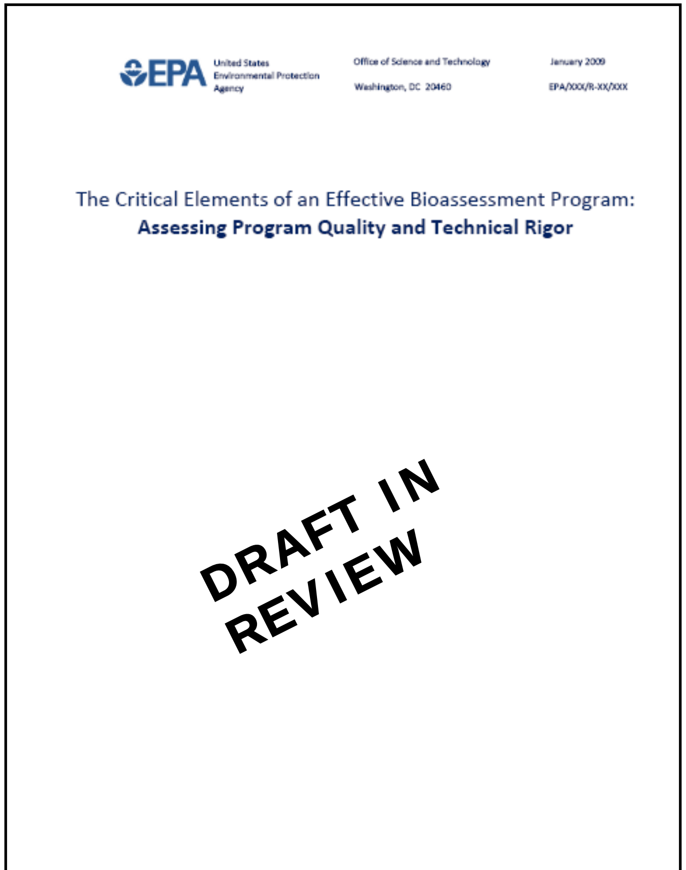

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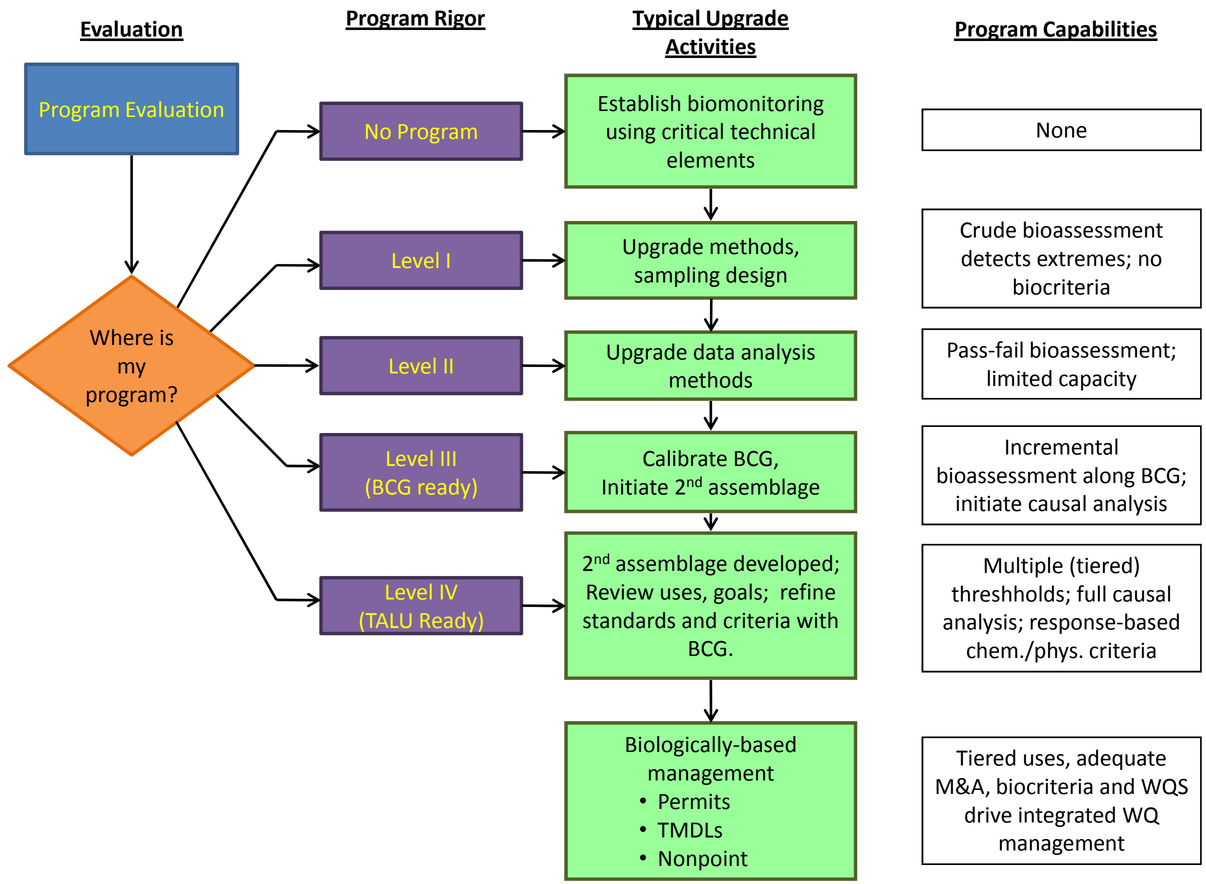
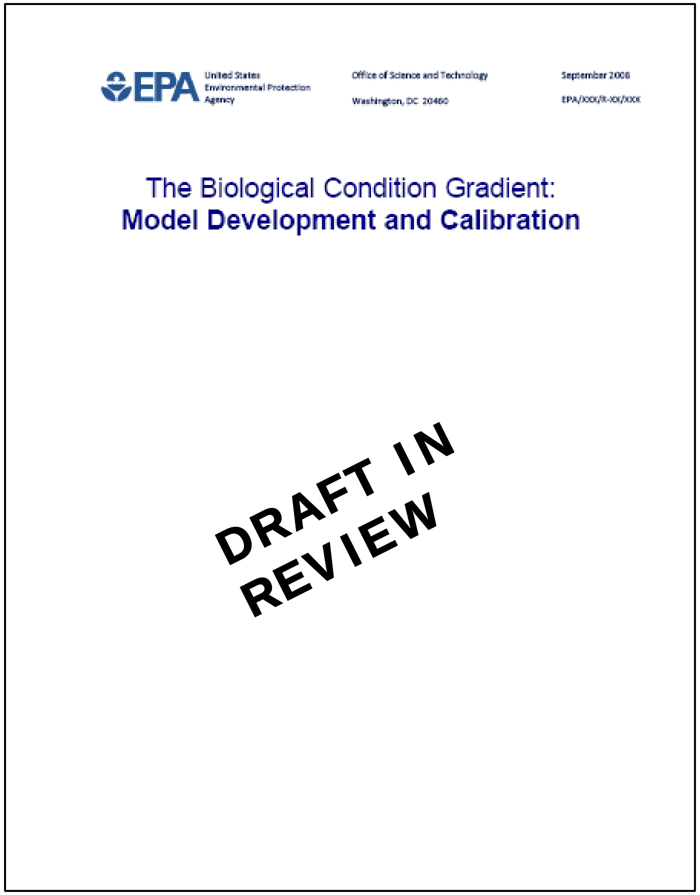


Return to – What Type of Information Do I Need?



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Washington, DC 20460

September 2008
EPA/XXX/R-XX/XXX

The Biological Condition Gradient:
Model Development and Calibration

DRAFT IN REVIEW

This document describes the numeric calibration of the BCG model to waterbodies, and the development of decision criteria models that can be used to automate the application of the BCG to a state's waterbodies. The key components of calibrating a BCG are:

Biomonitoring data that cover the entire range of conditions and stresses within at least one ecological region. This requires a sufficiently large dataset, identification of natural, ecological classification, and identification of reference sites that are the least stressed that exist.

Ecological experts who are familiar with the region's assemblages and species and their responses to stress.

One or more ***workshops to build expert consensus*** on the description of the BCG levels in the region

Quantification of the BCG levels with quantitative descriptions of the attributes and decision rules for each level

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What is the Experience of Other States That Took the First Step?

The following are two examples of states that took the first step to evaluate their technical program and determine how to build on current strengths and address program gaps.

Minnesota: Minnesota is working to revise its Water Quality Standards (MN Rule Chapter 7050) to incorporate a biologically-based tiered aquatic life use framework for rivers and streams in the state. This framework will enable the State to appropriately classify their waters, set biological goals based on potential to achieve higher levels of water quality , establish biological criteria and to more effectively communicate environmental outcomes to stakeholders and the public. To start the development process, MPCA evaluated the strengths and limitations in their technical program and prioritized the critical tasks that needed to be accomplished to support their program goals. The evaluation revealed that Minnesota's technical program rigor was between Level II and Level III and provided specific recommendations to address technical needs. Based on these findings, MPCA developed a detailed plan to advance their program to a Level IV to support statewide biological criteria development and a framework for tiered aquatic life uses by 2010. Application in listing impaired waters and undertaking formal rule making for WQS revision will proceed in 2011 – 2014. MCPA is planning for extensive dialogue with their stakeholders and public throughout the technical development and rulemaking process. To learn more visit: http://www.pca.state.mn.us/water/talu.html.

