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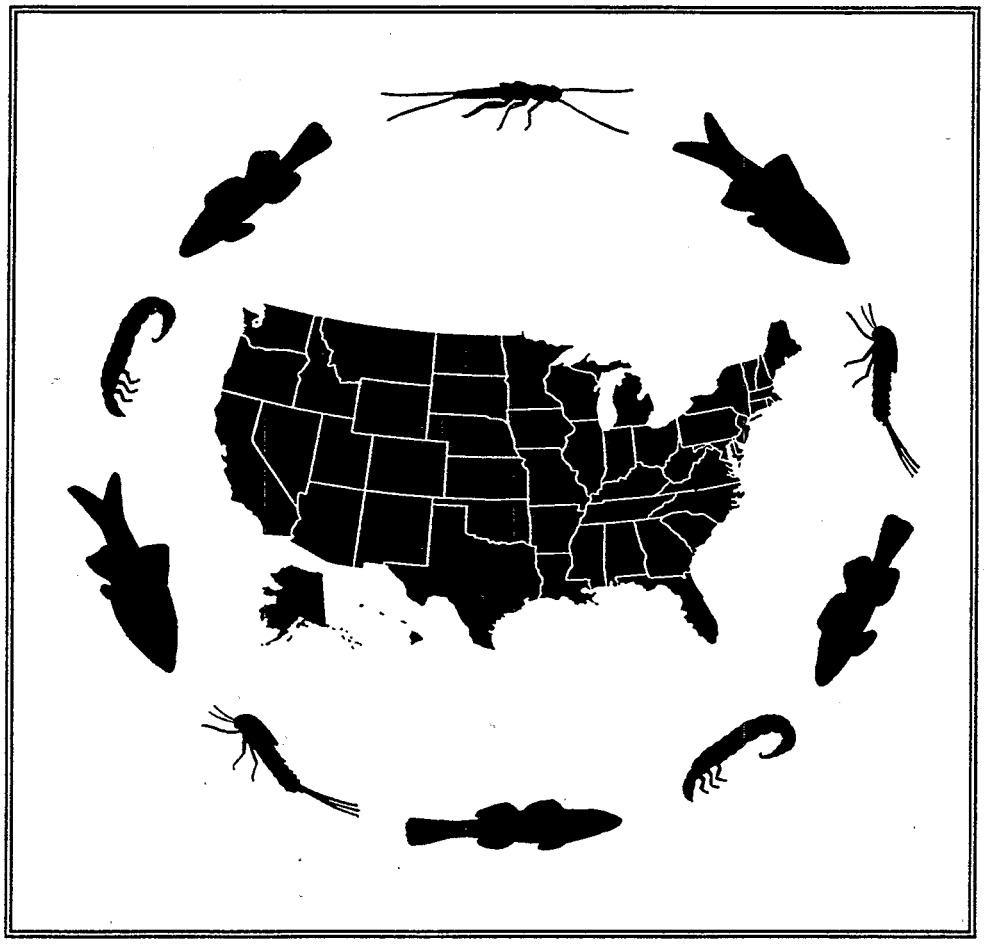
Summary of State Biological Assessment Programs for Streams and Rivers



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SUMMARY OF STATE BIOLOGICAL ASSESSMENT PROGRAMS FOR STREAMS AND RIVERS

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Section 1. Introduction

1.1 BACKGROUND

Biological integrity is commonly defined as "the ability to support and maintain a balanced, integrated, and adaptive community with a biological diversity, composition, and functional organization comparable to those of natural aquatic ecosystems in the region" (Frey 1977, Karr and Dudley 1981, and Karr et al. 1986). The U.S. Environmental Protection Agency has endorsed the use of biological integrity as an indicator of environmental condition and, more specifically, ecological health (U.S.EPA 1990a,b). It is unique among currently used indicators in that i) it uses information gathered directly from the aquatic organisms and the biological community of which they are a part, ii) the biota with which biological integrity is concerned is shaped by all environmental factors to which it is exposed over time, whether chemical, physical, or biological, and iii) it combines multiple, community level, biological response characteristics into an indicator of cumulative environmental impacts (Karr 1991, 1993).

A cooperative effort among the Ohio Environmental Protection Agency and U.S. EPA's Environmental Research Laboratory in Corvallis, Oregon, was started in the early 1980s to demonstrate how indicators of biological integrity could be used in state-wide water quality management programs. The effort resulted in unique tools for state use such as the applicability of ecological regions to reduce natural variability in biological data sets, the use of multiple reference sites within an ecoregion to develop attainable water resource goals (i.e., reference conditions), a consistent sampling methodology for fish and benthic macroinvertebrate assemblages, and a multiple metric approach for analyzing biological data (i.e., Index of Biological Integrity) that made the interpretation of biological data less subjective (Whittier et al. 1987). In 1987, U.S. EPA hosted the first national workshop on biological monitoring and assessment and was directed toward building EPA's understanding of state programs and their needs, as well as providing support for state agencies to build their capabilities by learning what other states found to be successful approaches (Simon et al. 1988, U.S. EPA 1987). Since that workshop, U.S. EPA and the state agencies have been involved in several cooperative ventures and the implementation of biological integrity indicators within state programs has grown.

Definitions of Terms and Phrases

Bioassessment - an evaluation of the biological condition of a waterbody that uses biological surveys and other direct measurements of resident biota in surface waters

Water Resource Management (Non-Regulatory) - decisions on management activities relevant to a water resource such as problem identification, need for and placement of best management practices, pollution abatement actions, and effectiveness of program activity.

Interpret Aquatic Life Use - biological assessment results are used to help interpret attainment of aquatic life use, a beneficial use designation in which the waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms; aquatic life use designation is part of the state water quality standard

Water Quality Standard - a law or regulation that consists of the beneficial designated use or uses of a waterbody, the numerical and narrative water-quality criteria (including biocriteria) that are necessary to protect the use or uses of that particular waterbody; biological criteria are defined as numeric values or narrative expressions that describe a reference biological condition of aquatic communities

Organism Group - equivalent to *assemblage*; a group of phylogenetically (e. g., fish) or ecologically (benthic macroinvertebrates, periphyton) related organisms that are part of the aquatic community or biota

Reference Conditions - the chemical, physical, or biological quality or condition exhibited at either a single site or an aggregation of sites that are representative of the least-impacted and attainable condition; an ecoregional reference condition is a description of the chemical, physical, or biological condition based on an aggregation of data from least-impacted sites that are representative of a waterbody type in an ecoregion, subecoregion, watershed, or political unit

Multiple Metrics - of the multimetric approach, a technique for characterizing and assessing biological condition; a metric is a calculated term or enumeration that represents an aspect of biological assemblage structure, function, or other measurable characteristic that changes in some predictable way with changes in human influence; a multimetric approach aggregates metrics into an overall assessment of biological condition

State programs report on the quality of their waters through a biennial report referred to as the "305(b) report". U.S. EPA compiles and analyzes this state information in a biennial report to Congress called the National Water Quality Inventory (U.S. EPA 1994a). Traditionally, little documentation was available on the amount and quality of biological information used in these state assessments. But as U.S. EPA faces more pressures on documenting true environmental results achieved by the Nation, these biological measures have become a focus for measuring the degree to which the biological integrity objective of the Clean

Water Act is being met nationwide. Some of these pressures are legislative such as the Government Performance and Results Act of 1993, while others are as a result of U.S. EPA's internal strategic planning efforts (e.g., National Environmental Goals Project and the Office of Water Environmental Indicators Effort). In any case, the need for direct and accurate measures of the quality of our water resources is widely recognized, and those measures have consistently been identified as biological integrity indicators (U.S. EPA 1990a, U.S. EPA 1990b, U.S.EPA 1995a).

Although the National Water Quality Inventory includes information on the nationwide status of aquatic life designated use attainment (i.e., state water quality standards), it is recognized that the results reported do not consistently present information necessary to determine the ecological/biological condition of the Nation's water resources. As currently reported in state 305(b) water quality assessments, aquatic life use attainment may be determined solely by chemical parameters and comparison with state chemical water quality standards. This can result in an underestimate of biological degradation since chemical water quality criteria do not detect degradation due to nonchemical stressors or cumulative effects of those stressors; in addition, not all chemicals are monitored. Attainment of chemical water quality standards alone does not ensure a healthy biological condition (Yoder and Rankin 1995). Efforts are underway to incorporate a greater amount of biological information in the aquatic life use attainment determinations and this does show great promise, but it is difficult to estimate when these approaches would be fully integrated into state programs.

This project has grown out of the need to produce nationwide assessments of biological condition for our water resources. Diversity of contemporary state bioassessment programs for streams and rivers generally ranges from: i) pilot projects developed to explore the utility of biological monitoring, assessment, and criteria; ii) to approaches that use bioassessments and biocriteria concepts to enhance water quality programs; iii) to programs that use sophisticated biological assessment methods and incorporate numeric biological criteria into water quality standards. The purpose of this document is to present an aggregated assessment of national water resource quality using biological monitoring and assessment results from state monitoring programs. It uses data qualifiers to evaluate and select data that are appropriate for aggregation and records state program characteristics and capabilities. This document also contains the biocriteria language appear in water quality standards from the states and territories, and definitions related to those standards.

1.2 RECOMMENDATIONS FOR STATE BIOLOGICAL ASSESSMENT PROGRAMS

Minimum requirements for state biological assessment programs have been suggested by U.S. EPA (1995a) as part of the Section 305(b) reporting requirements and by the Intergovernmental Task Force on Monitoring Water Quality (ITFM 1995). These requirements are based upon existing state programs and would ensure greater accuracy and consistency in state biological assessment and criteria development efforts. They are also the basis for the data qualifiers used in this project (see Section 3).

Recommended Bioassessment Program Characteristics

- *Multiple assemblages*
- *Multiple metric indices*
- *Habitat structure assessment*
- *Regional reference condition*
- *Index period*
- *Standard operating procedures and quality assurance program*

Multiple assemblages - use of more than one organism group (e.g., benthos and/or fish and/or periphyton) is believed to give greater accuracy in detecting water resource quality impairment from human activities, as well as substantially decreasing uncertainty in the assessment.

Multiple metric indices- are recommended to strengthen data interpretation and reduce error in judgement based on isolated indices and measures. Reliance on several ecological attributes of the community that can be tested and combined into an index is recommended for an overall assessment of biological condition.

Habitat structure assessment - is a critical element of a biosurvey to assist in the interpretation of biological data and discerning effects of physical habitat alteration from chemical impacts. Habitat structure assessments are used with biosurveys to establish the biological potential of waterbodies.

Regional reference condition - describing a reference condition from an aggregate of data from several minimally-impaired sites is preferable to using data from only a single reference site from which to compare biosurvey results. The regional reference condition is based on data collected from those minimally-impaired sites representing regions of similar physical characteristics such as climate, soils type, physiography and vegetation (e.g., ecoregions) and further stratified by drainage area, stream order, size, and/or subecoregions.

Index period - a defined time period during which data are collected; minimizes effects of year to year variability, reduces seasonal variability, and provides optimal accessibility of the target assemblages, and maximizes the efficiency of sampling gear.

Standard operating procedures (SOPs) and quality assurance (QA) program - the validity of an biological assessment and the interpretation of the results is dependent upon an effective QA plan. The QA plan contains several important guidelines for the program to follow such as objectives and milestones for achieving those objectives, lines of responsibility, accountability of staff for meeting data quality objectives, and accountability for ensuring precision, accuracy, completeness of the data collection activities, and documentation of the sample custody process. Documented SOPs for developing study plans, maintenance and application of field sampling gear. performance of laboratory activities and data analysis are integral quality control components for any program.

For additional information, please refer to the Guidelines for the Preparation of the 1996 State Water Quality Assessments (305b Reports), the final report and appendices of the Intergovernmental Task Force for Monitoring Water Quality (ITFM 1995), and the Generic Quality Assurance Project Plan Guidance for Programs Using Community Level Biological Assessment in Wadeable Streams and Rivers (U.S. EPA 1995c).

Section 2. Summary of Findings

2.1 SUMMARY OF CURRENT STATE BIOLOGICAL ASSESSMENT PROGRAMS

This report shows the national breadth of biological monitoring and assessment (Table 1). Biological monitoring and assessment programs are in place in 41 states, in varying degrees, and the results are used in making decisions in both the interpretation of aquatic life use attainment (Figure 1a), and aiding non-regulatory decisions related to water resource management (Figure 1b).

Table 1. National Summary of State Bioassessment Programs for Streams and Rivers in 1995 (50 States, the District of Columbia and the Ohio River Valley Sanitation Commission).

STATE PROGRAM (1995)	In-place	Under Develop-ment	None
Use of Bioassessments			
Water Resource Management (Non-Regulatory)	41	8	3
Interpret Aquatic Life Use Attainment	31	8	13
Narrative Water Quality Standard	29	11	12
Numeric Water Quality Standard	2	15	35
Organism Group Used			
Fish	29	5	18
Benthic Macroinvertebrates	44	5	3
Algae (Periphyton, Diatoms)	4	3	45
More than one assemblage	26	10	16
Reference Conditions			
Ecoregional	15	26	11
Site-Specific	31	0	21
State-Wide or Basin-Specific	6	0	46
Multiple Metrics for Data Analysis			
Biology	42	6	4
Habitat	33	6	13

There are three major biological assemblages, or groups, monitored in comprehensive biological assessment programs: fish, benthic macroinvertebrates, and algae (periphyton). Benthic macroinvertebrates and fish are the assemblages most often used. The algal assemblage is also used but by a much smaller number of states (Figures 2a-b). Twenty-six states use more than one assemblage and another ten currently use one, but are developing the capability of using a second (Figure 2c).

The key to successful use of biological assessments is establishing reference conditions to help discern human impacts from natural influences. Ecoregional reference conditions in state decision-making frameworks depends upon regionalization, classification of streams, and development of the bioassessment program. Regionalization of reference conditions can take five years, which is why it is still ongoing and under development in many states (Figure 3).

States that have narrative biological criteria are shown in Figure 4a; those that have adopted quantitative (numeric) biological criteria into their water quality standards regulations, and those in the developmental phase of doing so, are shown in Figure 4b. Activity in all of these areas will lead to increased use of data from biological monitoring and assessments in environmental decision making. It will also further the refinement of biological indicators and lead to a greater understanding of ecological responses to degradation.

2.2 USE OF BIOASSESSMENTS FOR ASSESSING BIOLOGICAL INTEGRITY

Biological integrity indicators are used to characterize the condition of rivers and streams with respect to their biological potential, or expectations. Whereas biological integrity is one of the overall objectives of the Clean Water Act, biological condition (or "health") is the ecological measure used to gauge progress toward meeting that objective. States designate water quality objectives, or uses, for most of their waters which include protection of warmwater (e.g., bass) and coldwater (e.g., trout) fisheries, among others. These "aquatic life designated uses" appear in state water quality standards and may include a wider range of acceptable conditions than would be considered solely for biological community health. This is because most state water quality standards rely upon chemical measures to represent conditions that protect biological community health. In some states, biological community health is used to directly interpret aquatic life use attainment goals. Table 2 presents the results from states that have stream and river assessments based upon biological community data and aquatic life use attainment and met the qualifiers presented on page 3-1.