Connecticut: (preliminary draft)
In 2007, the Connecticut Department of Environmental Protection (CTDEP) conducted a program evaluation of its biological monitoring program. The program evaluation concluded that their program rigor was at Level II. The evaluation also clarified the need for additional technical work to develop biocriteria thresholds for CTDEP's existing aquatic biological condition monitoring program. By developing tiered, numeric biocriteria, the CTDEP will be able to:

- set attainable management goals for waterbodies based on their best potential condition
- set goals for waterbodies where hydrologic changes are anticipated
- protect high quality waters
- have a direct endpoint of waterbody condition

CTDEP developed the biological condition gradient from its existing macroinvertebrate database and two macroinvertebrate biological indexes. Within one year of the baseline evaluation, CTDEP addressed its program's technical elements and reached a technical rigor of Level III. CTDEP has set a goal of improving its technical rigor to Level IV within five years.

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Ready to Take the First Step? Contact EPA Regional Biocriteria Programs

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Region 4: Jim Harrison
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Region 5: Ed Hammer
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Region 10: Gretchen Hayslip
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Holly Arrigoni
arrigoni.holly@epa.gov

Return to – How Do I Build on Current Programs? (link not working)

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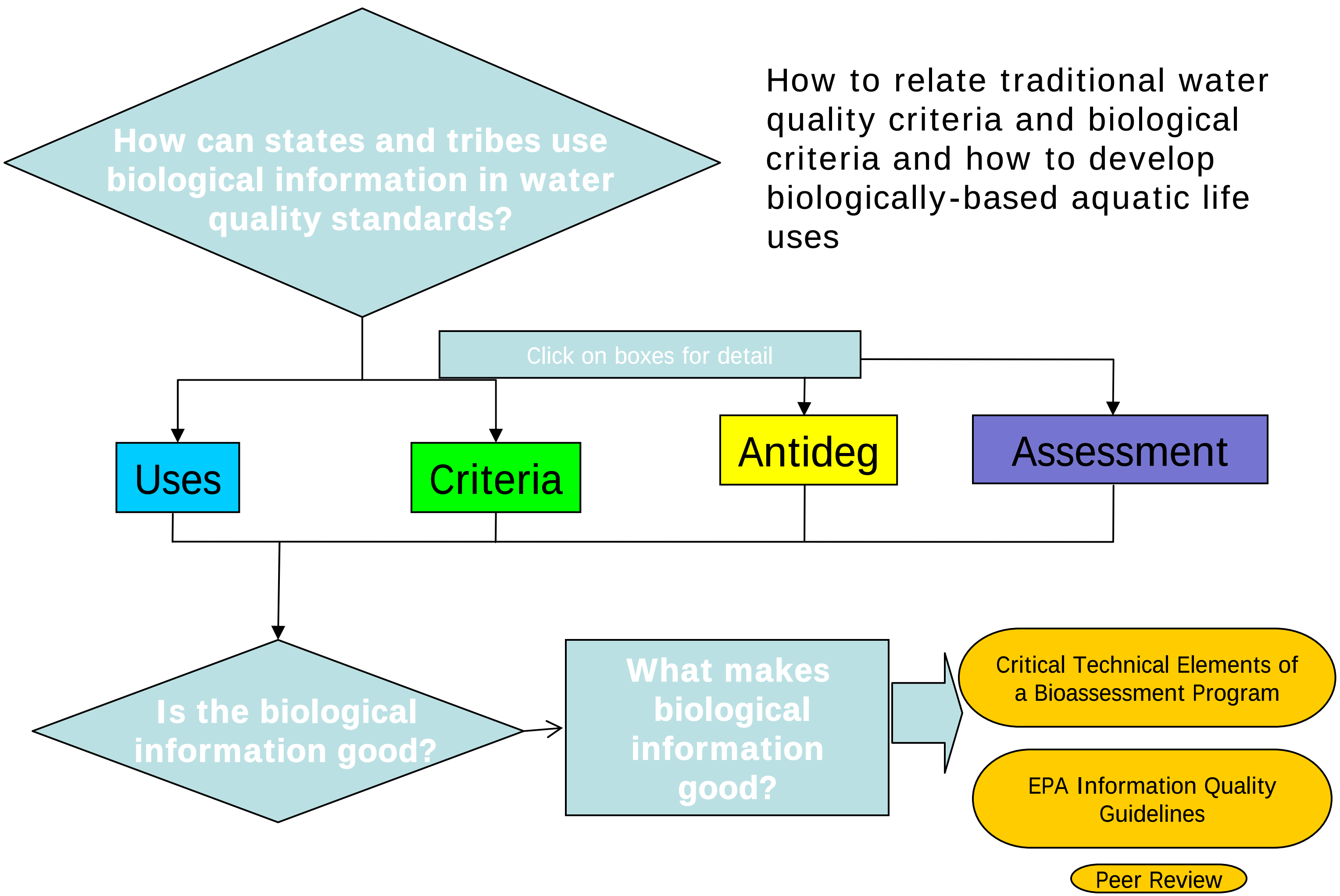
Using This Information in Water Quality Standards (Placeholder)

How to relate traditional water quality criteria and biological criteria and how to develop biologically-based aquatic life uses



Top Implementation Questions and Issues

Key Policy Workgroup Question or Demonstration Need # 1. Click HERE.

Key Policy Workgroup Question or Demonstration Need # 2. Click HERE.

Key Policy Workgroup Question or Demonstration Need #3. Click HERE.

Have other states done this?
Several states have successfully incorporated biology into their water quality standards. Click HERE.

What do I need to know to avoid pitfalls and dead ends?
How can this approach be implemented correctly and defensibly? What quality of data is necessary and how much data is enough? Click HERE.

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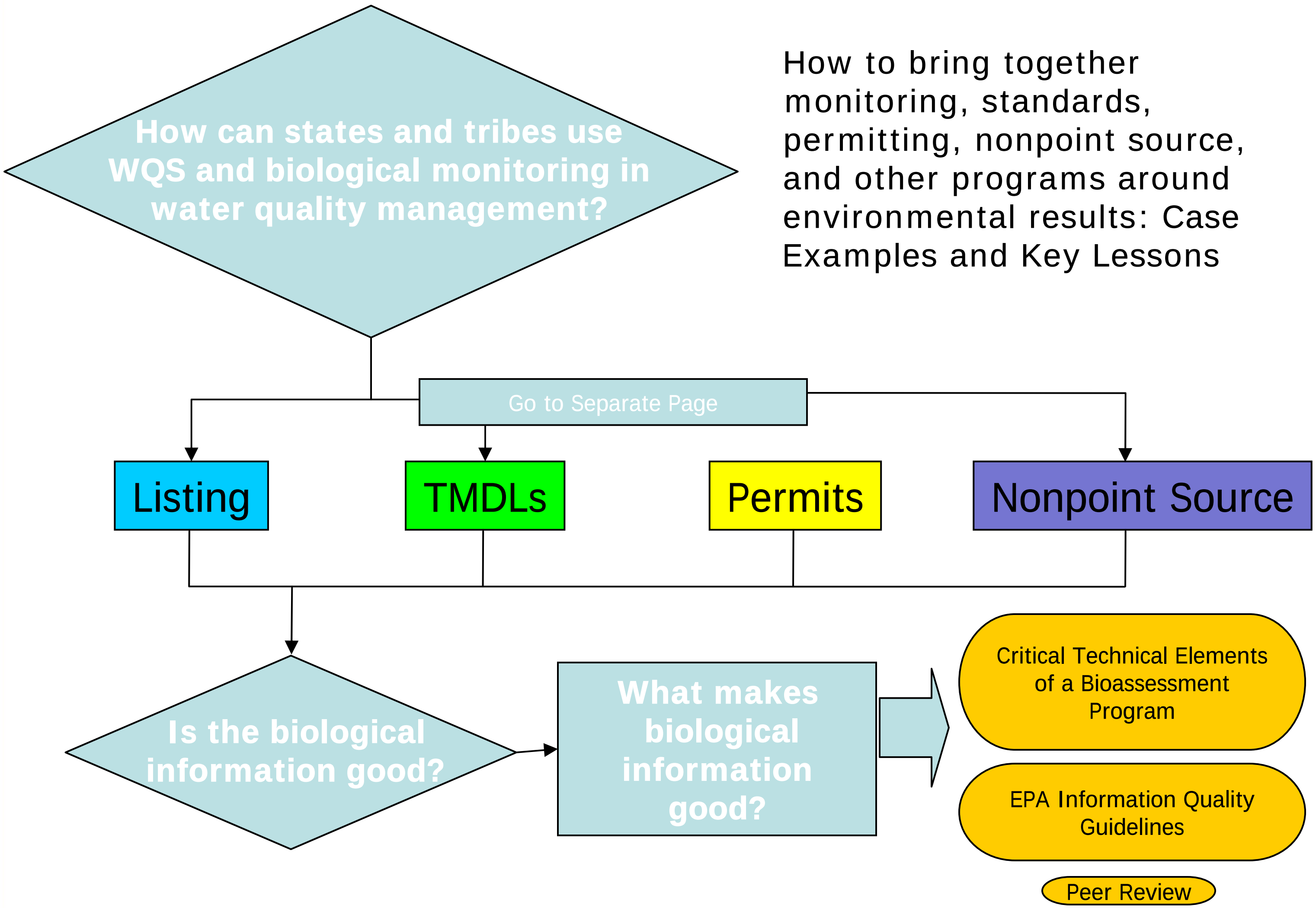
Use in Decision-Making (Placeholder)

How to bring together monitoring, standards, permitting, nonpoint source, and other programs around environmental results: Case Examples and Key Lessons



Top Implementation Questions and Issues

Top Cross-Program Question or Demonstration Need # 1. Click HERE.