Only thirty states plus the District of Columbia and the Ohio River Valley Sanitation Commission (ORSANCO) currently have numeric data of sufficient quality to be confident in the determination of biological condition (see Table 2). These data will serve as a baseline for EPA's biological health (a.k.a. biological integrity) environmental indicator.

Table 2. Comparison of Biological Condition Results and Aquatic Life Use Attainment (based on 1994 State CWA Section 305(b) reporting).

		AQUATIC LIFE USE			BIOLOGICAL CONDITION		
	Total Perennial Stream Miles[1]	% Perennial Miles Assessed[2]	Miles Impaired	Miles Not Impaired	% Perennial Miles Assessed	Miles Impaired	Miles Not Impaired
AL	47077	25.1	3093	8405	1.1	85	415
CT	5484	16.3	222	668	4.7	105.5	188
DC	40.1	97.4	23	14	99	28.9	9.7
DE	2472	36.2	180	714	100	2063	364
FL	22993	34.5	4127	7753	2.1	320	157
GA	44056	NA	4025	2217	5.8	1835	700
IA	26630	21.4	2755	2957	19.5	2413	2776
IL	30246	46.8	7257	6902	25.5	3839	3865
IN	21094	34.8	1479	5860	8.6	729	1094
KS	23731	70.1	15651	1176	1.7	100.5	292
KY	34334	43.5	2424	12512	4.7	260	1359
MA	7133	19.1	362	998	3.9	134	141
MD	12343	35.5	1865	4135	12.2	1175	325
ME	23879	100	148	31508	1.3	28	272
MI	29033	70.9	443	20132	9.2	1535	1140
MS	26454	33.9	7580	1278	1.4	63	301
NC	37536	70.4	7742	18321	18.7	1914.9	5105
NE	16090	41.9	4754	2694	40.5	4515	2006
NJ	6450	24.5	516	1101	8.8	348	222
NM	8682	49.6	289	4021	7.1	304	314
NY	46266	100	4386	45701	2.1	713	367
OH	27825	27.1	4904	3433	28.6	4905	3432
PA	24948	63.1	4647	20301	5	674.9	1297
RI	979	68.1	106	561	34.7	79	261
SC	25729	100	2275	24039	1.2	40	260
TN	19124	57	3816	7091	0.5	70.3	36.2
VA	44852	77.1	1810	32765	2.6	685	460
VT	5264	100	998	4266	25	425	890
WI	32010	66.9	4153	17201	16.7	1419.8	3915
WV	21114	25.1	3672	2662	1.5	170	155
WY	32520	13.2	2808	1476	2.2	506	207
ORSANCO	981	100	981	0	100	981	0
			99491	292862		32465	32325

[1]from state 1994 305(b) reports or EPA National Water Quality Inventory when state data not available;
[2]percentage of state perennial miles or EPA perennial miles when state perennial miles are not available - total state miles used for NC, NJ, TN, VT (perennial miles listed are greater than total).

Based on 1994 CWA Section 305(b) reporting, a total of 64,790 miles were assessed by these states, the District, and ORSANCO based on biological condition while 392,353 miles were assessed for aquatic life designated use assessments as required for CWA Section 305(b). Only Iowa, Ohio, and Nebraska appear to use biological condition as the predominant measure of aquatic life use attainment.

This comparison shows a difference in the percentage of miles rated as impaired between assessment to determine aquatic life use attainment and assessment of biological condition. Of the 392,353 miles assessed for aquatic life use attainment using biological or non-biological methods, 25.4% (99,491 miles) showed impairment and 74.6% (292,862 miles) showed no impairment. In contrast, based on biological condition, about half (50.1%; 32,465 miles) revealed impairment and only 49.9% (32,325 mile) showed no impairment.

Several factors could contribute to the differences in these results. First, the goals for biological community health and aquatic life use are different in that aquatic life use attainment is a state standard that is set considering social and economic needs, as well as ecological requirements. Second, selection of biological assessment sites could be biased toward examining impaired conditions despite the widespread use of watershed based approach that encourages a greater understanding of the factors potentially affecting a site. Third, the additional river miles assessed for aquatic life use could reflect sampling in less impaired waters. Fourth, the biological assessments could represent a more accurate depiction of the ability of the waters to support healthy communities and reveal impairments from sources that are episodic, cumulative, and/or nonchemical that may be missed in non-biological sampling. A comparison study done by Ohio EPA supports the assertion that more impaired waters may be revealed with biological assessments than with non-biological assessments alone. Yoder and Rankin (1995) reported that Ohio EPA assessed 645 waterbody segments using both biological and chemical sampling and found that biological impairment was indicated in 49.8% of the cases where no impairment was revealed based on chemical criteria violations. In nearly all of the cases in which chemical impairment was found, biological impairment was also seen.

The use of multiple assemblages may also be an important consideration in determining the condition of waters. U.S.EPA (1995a) has recommended the use of multiple assemblages for determining aquatic life use attainment in states. There has been considerable discussion regarding the potential financial and resource burden this could place on state programs; however, 26 states are already using more than one assemblage for biological assessments and another 10 (including ORSANCO) are developing the capability of assessing a second.

The importance of using more than one assemblage may also be overlooked. In a recent study, Ohio EPA (Yoder and Rankin 1995) examined more than 1300 sites to evaluate the relationship of determining aquatic life use attainment using only fish or only benthic macroinvertebrates, rather than using them together to make an assessment. Ohio EPA examined the relationship in large rivers (> 500 mi^2), small rivers and larger streams (50 to 500 mi^2), and small streams (< 50 mi^2) separately. They found that the level of agreement between assessments based on fish indices (IBI, MIwb) and those based on a benthos index (ICI) was only 43.5% for large rivers, 65% for small rivers and streams, and 74.8% for small streams. Based on the comparison, Ohio EPA concluded that using only one group will be from 80.4% effective (benthos) to 84.4% effective (fish) at identifying aquatic life use attainment or nonattainment. They concluded that, especially in larger streams, both groups should be used whenever possible.

2.3 BIOASSESSMENT PROGRAM SUCCESS SINCE 1989

When EPA was developing the Rapid Bioassessment Protocols for Use in Streams and Rivers, the Office of Policy, Planning and Evaluation (OPPE) summarized the bioassessment and biomonitoring capabilities in state regulatory programs (U.S.EPA 1989). The summary did not determine the actual use of the bioassessment data for all states, but provided an estimate based upon past knowledge of the state programs and on the documentation gathered during the 1989 summary. Table 3 presents a summary of the 1989 results along with an indication of changes made in the programs relative to 1995. Although extensive information was requested in 1989, the responses varied greatly in the amount of detail provided. Therefore, no estimates of bioassessment use for interpreting aquatic life use attainment or for narrative water quality standards could be made. Similarly, the number of states using statewide or basin-specific reference conditions and multimetric habitat assessments could not be determined. It appeared that many

states used single sites for their reference conditions and that their use was in the form of upstream-downstream comparisons, but this could not be thoroughly documented.

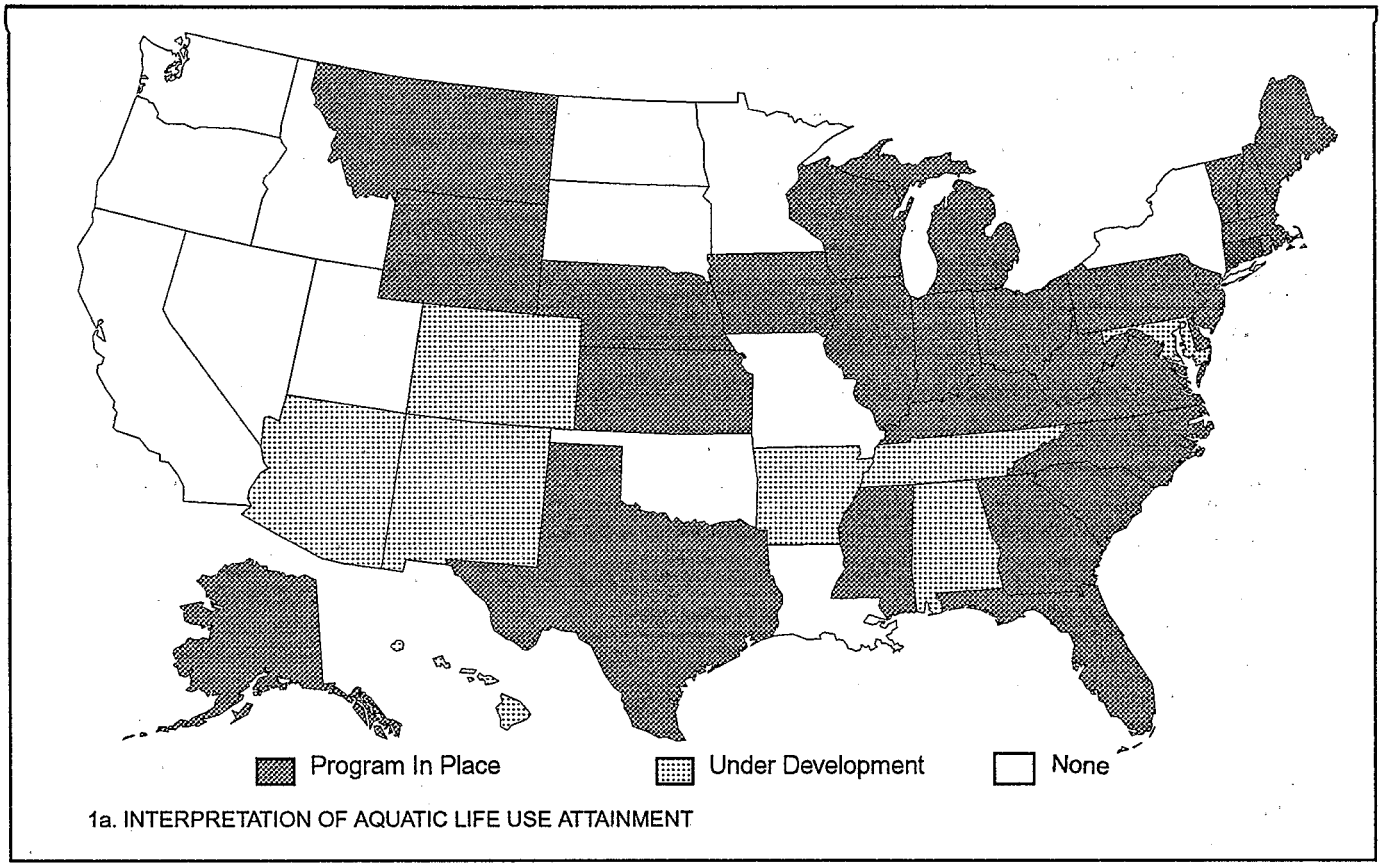
Most states used bioassessments for both point and nonpoint source impact assessments in 1989, therefore, there is little change in the overall numbers for water resource management use in 1995. The changes that did occur are in the level of technical rigor and analytical abilities of the programs. Since 1989, nine states have added the capability to conduct fish assessments, six have added the capability to assess benthic macroinvertebrates, and four fewer states now conduct periphyton assessments (three states have this capability "under development"). Twenty-four states used more than one assemblage in 1989 compared with 26 today and 10 more states are developing capabilities to use more than one assemblage.

Perhaps the greatest progress made since 1989 occurred in the use of ecoregional reference conditions and multiple metrics to assess both reference and ambient conditions. In 1989, only four states (Arkansas, Nebraska, North Carolina, and Ohio) were actively using reference conditions to establish numeric values for biological community expectations. As of 1995, 15 states used ecoregional reference conditions and another 24 states, some of which indicated interest in using ecoregions during the 1989 study, have programs under development.

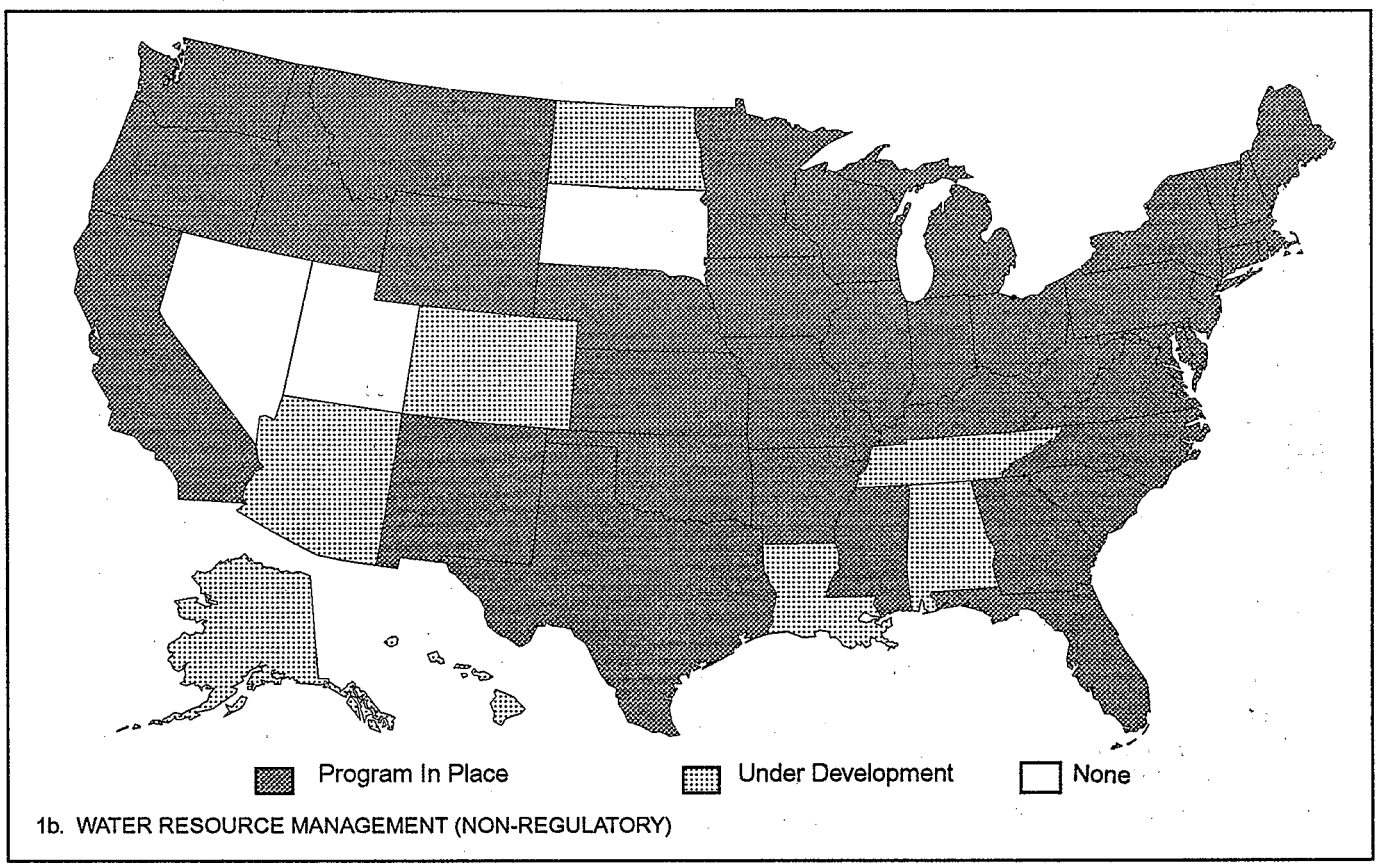
Multiple metric approaches have become widely used since they first appeared in Karr's Index of Biotic Integrity (Karr 1981, 1986). U.S.EPA's Rapid Bioassessment Protocols (Plafkin et al. 1989) are based on this analytical approach. Forty-two states now use multiple metric assessments compared with only three states in 1989. An additional six programs are being developed. This approach is more objective and systematic, reducing the chance for conflicting findings among different investigators. However, there is still considerable discussion within the scientific community regarding the application of multiple metric and multivariate approaches. Some state programs (e.g., Maine) are now using multivariate approaches to provide additional insight into, and sometimes calibrate, their multimetric reference conditions. The close and cooperative relationship among EPA and the states has resulted in the proliferation of more rigorous and standardized biological assessment approaches since 1989.

Table 3. National Summary of State Bioassessment Programs in 1989 and Net Change (in bold) in 1995.

STATE PROGRAM (1989)	In-place	Under Develop-ment	None
Use of Bioassessments			
Water Resource Management (Non-Regulatory)	**+3** (37)	**+5** (3)	**-5** (8)
Interpret Aquatic Life Use Attainment	unknown	unknown	unknown
Narrative Water Quality Standard	unknown	unknown	unknown
Numeric Water Quality Standard	**+1** (1)	unknown	**-1** (49)
Organism Group Used			
Fish	**+7** (22)	**+4** (1)	**-10** (28)
Benthic Macroinvertebrates	**+5** (39)	**+2** (3)	**-7** (10)
Algae (Periphyton, Diatoms)	**-3** (7)	**+3** (0)	**+1** (44)
More than one assemblage	**+2** (24)	**+6** (4)	**-10** (26)
Reference Conditions			
Ecoregional	**+11** (4)	**+24** (2)	**-33** (44)
Site-Specific	unknown	unknown	unknown
State-Wide or Basin-Specific	unknown	unknown	unknown
Multiple Metrics for Data Analysis			
Biology	**+39** (3)	**+5** (11)	**-21** (35)
Habitat	unknown	unknown	unknown

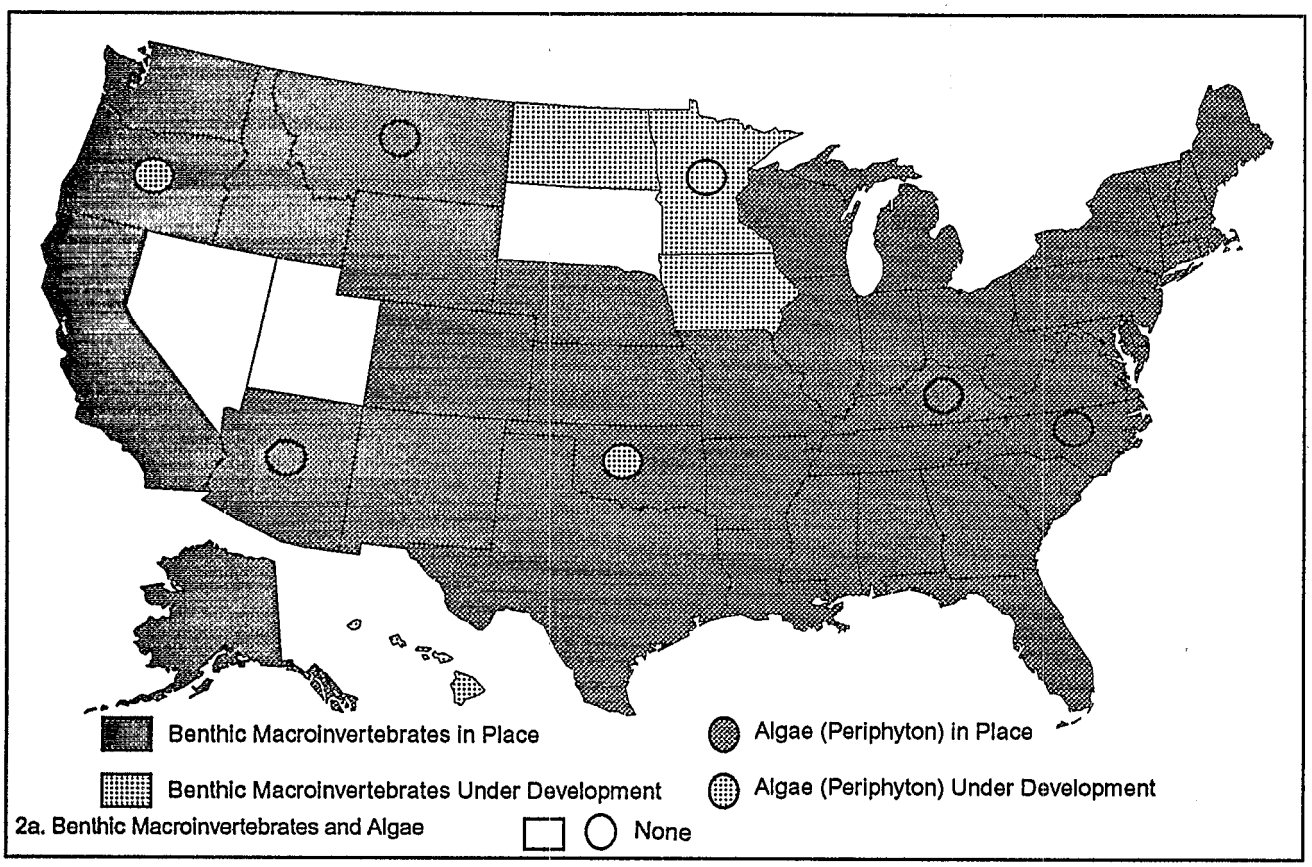


1a. INTERPRETATION OF AQUATIC LIFE USE ATTAINMENT

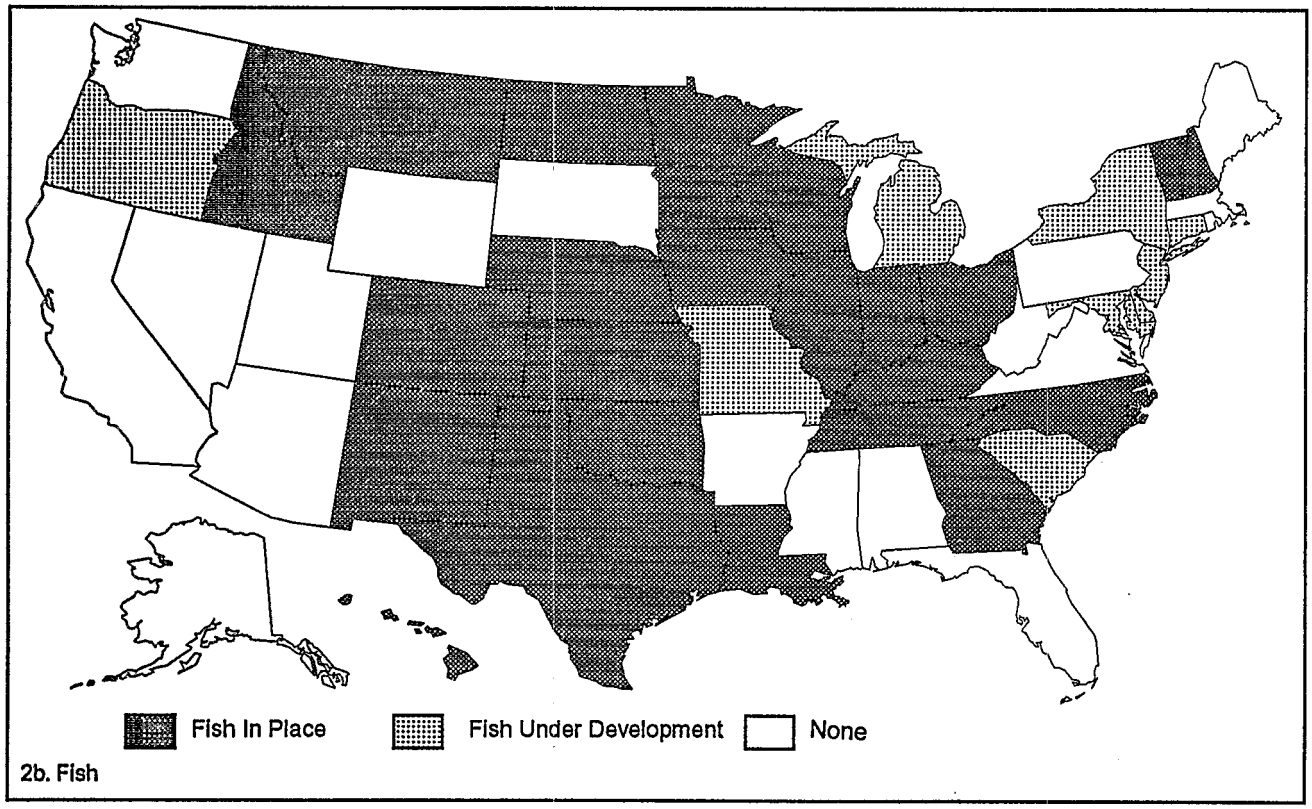


1b. WATER RESOURCE MANAGEMENT (NON-REGULATORY)

Figure 1. Use of Bioassessments in State Water Resource Programs



2a. Benthic Macroinvertebrates and Algae



2b. Fish

Figure 2. Target Assemblages Used or Under Development by State Bioassessment Programs.

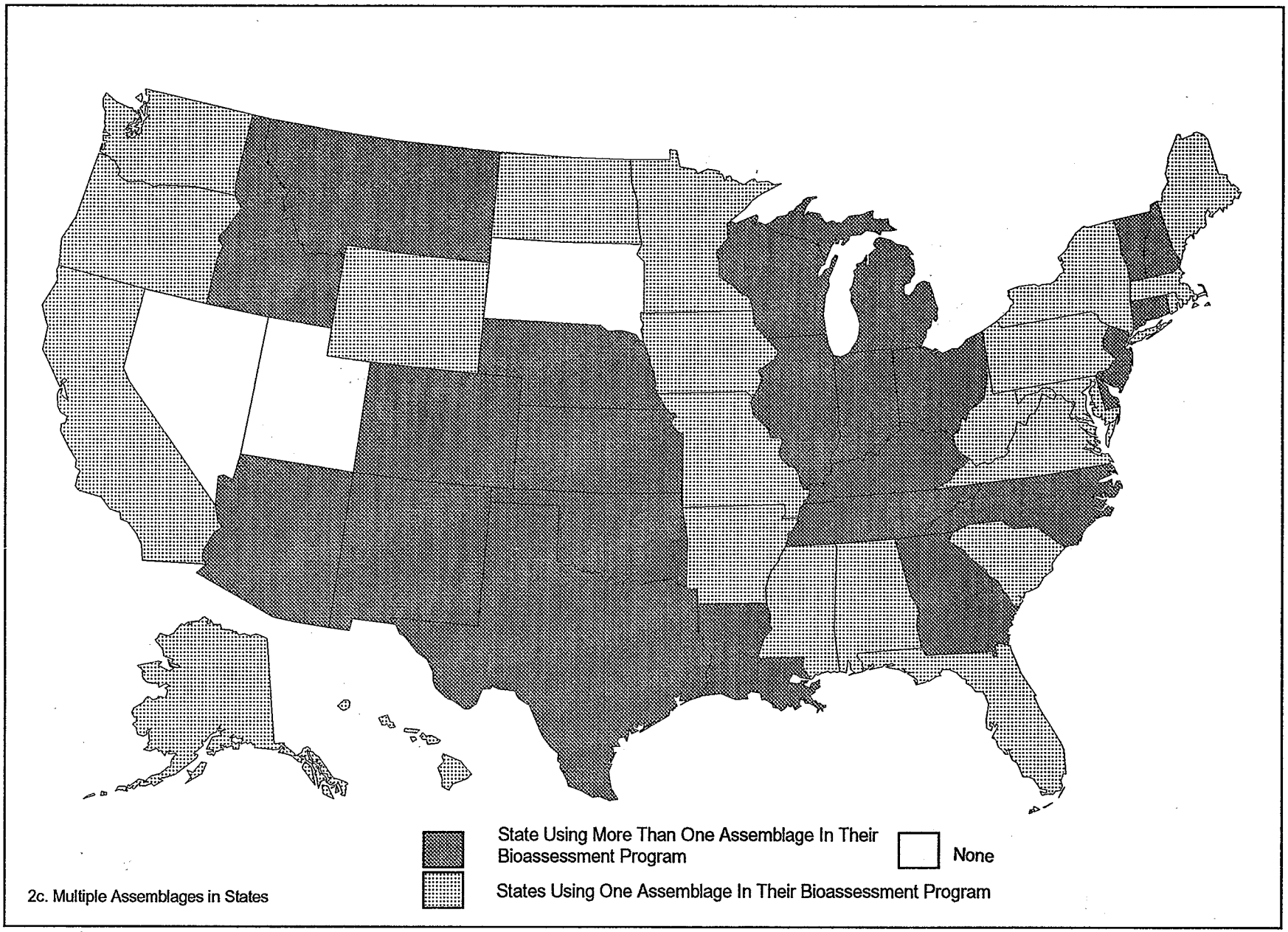


Figure 2 (cont). Target Assemblages Used or Under Development by State Bioassessment Programs