Top Cross Program Question or Demonstration Need # 2. Click HERE.

Top Policy Workgroup Question or Demonstration Need #3. Click HERE.

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Experience of Other States That Have Begun to "Go Down the Road" to Incorporate Biological Monitoring into WQS and Apply in WQM

The intent of this page is to provide information on experience states "new" to use of biology to define uses and develop BC: their drivers, experiences – lessons learned both what worked and pitfalls to avoid.

UNDER CONSTRUCTION

CASE EXAMPLES UNDER CONSTRUCTION; CANDIDATE EXAMPLES LISTED BELOW

•**Colorado (1), Minnesota (1), New Jersey (1), Pennsylvania(1)**: states in the process of identifying biological condition levels.
•**Colorado (2), Missouri (1):** These states started with commissions with stakeholders, and are in-process.
•**Connecticut (1)** – began with an interagency task force. Conducted cross-program dialogues that included managers, water quality standards and monitoring for a visioning process that focused on current environmental issues that need new approach (e.g., low flow). Lesson: bring programs together for conversation; use current issues as focal point.
•**Connecticut (2), New Hampshire (1)** – interfaced with probability design; applied their own methods.
•**Maine (3)** – early on, Maine began using biological information in hydropower licensing; could do this in advance of biocriteria adoption because technical standards were explicit in classes. Lesson: if a stats has good biological information, can begin using it.
•**New Jersey (1); Pennsylvania (2)** – Examples of biological BCG process
•**Vermont (1):** example of working with NGOs in designated waters. Lesson: different understandings of current program objectives

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Biological Information and Permits

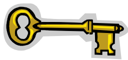
Permits are based on designated uses and the water quality standards that apply to each designated use. Here we show how biologically-based criteria are used in permits.

The water quality standard for a given designated use includes biological criteria, chemical criteria (e.g. DO, nutrients, toxic substances), and physical criteria (e.g., temperature, sediments). Use of biological information in permitting has two programmatic preconditions: that water quality standards include biological criteria and that monitoring (biological, chemical, and physical) is closely coordinated with water quality management.

Biological information in permits: Added value or burden?

Some NPDES permit writers have asked questions about increased workload and the added value of biological information for preparing permits. For states that have established biocriteria in water quality standards and use biological information in their permitting program, the added value is:

- Direct feedback on whether management action (permit) was successful for restoring waterbody or for preventing damage.
- Development of predictive associations between sources, stressors, and observed effects on biological condition. These can help determine limits for new or increased activity (**see permits in Maine example**), or they can help determine actions necessary to restore waters that do not attain the state criteria (**see DeCoster example**).
- Diagnostics and causal analysis to identify needed remediation of legacy pollutants as well as permit limits for cumulative effects for stream restoration (**see Ottawa River, OH example**).



The monitoring and the permitting programs are closely integrated in those states that have established biological criteria in WQS and are successfully using biological information in their permitting program. The relevant information is collected and provided in a timeframe and format the permit writers can directly use.

The first question the permit writers need answered from the technical program are:

- What designated aquatic life use applies to the waterbody under consideration?
- Are the designated aquatic life uses currently in attainment or not?

Permit writers do not collect monitoring information, nor do they work in isolation to determine what changes to the permit are required. Potential causes of biological impairment are investigated by biologists and other scientists in the monitoring program who then provide technical support to the permit writer to determine the most appropriate permit limits to balance both environmental and socio-economic goals. When causes of impairment have been identified, the permit program can estimate waste load allocations and total loads for permits to achieve designated uses. Coordination and communication between monitoring and permit personnel is critical for assuring success. Monitoring coordinators must know which permits are up for reissuance to assure that good information and assessments are in place. The permit program should neither have to wait for, nor perform, additional tasks to issue a permit. A systematic and coordinated monitoring program is an essential prerequisite to this process working. Link to Stratton video on what is in a permit.

Communication is not without costs and takes staff time, but the benefits of an integrated program far outweigh communication costs. Another communication requirement is that the permits program staff are informed and take part in the development of meaningful criteria, when criteria are developed or revised during the state triennial review (needs explanation, like, what does the permit write contribute? What is their role? What kind of workload is this?). Permit writers benefit from education on the basic concepts and principles of biological assessment and biological criteria, so that they can bring the perspective of managing towards improved biological outcomes into the development of their permits (what does the permit process then differ with this "perspective" brought in?).