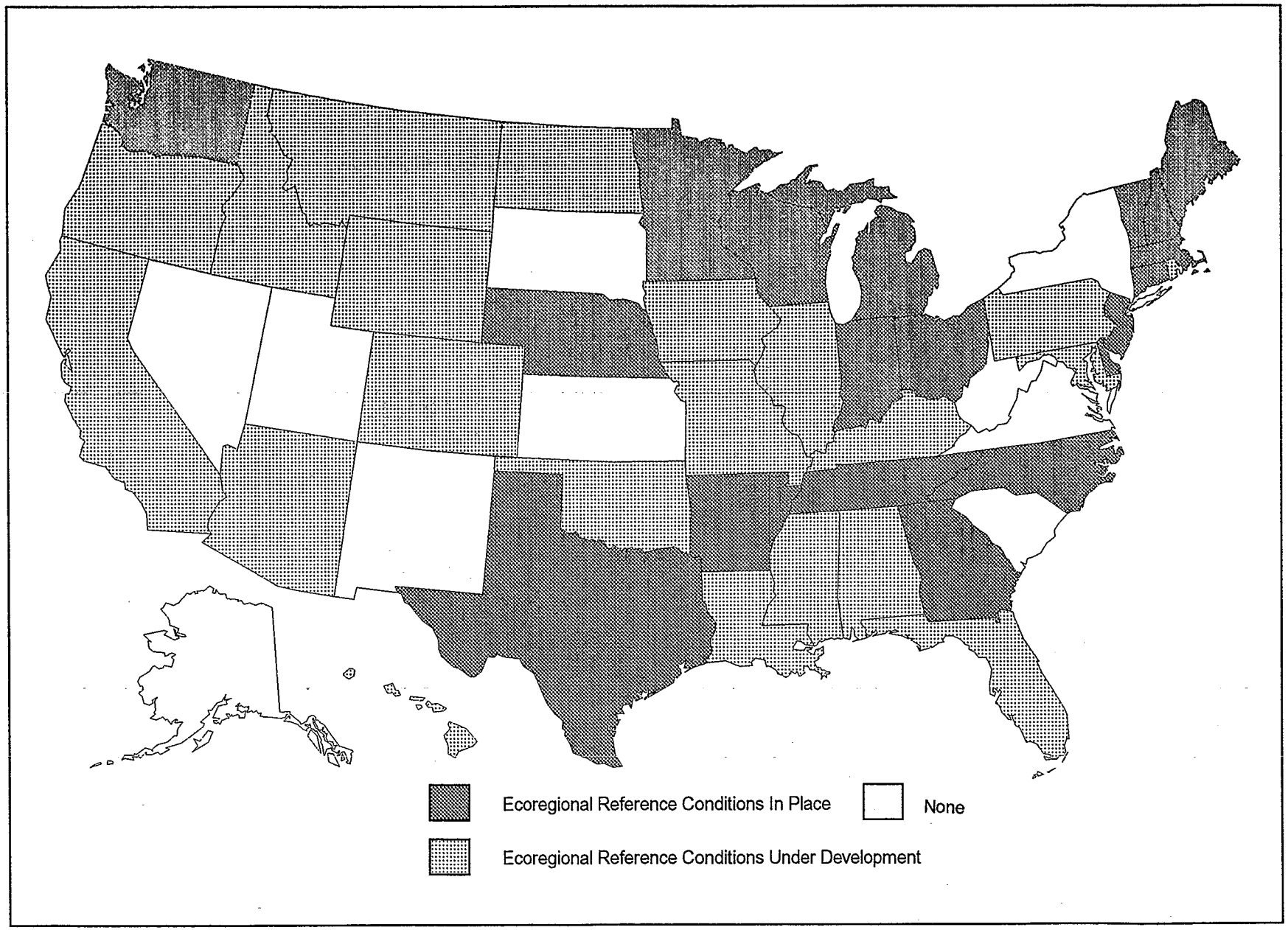
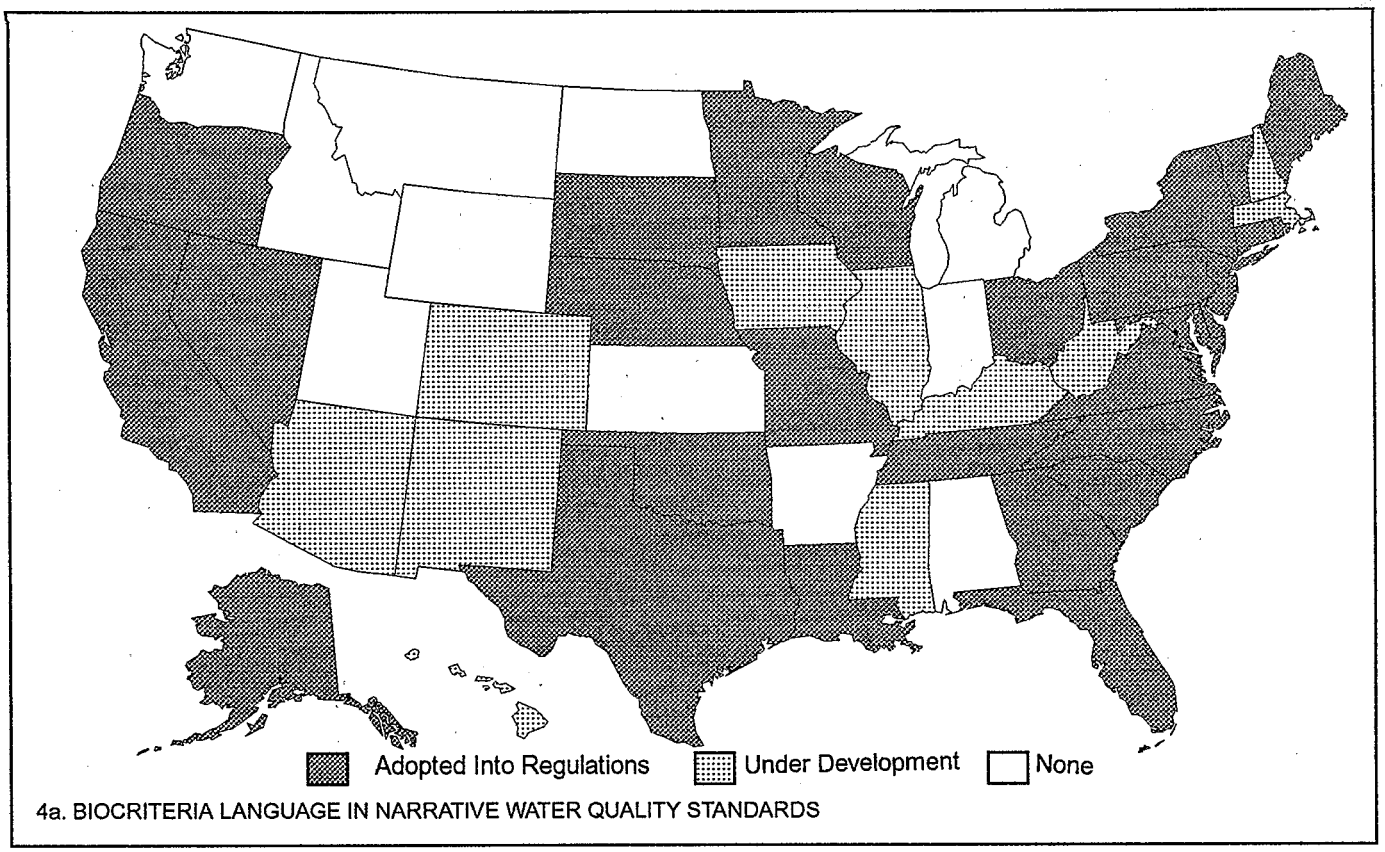
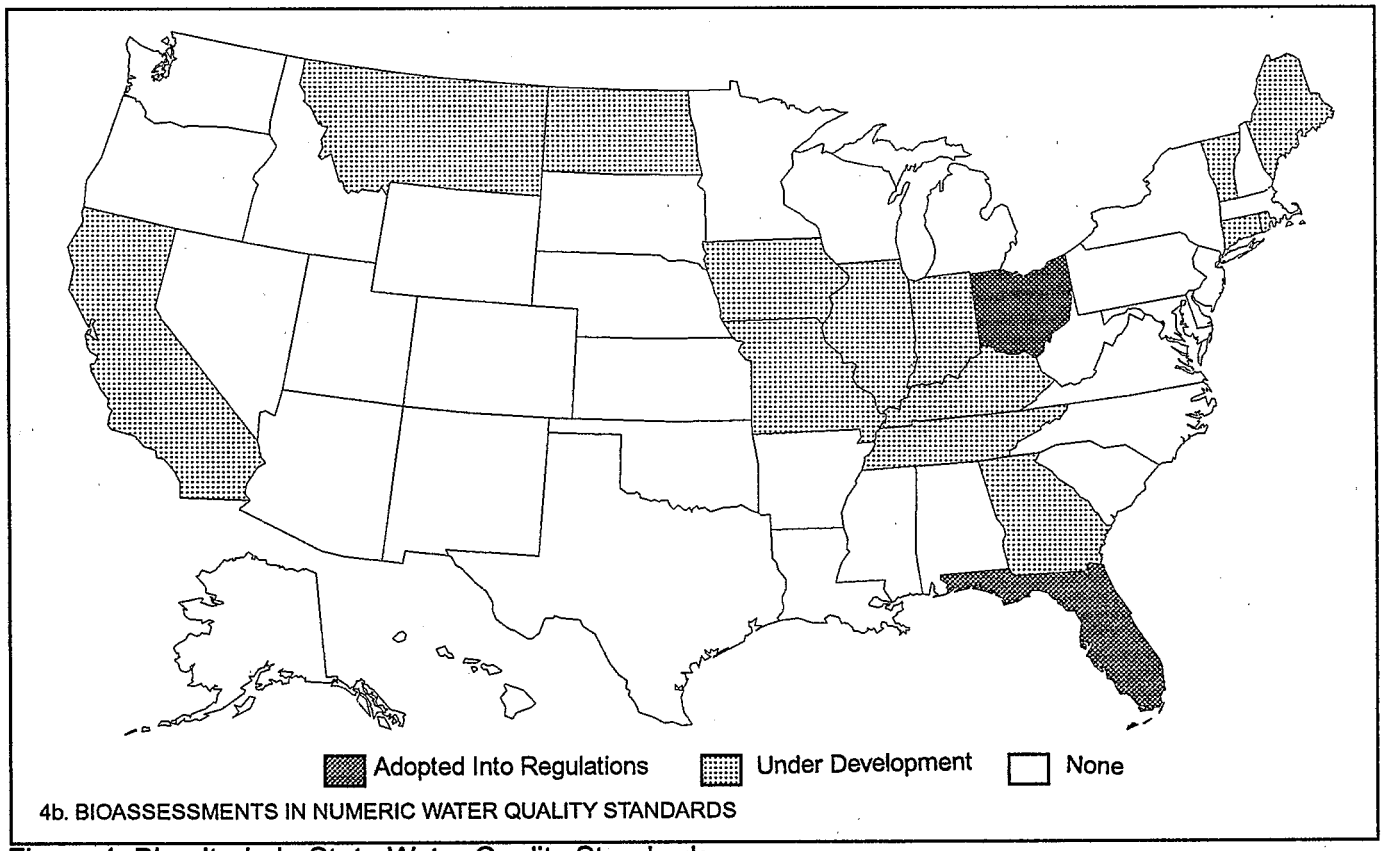


Figure 3. Use of Ecoregional Reference Conditions in State Bioassessment Programs



4a. BIOCRITERIA LANGUAGE IN NARRATIVE WATER QUALITY STANDARDS



4b. BIOASSESSMENTS IN NUMERIC WATER QUALITY STANDARDS

Figure 4. Biocriteria in State Water Quality Standards.

Section 3. Descriptions of State Biological Assessment Programs

3.1 STATE BIOLOGICAL ASSESSMENT PROGRAMS

The following information on the biological assessment programs in each state is current as of December 1995. We attempted to gather as much information as possible to allow for a comparison among states and to describe what changes occurred since the last summary was complied in 1989. We hope this information is used to build upon the strengths in the programs and to correct the weaknesses. State programs are dynamic and new initiatives occur frequently, as do closure of existing initiatives. Please use the names listed as state contacts on the following pages and other contacts listed in Section 6 if you need additional information about these programs.

3.2 METHODS USED IN ASSEMBLING STATE BIOASSESSMENT INFORMATION

State program information was collected by a preliminary assessment of state water quality inventory reports (prepared in fulfillment of 305(b) requirements), and direct contact with the state program management or staff if insufficient information was provided in the 305(b) report. In most cases, state officials initially contacted were from programs focused on regulatory applications or statutory requirements, such as state water quality inventories required under Section 305(b). For other states, a different department, division or unit may have been responsible for collection of monitoring data, using them more for water resource management purposes than for judging attainment of aquatic life designated use for state water quality standards. U.S. EPA Regional contacts were the water monitoring and 305(b) coordinators, regional biologists, and some water quality standards specialists. They were sent initial drafts of the summary table for comment and asked to obtain additional information from the states, and they were sent draft final copies of the report for review. All listed state contacts were asked to review draft and draft final versions of the report.

State Sampling and Analysis Methods

Information on the technical components of state programs (I. e., reference conditions, methods used, assemblage(s) assessed) was obtained either from their 305(b) reports, or more usually, from state protocols documents.

Data Qualifiers

The use of biological assessment data in this analysis (i.e., number of river miles impaired and unimpaired) was based on whether they met several qualifiers that reflect recommendations the Agency is providing for development of biological monitoring programs. These qualifiers were used for biological data captured under the category "Miles Assessed for Biological Integrity".

1) *Community/Assemblage Level Data.* State-supported biological survey information for fish, benthos, or periphyton used in 305(b) reporting or are provided in other state sources. Data NOT included are those from toxicity testing, fish tissue analyses, and single species indicators. Site impairment data from pilot programs are not included, since they are often tentative models of future programs, are often difficult to obtain, and may skew a national assessment by reflecting results only from reference sites.

This qualifier is based on the Agency's endorsement of the multimetric approach for assessing biological condition relative to biological integrity, the maintenance and restoration of which is a primary goal of the

Clean Water Act. The ecological basis and technical rationale for the multimetric approach is presented by Frey (1977), Karr (1981, 1993), Karr and Dudley (1981), Karr et al. (1986), Gibson (1994), and Barbour et al. (1995).

2) *Site Assessments Must Be Performed.* Data may or may not be used strictly for determining aquatic life use attainment; and are included providing that they are community/assemblage level survey information used for determining the level of biological impairment (e. g., impaired, unimpaired, excellent, good, fair, poor, etc).

Biological monitoring results that are used in this analysis have been converted (by the state) into categorical assessments of the biological condition. Categorical assessments result from assigning a narrative classification to a calculated numerical value, such as Ohio EPA's "poor" rating for sites receiving an IBI score in the range of 16-25 (Yoder and Rankin 1995).

3) *Recency of Sample/Data Collections.* Data used are at most five years old, per 305(b) guidelines. Some states use two years of data in their 305(b) reports whereas others use five years (or more) as "monitored" data. Other states are beginning programs and only have limited temporal coverage.

Older bioassessment results are not used because the potential for change in the condition of a site becomes more likely with longer time intervals. If they were used, there would be an increase in the uncertainty associated with aggregation of the results.

4) *Type of Bioassessment.* Rapid Bioassessment Protocol (RBP) levels II and III are appropriate for benthos and are minimally acceptable as are the Index of Biotic Integrity (IBI, and/or RBP V) for fish, and/or a multimetric approach for algae. RBP I and IV are highly qualitative and are not appropriate for use in this compilation.

Data used are from sampling and analysis procedures comparable to, or more sophisticated than (e.g., Ohio EPA's Invertebrate Community Index), the RBPs. Plafkin et al. (1989) presented a general framework for an assessment methodology using fish and benthic macroinvertebrates. The set of protocols consisted of five tiers of assessments:

RBP I - benthic macroinvertebrates; order-level field taxonomy; no standardized level of effort for sampling; requires much "best professional judgment"

RBP II - benthic macroinvertebrates: *field or laboratory taxonomy, family-level*; with standardized level of effort for sampling; assessment decisions based on numerical data

RBP III - benthic macroinvertebrates; *laboratory taxonomy, genus/species-level*; with standardized level of effort for sampling; assessment decision based on numerical data

RBP IV - fish; no sampling, data based on questioning of local citizens, state game & fish biologists, or others that may have familiarity with the site; requires much "best professional judgment"

RBP V - fish; equivalent to the IBI (Karr et al. 1986); standardized level of effort for sampling; assessment decisions based on numerical data

Many states have adapted the specific sampling approach and metrics to be most appropriate for their region and stream types. Though the states have not necessarily indicated that they are using one of the "Rapid Bioassessment Protocols", the monitoring and assessment programs have usually retained basic components of the framework. Some states such as Illinois and Wisconsin conduct genus/species level

macroinvertebrate identifications and employ a long used biotic index developed or modified for that state. These results were included since the states also use other metrics, although less formally applied.

5) *Basis of Impairment Decision.* Assessments should be based upon comparison with a suitable reference condition.

In general, assessments that are strictly derived from upstream-downstream comparisons are not included, although those that use the original RBP guidance of a single representative reference site in a watershed are accepted. Preferred assessments are those that use an ecoregional reference condition or a reference condition developed for some waterbody class. For a discussion of ecoregions, waterbody classification, and reference conditions, see Gallant et al. (1989), Hughes (1995), Hughes et al. (1986, 1990, 1994), Gibson (1994) and Omernik (1995).

6) *Assessment Coverage.* State must provide river miles assessed or number of sites.

To allow the aggregation of state program results, it was necessary that an estimate of stream miles assessed accompany each bioassessment. In some cases, e. g., with the state of Delaware, the program design is based on a probabilistic site selection process, and it is thus, valid to say that 100% of the waters have been assessed. The number of miles assessed, then, is taken to be that representing all non-tidal, freshwater streams, or 2427 miles. If no estimate of stream mileage was given by the state, then a default rule of five miles per assessment site was used, after consultation with the individual states' staff.

7) *Results.* Results must be documented either through specific state 305(b) reports, biological trend reports, written communication, or documented and verifiable telephone contacts.

The sources and hard copy documentation for all information is organized by state in several records notebooks that will be retained by the U.S. EPA. The primary data sources and how they are documented in the records notebooks are:

- State 305(b) report (pertinent pages photocopied)
- State protocols document (pertinent pages photocopied)
- National 305(b) report (pertinent pages photocopied)
- Direct contact with state monitoring personnel (E-mail messages; typed transcriptions of telephone conversations)
- Direct contact with EPA regional 305(b) and/or monitoring coordinators (E-mail messages; typed transcriptions of telephone conversations)

Questions on the results and documentation may be addressed by contacting Wayne Davis, USEPA, Office of Policy, Planning and Evaluation, at 202-260-4906 (phone), 202-260-4903 (fax), or email at DAVIS.WAYNE@EPAMAIL.EPA.GOV.

Table 4. State Bioassessment Programs For Streams (1995).

State	Total Miles (EPA/State) [a]		Miles Assessed-Aquatic Life Use		Miles Assessed-Biological Condition[c]			Biological Indicator			Reference Condition			Multimetric		# of Sites Monitored		Decision Thresholds [d]			
	Total	Perennial	Miles	%[b] Miles	%[b] Miles	Impaired	Not Impaired	Fish	Benthos	Algae	Eco-region	Site-single	Other	Bio	Hab	Ref	Amb	WRM	ALU	WQS	
																				Nar	Num
AK	365,000	-	-	-	pilot studies				√			√		√	√		~25	UD	√	√	
AL	77,274	47,077	11,873	25.1	1.1	85	415		√		UD	√		√	√	25	100	UD	UD		
AR	87,617	28,408	7,231	25.5	special studies				√		√			√				√	UD		
AZ	104,200	3,300	5,472	100	under development				√	√	UD			UD	UD	100	30	UD	UD	UD	
CA	211,513	64,438	11,725	18.3	special studies				√		UD	√		√	√			√		√	UD
CO	105,581	31,415	-	-	under development			√	√		UD			√	√		50	UD	UD	UD	
CT	5,830	5,484	893	16.3	4.7	105.5	188	√	√		UD	√	√	√	√		87	√	√	√	UD
DC	39	-	37	97.4	99	28.9	9.7	√	√			√		UD	UD	3	29	√	√	√	UD
DE	3,158	2,427	894	36.8	100	2063	364	√	√		√			√	√	10	179	√	√	√	
FL	51,858	22,993	11,880	34.5	2.1	320	157		√		UD	√		UD	√	66	69	√	√	√	√
GA	70,150	44,056	-	-	5.8	1835	700	√	√		√	√		√			507	√	√	√	UD
HI	249	249	-	-	pilot studies			√	UD		UD			UD			25	UD	UD	UD	
IA	71,665	26,630	5,702	21.4	19.5	2,413	2,776	√	UD		UD	√		√	√		~390	√	√	UD	UD
ID	115,595	54,948	-	-	not reported			√	√		UD			√	√	60	1170	√			
IL	32,190	30,246	14,159	46.8	25.5	3,839	3,865	√	√		UD		√	√	√		700	√	√	UD	UD
IN	35,673	21,094	7,416	34.8	8.6	729	1,094	√	√		√	√		√	√		341	√	√		UD
KS	134,338	23,731	16,827	70.1	1.6	100.5	292	√	√			√		√	√		36	√	√		
KY	89,431	34,334	14,936	43.5	4.7	260	1,359	√	√	√	UD	√	√	√	UD	45	66	√	√	UD	UD
LA	66,294	32,955	9,164	27.8	pilot studies			√	√		UD			√	√	25		UD		√	

[a]Total and perennial miles, and aquatic life use support, from 1994 National Water Quality Inventory (U.S. EPA 1995). [b] Percent of perrenial miles, or total miles when perrenial miles not available. [c]Refer to the list of qualifiers in Section 3.. Five mile default used for: AL, MD, MI, MS, NY, SC, VA, VT, and WV. [d]Decision Thresholds are based on biological data used to make decisions on: WRM - water resource management (non-regulatory management decisions); ALU - aquatic life use; WQS - water quality standards, narrative and numeric biocriteria. √ = incorporated into program; UD = under development; REF = reference sites; AMB = ambient sites; NR = not reported; not applicable = did not meet minimum requirements as per the attached data qualifiers. ORSANCO = Ohi o River Valley Sanitation Commission.

Table 4 (continued).

State	Total Miles (EPA/State) [a]		Miles Assessed-Aquatic Life Use		Miles Assessed-Biological Condition[c]			Biological Indicator			Reference Condition			Multimetric		# of Sites Monitored		Decision Thresholds [d]			
	Total	Perennial	Miles	%[b] Miles	%[b] Miles	Impaired	Not Impaired	Fish	Benthos	Algae	Eco-region	Site-single	Other	Bio	Hab	Ref	Amb	WRM	ALU	WQS	
																				Nar	Num
MA	8,229	7,133	1,360	19.0	3.9	134	141		√		UD	√		√	√		21	√	√	UD	
MD	17,000	12,343	6,000	35.5	12.2	1,175	325	UD	√		UD	√		√	√		300	√	UD	√	
ME	31,672	23,879	31,656	100	1.3	28	272		√		UD	√	√	√	√	60	71	√	√	√	UD
MI	51,438	29,033	20,575	70.9	9.2	1,535	1,140	√	√		UD	√		√			535	√	√		
MN	91,944	32,985	3,440	10.4	pilot studies			√	UD	UD	√	√		UD		50	57	√		√	
MO	51,015	21,015	21,005	100	not applicable			UD	√		UD	√		UD	UD	180		√		√	UD
MS	84,003	26,454	8,974	33.9	1.4	63	301		√		UD	√		√		15	74	√	√	UD	
MT	176,750	53,221	17,680	33.2	pilot studies			√	√	√	UD			√	√	38	63	√	√		UD
NC	37,536	-	26,063	70.4	18.7	1,914.9	5,104.7	√	√	√	√	√		√	UD		737	√	√	√	
ND	11,868	9840	7,120	72.4	pilot studies			√	UD		UD			√	UD		104	UD			UD
NE	81,573	16,090	7,448	46.3	40.5	4,515	2,006	√	√		√			√	√	17	100	√	√	√	
NH	10,881	8,636	10,841	100	under development			√	√		UD	√		√	√		9	√	√	UD	
NJ	6,450	-	1,617	24.5	8.8	348	222	√	√		√	√		√	√	40	190	√	√	√	
NM	110,741	8,682	4,310	49.6	7.1	304	314	√	√			√		√			58	√	UD	UD	
NV	143,578	14,988	1,440	9.6	not applicable															√	
NY	52,337	46,266	52,337	100	2.1	713	367	UD	√			√	√	√	√		216	√		√	
OH	29,113	27,825	8,337	27.1	28.6	4,905	3,432	√	√		√			√	√	246+	1830	√	√	√	√
OK	78,778	22,386	6718	30	not reported			√	√	UD	UD			√				√		√	
OR	114,823	51,695	-	-	pilot studies			UD	√	UD	UD			√	√	34	128	√		√	

[a]Total and perennial miles, and aquatic life use support, from 1994 National Water Quality Inventory (U.S. EPA 1995). [b] Percent of perrenial miles, or total miles when perrenial miles not available. [c]Refer to the list of qualifiers in Section 3.. Five mile default used for: AL, MD, MI, MS, NY, SC, VA, VT, and WV. [d]Decision Thresholds are based on biological data used to make decisions on: WRM - water resource management (non-regulatory management decisions); ALU - aquatic life use; WQS - water quality standards, narrative and numeric biocriteria. √ = incorporated into program; UD = under development; REF = reference sites; AMB = ambient sites; NR = not reported; not applicable = did not meet minimum requirements as per the attached data qualifiers. ORSANCO = Ohi o River Valley Sanitation Commission.

State	Total Miles (EPA/State) [a]		Miles Assessed-Aquatic Life Use		Miles Assessed-Biological Condition[c]			Biological Indicator			Reference Condition			Multimetric		# of Sites Monitored		Decision Thresholds [d]			
	Total	Perennial	Miles	%[b] Miles	%[b] Miles	Impaired	Not Impaired	Fish	Benthos	Algae	Eco-region	Site-single	Other	Bio	Hab	Ref	Amb	WRM	ALU	WQS	
																				Nar	Num
PA	53,962	39,510	24,948	63.1	5.0	674.9	1,296.6		√		UD	√		√			168	√	√	√	
RI	1,106	979	667	68.1	34.7	79	261		√		UD	√		√	√		56	√	√	√	UD
SC	35,461	25,729	26,314	100	1.2	40	260	UD	√			√			√		60	√	√	√	
SD	9,937	1,932	3,352	-	not applicable															√	
TN	19,124	-	10,907	57	0.5	70.3	36.2	√	√		√	√		√	√		44	UD	UD	√	UD
TX	191,228	40,194	14,324	35.0	not reported			√	√		√			√	√	14	42	√	√	√	
UT	85,916	16,457	5,726	45.9	not applicable																
VA	44,852	44,852	34,575	77.1	2.6	685	460		√			√		√	√		229	√	√	√	
VT	5,264	-	5,264	100	25.0	425	890	√	√		√	√		√	√	30	263	√	√	√	UD
WA	73,886	39,483	7,021	17.8	pilot studies				√		√			√	√	19	87	√			
WI	57,698	32,010	21,411	66.9	16.7	1,419.8	3,915	√	√		√		√	√	√		900+	√	√	√	
WV	32,278	21,114	6,334	25.1	1.5	170	155		√			√		√	√		65	√	√	UD	
WY	113,422	32,520	4,284	13.2	2.2	506	207		√		UD	√		√	√		59	√	√		
ORSANCO	981	981	981	100	100.0	981	0	√	UD		√						25	√	√		
Total	3,542,499	1,182,017	521,268	46.6	8.9	32,465	32,325									831	8980				

[a]Total and perennial miles, and aquatic life use support, from 1994 National Water Quality Inventory (U.S. EPA 1995). [b] Percent of perrenial miles, or total miles when perrenial miles not available. [c]Refer to the list of qualifiers in Section 3.. Five mile default used for: AL, MD, MI, MS, NY, SC, VA, VT, and WV. [d]Decision Thresholds are based on biological data used to make decisions on: WRM - water resource management (non-regulatory management decisions); ALU - aquatic life use; WQS - water quality standards, narrative and numeric biocriteria. √ = incorporated into program; UD = under development; REF = reference sites; AMB = ambient sites; NR = not reported; not applicable = did not meet minimum requirements as per the attached data qualifiers. ORSANCO = Ohi o River Valley Sanitation Commission.

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ALABAMA

Alabama Department of Environmental Management (DEM) monitoring programs integrate chemical criteria, whole effluent toxicity evaluations, and biological assessments to evaluate the water quality of Alabama's surface waters. Biological monitoring allows the assessment of a wide range of stressors and the type of biomonitoring is determined by the primary objectives of each program and the responsibilities of DEM. Benthic macroinvertebrate community assessments have proven to be a cost-effective water quality monitoring tool and as a result, DEM currently conducts macroinvertebrate surveys as part of the ambient monitoring program, water quality demonstration projects, nonpoint source demonstration projects, and other special studies.

A modified multihabitat bioassessment protocol (MBP), based on USEPA's Rapid Bioassessment Protocol III (RBP III), is used to sample wadeable streams. A similar multihabitat bioassessment protocol modeled after the North Carolina Department of Environmental Regulation Multihabitat Assessment of large rivers, is used for nonwadeable streams. DEM standardized procedures include the utilization of the Habitat Assessment Matrix (as described in RBPs for streams and wadeable rivers), and the collection of macroinvertebrate fauna from comparable habitat types present at each monitoring station. A total of 43 wadeable and 6 nonwadeable sites were sampled using MBP during 1993. The biological scoring criteria (as outlined in the RBPs) are currently utilized to evaluate the biotic integrity of each stream in relation to ecoregional reference sites.

A joint ecological reference site development project was initiated in 1990 by Alabama, Mississippi, EPA Region IV and EPA-Environmental Research Laboratory-Corvallis. This pilot project allowed participating states to further refine the largest shared (Alabama/Mississippi) ecoregions and locate candidate reference sites, and provided the groundwork for DEM to independently begin subecoregion-level reference site work. Sites in the Southeastern Plains Ecoregion (Blackland Prairie, Flatwoods Alluvial Margins, Sand Hills, Piedmont, Southeastern Plains and Hills, Southern Pine Plains and Hills, Dougherty/Marianna Plains Subregions), Central Appalachians Ridges and Valleys, Southwestern Appalachians, and Interior Plateau Ecoregions have been visited to determine their suitability as least-impacted reference sites. A total of 33 reference sites are currently sampled on an annual basis.

At present, Alabama has not adopted specific biocriteria. However, to assist in determining support of use classifications, the support/non-support for the aquatic life use designations utilized in the 1992-1993 305(b) report were based upon the Biological Condition Scoring Criteria (Plafkin et al. 1989). Streams falling into the "nonimpaired" bioassessment category are designated as "fully supporting" aquatic life use, and "moderately impaired" streams are designated as "partially supporting". The application of these criteria for use in the 305(b) report was DEM's initial use of ecoregional reference sites to determine overall aquatic life use support.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **ALABAMA**

Contact: Robert W. Cooner

Address: Dept. of Environmental Management
Field Operations Division
P.O. Box 301463
Montgomery, AL 36130-1463

Phone/Fax: (334) 260-2700 / 272-8131

1. Miles assessed as:

Non-impaired	415
Impaired	85
Excellent	—
Good	—
Fair	—
Poor	—
Total	500

2. Number of sites sampled:
   Wadable streams: 38 (1992) - 15 candidate reference
   43 (1993) - 24 candidate reference
   Non-wadable streams: 6 (1993)
   Non-wadable special study stations: 10 (1992)
   3 (1993)

3. Miles per site: 5 mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Modified RBP III = MBP (Multihabitat Bioassessment Protocol); Semi-quantitative collection - Hester-Dendy Multiplate Samplers

6. Decision criteria based on:
   X Reference sites
   UD Ecoregional reference conditions—Number of reference sites 33 sampled annually
   — Other Explain:

7. Data Analysis/Interpretation:
   — Multivariate analysis—Statistical routines used:
   X Multimetric approach—Metrics used or under development:

   Taxa Richness, EPT Index, Chironomid Taxa Richness, Biotic Index, % Contrib. Dominant Taxon, EPT/(EPT+Chironomidae) Sorenson's Community Similarity Index, Quantitative Similarity Indices.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	—	—	—
Numeric (in place)	—	—	—
Under development	—	X	X

9. Pertinent citations: Alabama DEM (1992, 1994a,b, 1995); Harrison (1995a); Hulcher (1995); Sabock (1994); SEWPBA (1995); U.S. EPA (1994a).