Monitoring program responsibilities:
Once biological criteria are established in Water Quality Standards, the monitoring program needs to provide technical support and data in format relevant to permit writer's needs for information ►Link to Sample Data Sheets and Technical Information provided to permit writers

Permit writer responsibilities:
Provide schedule of permit renewals to monitoring program so that the appropriate biological, chemical, and physical data is collected to determine if WQS standards are attained.

Case Examples: DeCoster egg farm, ME Fish Hatcheries, and Ottawa River, OH.

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Permits and Biocriteria in Maine

Integrated programs that use biological assessment information are better-equipped to achieve environmental improvements because they can observe the biological responses to management actions. They can also report the same responses, and communicate successes to the public.

For example, Maine DEP permit-writers Bob Stratton and Dennis Merrill report that biomonitoring results play a crucial role in permitting, especially for certain industries.

"Fish hatcheries in Maine commonly discharge to small, cold-water Class A streams, our most protective aquatic life use class. Several years ago our Legislature was preparing to vote on funding to increase fish production in state fish hatcheries. The Biological Monitoring Program provided convincing and compelling documentation of biological problems that were commonly occurring at existing production levels. The Department ended up completely overhauling the hatchery permitting process and the Legislature ultimately directed funding to improve hatchery pollution control processes to better protect stream resources, before spending public funds to increase hatchery production. The revised hatchery permits (insert link to MDEP hatchery permit) are iterative- they can be re-opened if the required biomonitoring data shows the receiving water is failing to attain applicable biocriteria."

Bob Stratton
Maine Department of Environmental Protection

Preliminary biomonitoring in 2007 demonstrated marked improvement in biological condition after changes in treatment were implemented, as required in the permit. For more information on permits and biocriteria in Maine, see: http://www.youtube.com/watch?v=p4MEsFLS5i8&feature=related

Maine relies on an internal communication process to ensure the effective and appropriate use of biomonitoring data in permits. Permit writers send a list of upcoming permit renewals to the monitoring program to determine whether biomonitoring data indicates any need to revise the permit.

"The permit-writer needs to hear how the permit needs to be changed to fix the biological problem. To make it work you need a number you can justify. We would have a hard time using the data from bioassessment if we did not have biocriteria in water quality standards. You need to have a clear legal basis and good data to document why the changes are necessary and required."

Dennis Merrill,
Maine Department of Environmental Protection

At Maine DEP, the technical process to develop new permit provisions that will solve an observed biological problem is likely to involve biomonitoring and toxicity professionals, water quality modelers, facility inspectors and the permit-writers themselves. The permit-writer needs to make the determination that the activity "will not cause or contribute to a violation of designated use". Because Maine has tiered aquatic life uses the permit-writer first determines the designated use class in WQS (Class A, Class B or Class C). The classification determines what criteria apply for aquatic life, dissolved oxygen and other restrictions if any (link to table of Maine classes and criteria for DO, bio etc.). From that point on a typical process is applied to develop a permit that is protective of the applicable ALU condition. In cases where there is lingering uncertainty about whether or not the permit provisions are fully adequate to prevent problems, the Department relies on a re-opener clause that can be triggered by a finding of biocriteria non-attainment, i.e., a violation of aquatic life use.

(Link to state self-assessment)

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Maine River Classes and Criteria

	Dissolved Oxygen	Bacteria (*E. coli*)	Habitat	Aquatic Life (Biological*)
AA	as naturally occurs	as naturally occurs	free flowing and natural	as naturally occurs
A	7 ppm; or 75% sat.	as naturally occurs	natural	as naturally occurs
B	7 ppm; or 75% sat.	64-GM 236/100 ml (instan-taneous)	unimpaired	support all aquatic species indigenous to the receiving water; no detrimental changes to the resident biological community
C	5 ppm; or 60% sat.; 30-day avg. 6.5 ppm	126-GM 236/100 ml (instan-taneous)	habitat for fish and other aquatic life	support indigenous fish; maintain the structure and function of the resident biological community

***Numeric biocriteria in rule, based on benthic macroinvertebrates**

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Adjusting Permit Limits with Bioassessment Data: Maine Case Study

The Maine Department of Environmental Protection (MDEP) has defined three aquatic life use classes for its streams, A, B and C, which generally span the upper four levels of the Biological Condition Gradient (Fig 1). Attainment of the use class is determined by the condition of a site's benthic invertebrate community as well as attainment of other criteria that apply to that class (Table 1). Class A is equivalent to natural biological integrity (minimally disturbed streams); Class B consists of streams in areas of altered land use, or that are receiving waters for minor or well-diluted wastewater discharges, and Class C consists of streams altered by high-density residential and urban land use and/or major industrial discharges.