10. Comments: Bioassessments conducted during 1992-1993 reporting period. Alabama DEM (1994b) also conducted a trend analysis of their macroinvertebrate assessments at selected stations (1974-1992).

ALASKA

The Alaska Department of Environmental Conservation (DEC) is conducting pilot bioassessments of streams on Admiralty Island and Prince of Wales Island through 319 grant monies. The two projects have been initiated to evaluate USEPA's Rapid Bioassessment Protocols (RBPs) for use in Alaska, especially the southeastern part of the state. Macroinvertebrate communities and habitat are being assessed in order to describe the biological condition of streams and identify impaired waterbodies within the study region.

Specific objectives of the Admiralty Island (Michael Creek) pilot study are to assess the effectiveness of Alaska Forest Practices Act riparian buffers best management practices, and to assess the effectiveness of macroinvertebrates as an indicator of overall stream health. Macroinvertebrate community analysis will include the calculation of community structure metrics, and metric values tabulated for downstream sample locations will be compared to upstream reference values.

Prince of Wales Island pilot studies have been initiated to:

- validate RBPs as appropriate tools for the assessment of stream water quality in Alaska,
- describe the biological condition of Prince of Wales Island reference streams using the multimetric approach,
- assess prevailing condition of Prince of Wales Island streams using RBPs,
- identify impaired streams that will require further evaluation to characterize impairment sources and severity, and
- refine and adapt stream assessment procedures for application in conjunction with current nonpoint source water quality assessment programs.

DEC has initiated discussions with the U.S. Forest Service (Southeast Alaska), National Marine Fisheries Service, and Alaska Fish and Game to foster the development and adoption of a set of multiagency-endorsed bioassessment protocols. At present, DEC has not developed formal biological criteria or incorporated bioassessments into their water quality standards regulations.

The Department does maintain, however, narrative criteria in the water quality standards that prohibit toxic effects on aquatic life in sediments or in the water column (18 AAC 70.020). Some investigators outside the Department (e.g., University of Alaska) have conducted rapid bioassessment surveys in the Anchorage, Fairbanks, and Denali regions. These studies have established a close relationship between pollution and benthic macroinvertebrate community composition that supports the ADEC narrative standard prohibiting toxic effects.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **ALASKA**

Contact: Jeffrey Hock

Address: Alaska Department of Environmental Conservation
Water Quality Technical Services Section
10107 Bentwood Place
Juneau, AK 99801-8552

Phone/Fax: (907) 790-2169

1. Miles assessed as:

Non-impaired	___
Impaired	___
Excellent	___
Good	___
Fair	___
Poor	___
Total	Pilot Studies

2. Number of sites sampled: approximately 25

3. Miles per site: <1

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol III

6. Decision criteria based on:
   - X Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Taxa richness, EPT index, Pinkham-PearsonCommunity similarity index, family biotic index, % contribution of dominant family, % EPT/(EPT + *Chironomidae*)

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	___	X
Numeric (in place)	___	___	___
Under development	___	X	___

9. Pertinent citations: Hayslip (1993); Hock (1995); Redburn (1995); Sabock (1994); U.S. EPA (1994a).

10. Comments: Information on number of sites sampled from D. Redburn, personal communication. Additional investigations of the utility of RBP's have been conducted by Environmental and Natural Resources Institute (ENRI), of University of Alaska Fairbanks -- streams studied in Anchorage vicinity.

ARIZONA

The Arizona Department of Environmental Quality (DEQ) has implemented a plan for the eventual development of narrative biological criteria, and incorporation of the criteria into state water quality standards. Initial program efforts have focused on small to medium-sized perennial waters, with approximately 100 streams statewide sampled from 1992-1995. These streams, along with 14 sites sampled within Grand Canyon National Park by Park Service personnel, are intended to be reference sites or representative least-impacted streams within their respective regions. A few additional locations with known sources of impact have been sampled to serve as comparisons to the least-impacted sites. Sites were not selected on the basis of ecoregion designation, but rather were selected to provide as broad a coverage as possible with an even distribution among Arizona's major river basins.

Current reference condition development efforts focus on testing the adequacy of the ecoregion approach for differentiating among macroinvertebrate communities throughout the state. Data will be collected from least-impacted/reference sites for three to five years before narrative biological criteria are developed. The multiple-year data set will be used to address temporal biological variation, and will ultimately comprise the reference conditions for Arizona.

Since the present knowledge of the non-fish aquatic resources is limited, the bioassessment program is in a biological inventory phase. Macroinvertebrate kick samples and algal (periphyton) rock scrapings have been collected for three years (1992-1994), and DEQ is beginning to process the data and consider biological metrics. Candidate biological metrics have not yet been individually tested for their ability to distinguish biological impairment or ecoregional differences.

Bioassessments of macroinvertebrates and algae, along with assessments of stream habitat (i.e., habitat evaluation as per U.S. EPA Rapid Bioassessment Protocol guidance) are intended to be used to: develop an inventory of aquatic biological resources in Arizona streams; evaluate various assessment methods; investigate biological community-habitat relationships; identify regional differences in community structure; and develop narrative biocriteria for inclusion in Arizona water quality standards. The present bioassessment program is the initial step toward the development of narrative biocriteria in Arizona, and as the program develops, ADEQ plans to expand its scope to develop numeric biocriteria for perennial streams as well as other waterbody types (e.g., large rivers, intermittent, effluent-dominated, and ephemeral streams).

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **ARIZONA**

Contact: Patti Spindler

Address: Arizona Dept. of Environmental Quality
Water Quality Standards Unit
3033 North Central Avenue, 3rd Floor
Phoenix, AZ 85012

Phone/Fax: (602) 207-4543/4528

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Under Development

2. Number of sites sampled: 30 sites for Verde River bioassessment project

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; periphyton

5. Sampling gear or Method: Benthic macroinvertebrates = D-frame kicknet
   Periphyton - Cobble/gravel scrapings

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites 90-100
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - UD Multivariate analysis—Statistical routines used: Canoco; cluster analysis
   - UD Multimetric approach—Metrics used or under development:

Family HBI. Considering: species richness; EPT;
EPT/Chironomidae; scrapers/filterers; shredders/total; % contribution dominanat 5 taxa; Shannon-Wiener diversity index; % Hydropsyche/Trichoptera; % Baetidae/Ephemeroptera; % Tanytarsini; % Chironomidae; % Simuliidae; % Diptera+non-insect taxa.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	___	___
Numeric (in place)	___	___	___
Under development	X	X	X

9. Pertinent citations: Meyerhoff and Spindler (1994); Sabock (1994); Spindler (1995a,b); U.S. EPA (1994a).

10. Comments: 1995 represents fourth year of sampling. Initiated analysis of 3 years of reference sire data, and development of reference site database. Sampling for first assessment begun in Verde River watershed, spring 1995.

ARKANSAS

The Arkansas Department of Pollution Control and Ecology (ADPCE) has, since the 1970s, used bioassessments to investigate point source pollution, nonpoint source pollution, and water quality trends. Pilot studies initiated by the ADPCE Biomonitoring Section, focus on the evaluation of bioassessment techniques, the design of a biological metric scoring system, and the development of biocriteria for the determination of aquatic life use status. The ADPCE biological metric scoring criteria, based on aquatic macroinvertebrate community measures, follow the technical guidance of U.S. EPA's Rapid Bioassessment Protocols (RBPs). Semi-quantitative and qualitative measures of stream macroinvertebrate communities are utilized in metrics representative of community diversity, indicator organism, and functional group approaches.

ADPCE biomonitoring stations are chosen on a priority basis and are primarily at streams possessing high resource values and/or potential for water quality impairment. A priority list aids in the selection of monitoring locations, and is formulated from information such as discharge monitoring reports, knowledge of potential sources of pollutants, and land use information. Current bioassessment program emphasis is on pollution point sources.

Arkansas has identified and conducted extensive research on the least-disturbed streams within its ecoregions, and combines an ecoregional reference and paired-station approach to bioassessments. Paired stations or sample sites that bracket pollutant sources not only examine site-specific changes in water quality, but also compare biological communities within the same ecoregion. ADPCE also uses habitat evaluations to verify whether significant differences between biological communities are attributable to habitat or to water quality. Field habitat measures, maps, aerial photos, discharge permit information, and discharge monitoring reports form the basis of the habitat evaluation; and prior knowledge of land uses, potential pollutants, gradient, ecoregion and watershed size facilitate the consistency of sampling effort and the selection of sample sites.

Bioassessments in Arkansas are used in a decision matrix for impact identification which triggers further investigative action (e.g., chemical analysis of water, sediment, fish tissue; toxicity testing). The use of bioassessments and resulting biocriteria as a permit limit or water quality standard is in the proposal stage. Arkansas water quality standards provide for the protection and propagation of fish, shellfish and other forms of aquatic life through protection of fisheries use. The inclusion of macroinvertebrate biocriteria as a water quality standard are intended to enhance protection of fisheries uses and provide a measure of alterations of biological properties. The application of biocriteria is being proposed to aid in the determination of aquatic life use status of Arkansas streams. Streams falling into the "non-impaired" bioassessment classification would be designated as "fully supporting" aquatic life use. Locations rated as "minimally impaired", "substantially impaired", or "excessively impaired" would designate aquatic life use full, partial, and non-support, respectively.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **ARKANSAS**

Contact: John Giese

Address: Arkansas Dept. of Pollution Control & Ecology
8001 National Drive
Little Rock, AR 72219-8913

Phone/Fax: (501) 570-2121

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Not Reported

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol-Type (RBP precursor - RBP II equivalent)

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Dominants in common; Common Taxa Index, Quantitative Similarity Index; Taxa Richness; Indicator Assemblage Index; Missing Genera; Functional Group Percent Similarity.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	X	___
Numeric (in place)	___	___	___
Under development	___	___	X

9. Pertinent citations:; Arkansas DPCE (1994); Giese (1995); Sabock (1994); Shackleford (1988); U.S. EPA (1994a).

10. Comments: Once regarded as a model state program, bioassessments have not been widely used recently. There is no current data on stream health.

CALIFORNIA

The California Department of Fish and Game (CDFG) Water Pollution Control Laboratory uses chemical, toxicological, and biological techniques to assess status, damage, and monitor recovery of California streams. In December 1993, CDFG released a bioassessment plan consisting of a regional modification of U.S. EPA's Rapid Bioassessment Protocols (RBPs). These "California Stream Bioassessment Procedures" (CSBP) outline benthic macroinvertebrate sampling, macroinvertebrate laboratory analysis, and field and laboratory quality control procedures.

Current CSBP pollution point source monitoring strategies call for the comparison of macroinvertebrate kick samples from downstream (affected) sections and upstream (unaffected) sections of stream with homogenous gradient, substrate, and habitat condition. CDFG conducts a RBP habitat assessment at each sampling site if they have not previously collected habitat information from the location using their fisheries protocol quantitative habitat assessment procedures. The non-point source monitoring strategy calls for the comparison of macroinvertebrate communities from potentially impacted streams to communities from a local reference stream (or stream section) of similar habitat condition and channel type. All macroinvertebrate data are analyzed using the multimetric approach as recommended in the U.S. EPA biological criteria technical guidance document for streams and small rivers.

The CSBP has been successfully used to assess point source pollution of organic enrichment and inorganic sediment. Currently, the CSBP is being tested in pilot programs to assess biological condition of streams influenced by timber harvest practices, and to develop biocriteria as a water quality management tool in the Consumnes and Russian River basins. Specific pilot programs initiated during 1995 include: Consumnes River bioassessment and biocriteria development; Watershed Academy to train the timber industry in bioassessment protocols; Russian River bioassessment and development of citizen monitoring quality control procedures; Auburn River bioassessments to evaluate effluents and develop biocriteria for Sacramento Valley urban streams; and bioassessments of wild trout streams (i.e., potential reference streams for biocriteria development) for CDFG Inland Fisheries Division.

At present, California does not incorporate bioassessment results into aquatic life use attainment designations. CDFG, in cooperation with the State Water Resources Control Board and funding from U.S. EPA, has formed the California Aquatic Bioassessment Workgroup: to facilitate the development of ecoregional reference conditions, bioassessment procedures, and biocriteria; and to review and distribute standard procedures for bioassessments of California waters. The state has also formed an ecoregion workgroup with U.S. EPA and the Forest Service to begin work on the establishment of ecoregional reference conditions for streams.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **CALIFORNIA**

Contact: Jim Harrington

Address: California Fish and Game Department
Water Pollution Control Laboratory
2005 Nimbus Road
Rancho Cordova, CA 95670

Phone/Fax: (916) 358-2858/985-4301

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Under Development

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: California Stream Bioassessment Procedures (CSBP) (Regional Application of Rapid Bioassessment Protocol III)

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Species Richness; Modified Hilsenhoff Biotic Index; % Contribution of Dominant Taxon; EPT Index; Community Similarity Index; Diversity Index.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	___
Numeric (in place)	UD	___	___
Under development	___	___	___

9. Pertinent citations: California Dept. of Fish & Game (1995); Harrington (1995a,b); Sabock (1994); U.S. EPA (1994a).

10. Comments: CSBP released in December 1993 and revised in March 1995. Pilot programs in 1994 & 1995: Consumnes River Bioassessment and Biocriteria Development; Watershed Academy; Russian River Bioassessment; Auburn River Bioassessment; and Bioassessment of Wild Trout Streams.

COLORADO

Starting in 1992 the Water Quality Control Division of the Colorado Department of Public Health and Environment has shifted its emphasis from statewide monitoring to a watershed-specific approach. This approach provides more comprehensive information about the water quality and biological conditions within any one basin by focusing the majority of the Division's resources in that basin. Each of the major basins in Colorado will be revisited on a six-year cycle. The Rio Grande basin, and the Arkansas River basin have been completed. The Division is currently assessing the lower Colorado River Basin and the Gunnison River Basins. A number of programs participate in this watershed effort including the standards and nonpoint programs.

In addition to water quality sampling, one of the main objectives of this approach is to build a database for biological water quality criteria (biocriteria) for streams and lakes. It will be used to develop biocriteria for possible adoption as stream standards and to evaluate the appropriateness of the existing aquatic life use classifications. The sample plan for developing this data set is based upon selecting approximately 50 reference stream sites and six lake/reservoir sites for each of the major river basins. Selection of sites is based upon a regional approach, with least impaired sites selected to represent as many of the ecological subregions (EPA) as are found in each of the basins.

The following information is gathered at each site if it is not already available from other studies or agencies:

1. Identification and enumeration of macrobenthos in standardized traveling kick net samples in riffles, equivalent to level 3 of EPA's Rapid Bioassessment Protocols;
2. Identification, enumeration and length/frequency of fish in standardized samples (equivalent to RBPV);
3. Assessment of physical habitat with modified RBP rapid habitat protocols, supplemented with standardized pebble counts and instantaneous stream flow measurements; and
4. Trophic status of lakes/reservoirs is determined with Carlson's TSI based on chlorophyll a, total phosphorus, and Secchi disk. Profundal benthos are collected in ponar samples and identified and enumerated.

Bioassessments on a variety of stream types using the same protocols is also used by the standards program to evaluate the aquatic life use classifications and use attainability and by the nonpoint source program in project monitoring.

The nonpoint source program within the Colorado Department of Health Water Quality Control Division (WQCD) is conducting pilot biological assessments and habitat characterizations based on U.S. EPA's Rapid Bioassessment Protocols. The pilot studies focus on Cherry Creek and South Platte River, with the primary goal being the identification of nonpoint source pollution impacts. Approximately 100 sites in the Denver vicinity are being studied using physical, chemical, and bioassessment techniques. The pilot study is somewhat unique due to the intensity of the sampling effort within an urban area (i.e., 100 sites sampled four times per year along an approximate 15 mile length of stream). Locations of the monitoring sites were selected to specifically bracket stormwater outfalls or other pollution point sources. WQCD will use the data in conjunction with land use information to identify and prioritize the most impaired areas in the Denver vicinity.

At present; Colorado is developing statewide bioassessment procedures but has not developed formal biological criteria. However, the WQCD does use biological information from a variety of sources (e.g., Water Quality Control Division special studies, Superfund/NRDS studies, Colorado Nonpoint Assessment Reports) to supplement or reinforce water quality information in the determination of the intensity of designated aquatic life use impairment. When the survival, propagation, production, dispersion, community structure, and/or species diversity of aquatic life is protected within the limits of the physical habitat, full support of designated uses is implied. However, nonsupport of aquatic life uses is indicated when any or all of the above biological components are impaired and are coupled with state-prescribed water quality standard exceedances.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **COLORADO**

Contact: Bob McConnell

Address: Colorado Dept. of Public Health and Environment, Water Quality Control Division
4300 Cherry Creek Drive, South
Denver, CO 80222-1530

Phone/Fax: (303) 692-3578

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Under Development

2. Number of sites sampled: 50 per basin for ecoregional reference conditions

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates, fish

5. Sampling gear or Method: Rapid Bioassessment Protocol III

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites about 50 per basin
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - UD Multimetric approach—Metrics used or under development: Biological and Habitat

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	___	___
Numeric (in place)	___	___	___
Under development	X	X	X

9. Pertinent citations: McConnell (1995); Sabock (1994); U.S. EPA (1994a, d).

10. Comments: Pilot studies conducted on a watershed basis.

CONNECTICUT

The Connecticut Department of Environmental Protection, Bureau of Water Management (CTDEP/BWM), has utilized ambient biological monitoring of benthic macroinvertebrates to evaluate water quality in wadeable streams since 1973. Sampling methods initially consisted of Surber samplers and multiple-plate artificial substrates. Bioassessments were based on the evaluation of community structure parameters and derived indices. U.S. EPA's Rapid Bioassessment Protocol III (RBP III) was incorporated into the program in 1987 and adopted as the primary assessment method in 1989.

The CTDEP/BWM routinely utilizes the bioassessment process to evaluate spill incidents, pollution source impacts, and effectiveness of waste treatment installations. Benthic invertebrate community data has been collected to date at 219 sites on 76 waterbodies, and a fixed network is maintained that consists of 50 sites on 34 waterbodies that are visited on a rotating schedule. Intensive basin surveys are conducted as needed. Twelve monitoring sites have been identified as reference sites, six of these are utilized as primary reference sites for RBP III assessments.

Narrative biological criteria for benthic macroinvertebrates in wadeable streams were adopted into Connecticut Water Quality Standards in 1987. Work was initiated to develop numeric biological criteria in 1989 and continues as limited resources permit. In 1989, macroinvertebrate community data were employed to assess aquatic life use support and impairment at 22 sites in support of numeric criteria development for copper and zinc based on ambient water quality monitoring.

Connecticut's 305(b) reports have directly incorporated biomonitoring information as a measure of aquatic life use support since 1988; however, the bioassessment program continues to be subject to sever resource constraints (1-2 FTE). The bioassessment program relies heavily on macroinvertebrate community data, but fish community assessments are also utilized whenever possible. Fish community information is obtained through cooperation with the CTDEP Fisheries Division. Analyses of contaminants in fish and invertebrate tissues are also incorporated into both 305(b) and other assessments.

STATE: **CONNECTICUT**

Contact: Earnest Pizzuto, Guy Hoffman

Address: Bureau of Water Management PERD
Connecticut Dept. of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Phone/Fax: (860) 424-3715 , 3733; (860) 566-8650 (fax)

1. Miles assessed as:

Non-impaired	188
Impaired	105.5
Excellent	—
Good	—
Fair	—
Poor	—
Total	293.5

2. Number of sites sampled: 87

3. Miles per site: 3.4, but variable and site specific

4. Assemblage(s): Benthic macroinvertebrates; fish (not reported)

5. Sampling gear or Method: Rapid Bioassessment Protocol III

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrate: Taxa Richness, Hilsenhoff Biotic Index (modified), ratio of scrapers/filterer-collectors, ratio of EPA and chironomid adundance, % contribution of dominant taxon, EPT index, community loss index

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Connecticut DEP (1992); Pizzuto (1995); Sabock (1994); Switzer (1995); U.S. EPA (1994a).

10. Comments: Numbers represent 5 year period prior to spring 1995. Fisheries studies conducted by the CDEP Fisheries Division.

DELAWARE

The Delaware Department of Natural Resources and Environmental Control (DNREC) bioassessment program focuses on overall assessment of non-tidal streams. The DNREC assesses these streams with application to the biennial water quality assessment reporting process, management of water resources, and as a tool for determining nonpoint source impacts to streams. The bioassessment program has been in existence for nearly five years, and standard operating procedures are at present being finalized. The objective of the bioassessment program is to establish narrative and numeric biocriteria in state water quality standards. These biocriteria will in the future be used to identify and control activities the impact designated uses.

The DNREC bioassessment program began with the sampling of invertebrate communities at 93 locations in Kent and Sussex Counties during 1991. A total of 96 sites were surveyed during 1993, and all surveys (during survey years) included habitat quality measurements. The primary objective of the studies was to provide an assessment of the biological and habitat condition of nontidal streams throughout the state. A secondary objective was to quantify the relationships between biological quality using macroinvertebrates and habitat quality.

DNREC habitat assessment procedures follow the technical guidance of USEPA's Rapid Bioassessment Protocols (RBPs), with some modifications. Habitat scores are compiled separately for the Northern Piedmont and Coastal Plain regions. Canonical correlation analysis is used to identify reference sites according to habitat and biological variables. Site scores were divided by reference values to provided a "percent of reference" final score.

Biological assessment procedures follow RBP guidance and focus on the macroinvertebrate community. In the Piedmont Region, collection methods are the same as those contained in the RBP guidance. In the Coastal Plain Region, collection methods utilize procedures developed in conjunction with several other states in USEPA Regions II, III, and IV. The Mid-Atlantic Coastal Streams workshop has established a standardized macroinvertebrate method consisting of 20 "jabs" with a D-frame net in stable and productive habitats. DNREC uses a probability-based design to select sampling stations for 305(b) reporting. The primary advantage to using this statistical approach is that results obtained at a subset of sites can be applied to the larger total complement of streams with a greater degree of confidence.

Multiple sources of impairment (including various chemical stressors and habitat degradation) have been detected using the DNREC approach to water quality assessment. Impairment of aquatic life use attainment is determined using the reference condition as a point of comparison. Site are ranked as good, fair, or poor based on biological quality (percent of reference). Values in the "good" range are comparable to the reference and indicate high quality. Whereas, values in the "poor" range are not comparable to the reference and indicate severe degradation. And site values rated as "fair" are moderate in quality as compared to the reference.

STATE: **DELAWARE**

Contact: John Maxted

Address: Delaware Dept. of Natural Resources & Environmental Control
P.O. Box 1401
84 Kings Highway
Dover, DE 19903

Phone/Fax: (302)739-4590/6140

1. Miles assessed as:

Non-impaired	364
Impaired	2,063
Excellent	—
Good	—
Fair	—
Poor	—
Total	2,427

2. Number of sites sampled: 179 plus 10 reference (93 sites in 1991; 96 sites in 1993)

3. Miles per site: Probability design (100 meters per station)

4. Assemblage(s): Benthic macroinvertebrates; Fish (not reported)

5. Sampling gear or Method: D-frame dipnet; 20- jab method; 100 organism subsample; Rapid Bioassessment Protocol II

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites 10
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - Taxa Richness; EPT; % EPT; % Dominant family; % *Chironomidae*; Family Biotic Index; BCI.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Delaware DNREC (1994); Maxted (1994, 1995a,b); Sabock (1994); Shaver, et.al. (draft manuscript); MACS (1993, draft); U.S. EPA (1994a).

10. Comments: Numbers represent information (for 1991-1993 bioassessments) as per John Maxted. State program moving toward use of RBP III.

DISTRICT OF COLUMBIA

The District of Columbia Department of Consumer and Regulatory Affairs, Environmental Regulation Administration, Water Resources Management Division (WRMD) surface water quality standards include an aquatic life use class designation to assure the protection and propagation of fish, shellfish and wildlife. The District's chemical, physical and hydrological programs are by themselves inadequate to protect or determine aquatic life use. Fish are systematically sampled by the District's Fisheries Management Division; however, the data are primarily applicable to resource management, not water quality monitoring. WRMD collects monthly plankton samples from the Anacostia and Potomac Rivers; however, the resulting data are not yet in a form that can be used for assessments. The indicator assemblage chosen by WRMD for bioassessments is the macroinvertebrate community.

District-wide bioassessments were initiated during 1992 and 1993 through a grant from WRMD. The intensive surveys used U.S. EPA Rapid Bioassessment Protocols (RBPs) (combined with physical and chemical data) to assess most (29) of the District's surface streams. Approximately 150 measurements or metrics were determined for each monitoring site and compared to three least impaired reference sites to estimate biological and habitat quality (based on RBP technical guidance). This initial effort was used to: establish a specific methodology for future assessments; characterize available habitat and habitat degradation; establish baseline for stream monitoring and appraisal of future remediation efforts; and help locate areas of significant biological impact.

The District now uses bioassessment data for water resource management and to aid in the evaluation of aquatic life use attainability. In some cases, WRMD relies on bioassessments rather than chemical/physical standards to make aquatic life use decisions. Aquatic life use determinations (based on RBP data) are made using the following criteria:

- when reliable data show that the biological community has not been modified beyond the natural range of the reference condition, full support of aquatic life use is indicated,
- when at least one biological assemblage indicates less than full support with slight to moderate modification of the biological community, partial support of aquatic life use is indicated, and
- when data clearly show severe modification of at least one assemblage of the biological community, non-support of aquatic life use is indicated.

STATE: **DISTRICT OF COLUMBIA** Contact: Hamid Karimi

Address: Chief, Water Quality Monitoring Branch
DC Environmental Regulation Administration
Dept. of Consumer & Regulatory Affairs
2100 Martin Luther King, Jr. Avenue, SE
Washington, D.C. 20020-5732

Phone/Fax: (202) 645-6601

1. Miles assessed as:

Non-impaired	9.7
Impaired	28.9
Excellent	—
Good	—
Fair	—
Poor	—
Total	38.6

2. Number of sites sampled: 29

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; fish

5. Sampling gear or Method: Rapid Bioassessment Protocol III

6. Decision criteria based on:
   - X Reference sites (3 reference streams)
   - __ Ecoregional reference conditions—Number of reference sites __
   - __ Other Explain:

7. Data Analysis/Interpretation:
   - __ Multivariate analysis—Statistical routines used:
   - UD Multimetric approach—Metrics used or under development: Biological and Habitat RBP III used for Aquatic Life Use Support decisions.

   Macroinvertebrates - Taxa richness; modified HBI; Ratio of scrapers/filterers; Ratio EPT/chironomid abundance; % contribution dominant taxon; EPT; community loss index; Ratio of shredders/total.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9 Pertinent citations: Banta (1993); District of Columbia, Dept. of Consumer and Regulatory Affairs (1994); Karimi (1995); Sabock (1994); U.S. EPA (1994a).

10. Comments: Bioassessments conducted January 1992 to March 1993. RBP III used for Aquatic Life Use Support decisions.

FLORIDA

The Florida Department of Environmental Protection (DEP) has established a Surface Water Ambient Monitoring Program (SWAMP) for the purposes of :

- identifying and documenting prevailing surface water conditions,
- determining trends in surface water quality and documenting problem areas,
- determining support of water quality criteria,
- establishing stream ecoregion reference sites, and
- providing information for management, legislators, other agencies and the public.

DEP primary strategies for monitoring include the determination of ecoregion subregions and the development of community bioassessment protocols. Standard operating procedures have been written for laboratory and sample collection activities. DEP bioassessment protocols provide a multi-metric assessment methodology for evaluating Florida streams. The subregionalization of Florida from three ecoregions to 13 subregions has also been completed. Reference sites were established on 66 streams for use in development of community bioassessment protocols. The sites were selected to represent least-impacted or background sites for each of the subregional types, and were sampled two times per year (winger and summer). The goal of this sampling effort was to determine the best quality macroinvertebrate community present for the representative habitat and water chemistry.

Currently, Florida DEP has established a fixed-station network for monitoring reference sites scattered throughout three aggregated subecoregions. The reference condition developed from a composite of the reference sites within each of the three subecoreginal groupings is used to characterize a multimetric biological index for assessing impairment to Florida's streams. This monitoring approach, which is based on macroinvertebrate assemblage, is used to asses the condition of streams as part of the nonpoint source program and is used as a benchmark for assessing condition in the point-source program.

Macroinvertebrate assessment results are also used in the process of determining aquatic life use support. During the 1994 Water Quality Assessment reporting period, macroinvertebrate community information was used to assess aquatic life use support for a total of 69 watersheds. Biological-based water rules for Florida involve three major lines of evidence which include: determination of biotic integrity of a site, dominance of nuisance species, and imbalance of flora and fauna. The biological criteria protecting biotic integrity are based on Shannon-Weaver Diversity Index values for macroinvertebrate communities (sampled via Hester-Dendy type artificial substrate samplers). Community imbalance is defined as a 25% departure from reference conditions that is a 25% reduction in the diversity index from established background levels.