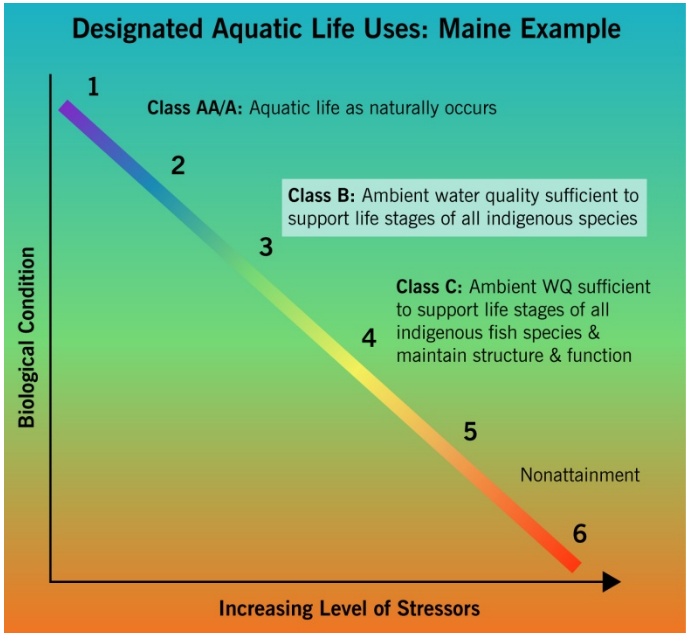

Figure 1. Diagram of Maine's tiered designated aquatic life uses, superposed on the 6 levels of the Biological Condition Gradient.

Runoff from the Decoster Egg Farm's manure and waste piles in Maine was contaminating surface and groundwater that fed Class B streams. Biological and water quality monitoring confirmed detrimental effects on the aquatic community and identified that the three impaired sites received groundwater upwelling contaminated by waste storage. One site was downstream of a treatment system that received waste from the egg washing operation. Monitoring and characterization of the habitat and watersheds of the sampled waterways revealed that, with best management practices, the streams should be able to attain Class B status, but they were not even meeting the minimum Class C status. Maine DEP brought enforcement action to improve management of animal waste products.

Five years after the enforcement and initial improvements to waste management, monitoring revealed that the streams were not in violation of chemical criteria for Class B and they had improved to attain biocriteria for Class C. Nevertheless, the streams were still not attaining the required Class B biological condition. MDEP implemented further source controls on the facility—the farm could no longer spread manure, and it had to further upgrade the wastewater treatment system. The egg washing operation was later removed. After implementing such source controls, the waters attained Class B status. (What happened to the egg washing job? Moved elsewhere? Different method? Effect on the egg farm?)

Maine's water quality management program includes a comprehensive monitoring and assessment program and multiple aquatic life uses, corresponding to Classes A, B and C. Because of this, MDEP was able to do the following:

- Detect impairments through biological monitoring that chemical monitoring could not.
- Adjust Best Management Practices (BMPs) and source control limits and work with Decoster Egg Farm to restore the streams.
- Establish Class B as the expected and attainable status for the streams.
- Restore the streams to a better condition than would be possible with a single, general aquatic life use criterion. Without multiple aquatic life uses, source controls would have stopped when a minimal condition was reached (Class C), and the two streams would never have recovered to Class B.

MDEP's use of biological and chemical monitoring information to inform both source controls and nonpoint source BMPs resulted in an environmental outcome that was a significant and measurable improvement in the condition of Maine's waters. Add: statement or video from perspective of Decoster Egg Farm owner.

Table 1. Maine's River Use Classes and criteria

Use Class	Dissolved Oxygen	Bacteria	Habitat	Aquatic Life
AA	as naturally occurs	as naturally occurs	free flowing and natural	as naturally occurs
A	7 ppm; or 75% sat.	as naturally occurs	natural	as naturally occurs
B	7 ppm; or 75% sat.	64-GM 236/100 ml (instantaneous)	unimpaired	support all aquatic species indigenous to the receiving water; no detrimental changes to the resident biological community
C	5 ppm; or 60% sat.; 30-day avg. 6.5 ppm	126-GM 236/100 ml (instantaneous)	habitat for fish and other aquatic life	support indigenous fish; maintain the structure and function of the resident biological community

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NPDES Permitting and Use Attainability Analysis in Ohio

The Ottawa River in northwest Ohio was impacted by the city of Lima, rural communities, and agricultural activities (row crops). Point sources included one major municipal and two major industrial discharges, industrial contributors to the Lima sewer system, combined sewer overflows (CSOs), and partial or untreated sewage discharges from semi-rural areas in the watershed. The effluent flow from the three major point sources comprised the majority of the Ottawa River flow during dry weather months. Toxic stressors, exposures, and responses reached a maximum in the segment directly impacted by the three major point sources (Ohio EPA 1998; Yoder and DeShon 2003). Evidence of multiple toxic exposures occurred in the water column chemistry, sediment chemistry, whole effluent toxicity, frequency of DELT anomalies, fish tissue contaminants, and biochemical markers. These indicators pointed strongly to impacts of a toxic character and the biological response signatures provided the corroborating feedback. None of the individual point sources involved were considered in non-compliance of their NPDES permits at the time of the assessments. However, their cumulative effect on biological condition resulted in severe biological impairment of the river.

Most of the Ottawa River was originally assigned the Limited Warmwater Habitat (LWH) aquatic life use, which was assigned to rivers thought to be so polluted that restoration was considered unfeasible. However, qualitative habitat evaluation index (QHEI) scores for the Ottawa indicated more than adequate habitat to support the WWH use designation (Rankin 1995). In a recovery zone immediately below the impacted reach, the biota eventually exhibited recovery to WWH status in the lower reaches of the river. In the impaired sections, the biological response signatures strongly indicated general toxicity, which is a fundamentally different response than what would occur in response to habitat or low D.O. alone (Yoder and Rankin 1995b; Yoder and DeShon 2003).

Ohio EPA redesignated (upgrade) the Ottawa River from LWH to WWH in 1989. The redesignation was controversial and resulted in legal actions challenging the WWH use. Plaintiffs contended that the habitat could not support a WWH assemblage and further argued that D.O. concentrations consistent with WWH criteria were unattainable due to upstream impoundments and the flow regime. The WWH designation was upheld because Ohio had a substantial record demonstrating the relationship between habitat condition (as QHEI) and attainable biological condition described in the tiered uses. The response signatures indicated that the cause of non-attainment in the Ottawa River was primarily toxicity.

The WWH redesignation and subsequent permitting of the three major point sources was a result of Ohio's systematic approach to monitoring directly tied to its TALUs. Ohio EPA imposed controls to significantly improve water quality, including chronic WET limits, close scrutiny of intermittent releases and spills, and internal audits conducted by two of the industrial facilities involved. In addition, an unregulated landfill leachate was discovered and subsequently required remediation.

References:

Ohio Environmental Protection Agency (Ohio EPA). 1998. *Ohio Water Resource Inventory, Volume I: Summary, Status and Trends*. E. T. Rankin, C. O. Yoder, and D.Mishne, (eds.). Division of Surface Water, Ecological Assessment Section. Columbus, Ohio.

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In the Pipeline: Progress on Tiered Aquatic Life Uses

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New England Interstate Water Pollution Control Commission:
In 2009, the New England Interstate Water Pollution Control Commission (NEIWPCC) started a project designed to illustrate the practice and value of biologically–based water quality management. Biological information from two to three waterbodies in New England will be used to generate a comparison of tiered versus non-tiered aquatic life uses. This work will assist management decisions in a regulatory context. NEIWPCC plans to release its program findings in a

report to EPA following the completion of the project.

CONTACTS??? STATUS?? TIMEFRAME??? VIDEO OR STATEMENT OF KEY STATE LEADS????

Also- I removed Mn and CT. See experience of first two states undertaking an evaluation. Instead, I suggest we do an overview of states piloting – and get a group sense of their drivers and program goals.

National Estuary Programs:
U.S. EPA is collaborating with four National Estuary Programs (NEPs) and the Southern California Coastal Water Research Project to test the BCG as an integrative framework for managing estuaries at several scales. The intent of the framework is not to replace existing guidance and local methods for biological assessment, but rather to provide tools and context for meaningful interpretation within a larger view of the estuary and watershed. The four NEPS are Casco Bay, Maine; Narragansett Bay, Rhode Island; Long Island Sound, New York and Connecticut; Delaware Bay, Delaware; and Tampa Bay, Florida. I added 5 estuary programs that I thought were engaged – and have identified 5. Also, what about Barneqat Bay?

Currently EPA and the participating NEPs are addressing the technical issues of an estuarine BCG-based science and management framework. Over the next year, locally-developed data will be used to populate the BCG framework. The frameworks will consider structure, function, condition, extent, and connectivity of waterbodies at multiple scales, including the whole-waterbody scale (e.g., integrative water column metrics, measures of the estuarine mosaic of living habitats) and the single-habitat scale (e.g., salt marsh assessment methods, benthic faunal indices). This holistic management approach is designed to address the cumulative impacts of many stressors at multiple scales. to presentation at December's NEP meeting, presentation made by Delaware Bay rep.

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