Stream monitoring in Florida will add a site randomization aspect, which is intended to enable a more accurate assessment of biological condition throughout the state. Fixed reference stations have been randomly selected to be sampled on a 5-year rotational cycle. In addition, 75% of the monitoring effort in any given year will focus on non-reference sites that will be randomly chosen for assessment. This monitoring approach of sampling both reference and non-reference sites in a random manner will provide data on the status of the reference database as well as a statewide assessment of biological condition and impairment.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **FLORIDA**

Contact: Ellen McCarron

Address: Florida Dept. of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Phone/Fax: (904) 488-0782/6579

1. Miles assessed as:

Non-impaired	157
Impaired	320
Excellent	—
Good	—
Fair	—
Poor	—
Total	477

2. Number of sites sampled: 69

3. Miles per site: Average is 7.2 miles per site

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol III
(currently testing difference between 20-jab method and artificial substrates).

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites 66
   - — Other Explain:

7. Data Analysis/Interpretation:
   - — Multivariate analysis—Statistical routines used:
   - UD Multimetric approach—Metrics used or under development:

   Biological and Habitat. Macroinvertebrates - Number of taxa; EPT; Number of Chironomidae taxa; Number of Crustacean/Mollusc taxa; Shannon-Wiener Index; % Dominant taxon; % Diptera; % Crustacan/Mollusc; Florida Index; % Class I and Class II; Hilsenhoff Biotic Index; % Collector-Gatherers; % Collector-Filterers; % Shredders.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	X	—	—
Under development	—	—	—

9. Pertinent citations: Florida DEP (1994); Florida DER (1992); Hand (1994); McCarron (1994, 1995); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers presented in #1 & 2 (above) represent 1994 305(b) reporting cycle -- 1992-1993. Florida 305(b) program is coordinated by Joe Hand (904) 921-9926.

GEORGIA

The Georgia Environmental Protection Division (EPD) uses trend monitoring, intensive surveys, and biological monitoring and assessments as surface water monitoring tools to manage and regulate Georgia water resources. EPD operates a fixed station trend monitoring network in cooperation with the U.S. Geological Survey that includes 145 strategically located stations. Intensive stream surveys, which complement fixed station monitoring, are conducted to address specific issues such as cause-effect relationships, wasteload allocations, and water quality assessments. During the 1994 Water Quality Assessment reporting period, EPD surveyed macroinvertebrates at six of the trend monitoring network stations.

EPD is continuing to refine state biological monitoring methods and is currently preparing a standard operating procedures manual for macroinvertebrate bioassessments. This Georgia bioassessment protocol will represent an intensive, multi-habitat, multi-biometric approach to assessing macroinvertebrate communities. Biological monitoring activities have begun for Georgia's River Basin Management Project on the Chattahoochee and Flint River basins; however, current Water Quality Management Program (WQMP) emphasis is on the solidification of bioassessment methodologies for streams throughout the state, development of the protocol, and the initiation of a long-term reference site monitoring program. Members of the WQMP are currently being trained in macroinvertebrate field collection techniques and habitat assessment methods. WQMP teams have assessed more than 20 streams using U.S. EPA's Rapid Bioassessment Protocol (RBP) revised habitat assessment methods for riffle/run and glide/pool prevalent streams.

Biological assessment information is used by EPD in the designated use support characterization process. Fish survey information provided by the Wildlife Resources Division has placed 494 miles of streams on the partial support list. The Index of Biotic Integrity is used to classify fish populations as excellent, good, fair, poor, or very poor. Stream segments rated as poor or very poor are considered as not meeting the "fishing" water use classification and are included in the partially supporting list.

In an expanded look at the work done by the Wildlife Resources Division, four drainages were sampled from 1990 - 1993: Ocmulgee, Flint, Chattahoochee, and Oconee drainages. These efforts covered 507 sites for fish assemblage assessments using the Index of Biotic Integrity, and were initiated to determine the effects of various land use practices on stream fish communities. A single IBI was developed basin on the ecregion approach for use across the west-central region of Georgia, across two major drainages (Apalachida and Altmaha). Physiographic areas included the Piedmont and Upper Coastal Plain. Statistical and graphical analysis indicated no significant differeneces in IBI scoring across both drainage and physiographic region. Principal components analyses was used to identify 12 factors that explained 70% of the variation in the data set. A preliminary discriminant analyses also revealed some important relationships among the physical-chemical data and the 12 IBI metrics.

STATE: **GEORGIA**

Contact: Mark Winn, III

Address: Georgia Department of Natural Resources
Environmental Protection Division
Water Quality Management Program
205 Butler Street, SE
Floyd Towers, East
Atlanta, GA 30334

Phone/Fax: (404) 656-4905/7843

1. Miles assessed as:

Non-impaired	700
Impaired	1835
Excellent	(60)
Good	(640)
Fair	(1310)
Poor	(470)
Very Poor	(55)
Total	2535 miles

Contact: Steve Schleiger

Address: Georgia Department of Natural Resources
Wildlife Resources Division
Fisheries Management Section
Highway 341 South, Route 3, Box 75
Fort Valley, GA 31030

Phone/Fax: (912) 825-7841

2. Number of sites sampled: 507

3. Miles per site: 5 mile (default) per site.

4. Assemblage(s): Fish; Benthic macroinvertebrates (not reported)

5. Sampling gear or Method: Fish Index of Biotic Integrity (modified metrics)

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Fish - Index of Biotic Integrity pilot studies.

   Fish IBI: Proportion of lithophilic spawners; number of sensitive/intolerant species; proportion of tolerant species; proportion of omnivorous species; proportion of insectivorous cyprinids; proportion of pioneer/piscivorous species; proportion of DELTs; total number of species; number of individuals; number of darter species; number of sucker species; number of sunfish species.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Georgia DNR (1994); Sabock (1994); Schleiger (1995); U.S. EPA (1994a); Winn (1995).

10. Comments: Bioassessments conducted 1990-1993 for fish IBI.

HAWAII

Rapid bioassessment protocols (RBPs) are under development to assess aquatic life uses of Hawaiian streams and support the narrative biological criteria proposed for incorporation into the State's Water Quality Management Program. The general approach of the Hawaiian stream bioassessment protocol (RBP) is to compare measures of community characteristics , and habitat, of a study stream to a minimally impacted ecoregional reference condition. Much of the basis for evaluation is the presence or absence of native taxa and the introduction of non-native species. Low abundance or low diversity of native fauna is indicative of diminished biological integrity. Standardized bioassessments using regional reference conditions can be used to augment the commonly used physical and chemical water quality assessments performed during ambient monitoring, use attainability studies, and other investigations. Ultimately, these methods may be used as a regulatory option in permitting dischargers and other regulated activities.

The RBP is incorporated into a standard operating procedure (SOP) made up of several activities: visual surveys, habitat characterizations, flow measurements, and physical/chemical water quality data collection. The time demands of each task is dependent upon the number of aquatic organisms in the stream, the size of the stream, and other local conditions.

Visual Surveys: Fish, crustaceans and larger mollusks are surveyed for relative abundance using randomized point counts or a linear transect method, depending upon the stream size and the number of aquatic organisms in the site. This survey technique was selected for its non-intrusive nature and relatively low cost.

Habitat Characterizations: Habitat evaluation involves scoring none habitat attributes grouped in three weighted tiers. Two characteristics are quantitative (pool-riffle ratio and width to depth ratio), and two are semiquantitative in nature (substrate composition and embeddedness). The remaining five habitat characteristics must be evaluated qualitatively. The scoring for these characteristics was developed from other bioassessment protocols, however each was analyzed separately to produce scoring ranges applicable to Hawaiian streams.

Flow Measurement and Water Quality Data Collection: These activities provide information that is not directly included in either the visual survey, macroinvertebrate sampling, or habitat characterization. Stream discharge measurement and information such as bed slope, altitude, pH and conductivity are intended to be logistically feasible, yet not so time consuming nor equipment intensive that other efforts are jeopardized.

Metrics have been developed for the Hawaiian Stream Bioassessment Index with scores ranging from 6 to 30. Additional testing of these methods and metrics will continue.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **HAWAII**

Contact: Gordon Smith

Address: Hawaii Dept. of Health and Environmental Planning
P.O. Box 3378
Honolulu, HI 96801

Phone/Fax: (808) 586-4351/4370
Email: gordo@hawaii.edu

1. Miles assessed as:

Non-impaired	___
Impaired	___
Excellent	___
Good	___
Fair	___
Poor	___
Total	Pilot studies

2. Number of sites sampled: 25 sites on 14 streams for the pilot study

3. Miles per site:

4. Assemblage(s): Fish and larger invertebrates

5. Sampling gear or Method: Visual surveys; randomized point count or linear surveys.

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - UD Multimetric approach—Metrics used or under development:

   Number of native amphidromous macrofauna; percent contribution native taxa; sensitive native fish species; introduced tolerant fish species; community weighted average; number of introduced taxa.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	UD	UD
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Hawaii Department of Health (1994); Sabock (1994); Smith (1995a, b, c, d, e); U.S. EPA (1994a).

10. Comments: The new narrative biocriteria will reference a technical document that will provide instructions on how to conduct the stream biosurveys.

IDAHO

The Idaho Department of Health and Welfare, Division of Environmental Quality (DEQ) has not established biological criteria for use in Water Quality Standards at the present time; however, bioassessment protocols have been developed for Idaho streams and wadable rivers. Bioassessments of the macroinvertebrate and fish communities are used in both the nonpoint source control and antidegradation facets of DEQ's water quality program.

Under an Antidegradation Agreement finalized in 1988, DEQ cosponsors Basin Area meetings every 2 years to: provide current water quality and fish habitat status information; discuss current and future nonpoint source activities; obtain public input; and identify stream segments of concern. Another key provision of the agreement is the establishment of a coordinated monitoring program. Three levels of monitoring intensity—basic, reconnaissance, and intensive—have been developed for water quality monitoring in support of the Antidegradation Program. Basic monitoring consists of an office compilation of existing monitoring and beneficial use data. Reconnaissance level monitoring includes: field inventories and qualitative assessments of instream beneficial uses conducted on all stream segments of concern; U.S. EPA Rapid Bioassessment Protocol (RBP) habitat assessments; and RBP macroinvertebrate surveys. Biological assessments at the intensive level of study involve quantitative habitat monitoring for selected parameters; use of a Hess sampler for macroinvertebrate surveys; and the four-step removal method for fish community assessments.

The DEQ biological monitoring program has expanded since the 1988 Idaho Antidegradation agreement. DEQ has conducted biological assessments at 1170 selected stream segments of concern (reference sites and 303d listed streams). The biological data are evaluated using a RBP and Index of Biotic Integrity-based approach for macroinvertebrates and fish, respectively. In order to provide consistency in monitoring and assessment methods, DEQ has prepared a series of protocols that address fish, benthic macroinvertebrates, and habitat including:

- Protocols for Evaluation and Monitoring of Stream-Riparian Habitats Associated with Aquatic Communities in Rangeland Streams,
- Protocols for Assessment of Biotic Integrity (Macroinvertebrates) in Idaho Streams, and
- Protocols for Assessment of Biotic Integrity (Fish) in Idaho Streams.

Biological assessments have been included in a variety of project-specific applications in Idaho as part of: State Agricultural Water Quality projects; enforcement cases; ecoregion refinement and Rocky Mountain ecoregion BMP effectiveness monitoring on forest lands; the Beneficial Use Reconnaissance project; and a variety of use attainability studies in northern Idaho.

Despite the large number of sites sampled, <u>assessment information for Idaho rivers and streams is not available.</u> To aid in shifting to a watershed approach, and to restore the utility of 303(d) lists of water quality limited segments, it was decided to limit the availability of stream bioassessment information. Assessments on which regulatory actions may be based will no longer be available through the State's Water Quality Status Report (305b). However, the DEQ emphasizes the use of biological integrity measurements for aquatic life use assessment.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **IDAHO**

Contact: Bill Clark

Address: Idaho Dept. of Health and Welfare
Division of Environmental Quality
1410 North Hilton
Boise, ID 83706-1253

Phone/Fax: (208) 373-0260/0576

1. Miles assessed as:

Non-impaired	___
Impaired	___
Excellent	___
Good	___
Fair	___
Poor	___
Total	Not Reported

2. Number of sites sampled: 1170

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates

5. Sampling gear or Method: Fish - backpack electrofishing; Rapid Bioassessment Protocol V; Macroinvertebrates - travelling kicknet, Hess (primary method), or Surber; Rapid Bioassessment Protocol III.

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Fish - total number of species, number of native species, number of introduced species, number of salmonid species, number of benthic insectivores, number of intolerant species, % introduced species, Jaccard coefficient, % carnivores, % omnivores, % insectivores, % salmonids, density (# and weight), salmonid (density & biomass), % Young of Year (YOY), % YOY salmonids, % anomalies, salmonid condition factor.

   Macroinvertebrates - taxa richness, EPT, HBI, abundance-catch/unit effort, percent scrapers, percent filterers, percent shredders, Jaccard coefficient.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	X	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Clark (1990); Clark and Maret (1993); Chandler et al. (1993); Hayslip (1993, 1995); Idaho DHW (1994); Maret et al. (1993); Robinson and Minshall (1995); Sabock (1994); U.S. EPA (1994a)

10. Comments: Idaho DEQ has developed a series of 8 in-depth protocol documents that address fish, benthic macroinvertebrates, habitat, and use attainability analysis. An important aspect of the biological monitoring program is the proper care and disposition of voucher specimens into permanent museum collections. Arrangements have been made with the Orma J. Smith Museum of Natural History, Albertson College of Idaho, to house these voucher collections for future reference and research.

ILLINOIS

Illinois Environmental Protection Agency (EPA) water monitoring programs consist of a combination of fixed station networks and intensive stream surveys of specific watersheds. IEPA operates an Ambient Water Quality Monitoring Network of 206 fixed stations to characterize and define trends in the physical, chemical, and biological condition of Illinois surface waters. Facility-related stream surveys target municipal and industrial wastewater treatment discharges, and consist of upstream-downstream comparisons of macroinvertebrate communities, water chemistry, stream flow, and habitat. The survey results are used to evaluate point source impacts, determine the significance of the biological impact, and evaluate the need for additional wastewater treatment controls.

IEPA conducts intensive river basin surveys in cooperation with the Illinois Department of Conservation (IDOC). Fish, macroinvertebrate, water chemistry, and habitat data are collected to: refine and update biological stream characterization activities; identify biological integrity and potential of streams in the basin; assess designated use attainment; and identify water quality limited resources and priority waterbodies. IEPA and IDOC biologists have also developed a Biological Stream Characterization Program (BSC). In addition to providing a stream classification system for Illinois, the BSC is also used in the determination of designated use attainment for streams. The BSC system consists of a provisional five-tier stream classification, predicted largely on attributes of stream fish communities. BSC "unique" and "highly valued" resource designations indicate full support of aquatic life use; "moderate" and "limited" aquatic resources classes indicate partial support; and "restricted" aquatic resource class denotes non-support. In the absence of adequate fish survey data, macroinvertebrate data or physical habitat descriptors (in that order) may be used to develop a provisional stream classification.

Illinois aquatic life use assessments are based on a combination of biological and physiochemical data generated from the various IEPA monitoring programs. The biological data consist of fish and macroinvertebrate community information which are evaluated using the Index of Biotic Integrity (IBI) and the IEPA Macroinvertebrate Biotic Index (MBI), respectively. Stream habitat data are used to estimate biotic potential in the form of a Predicted Index of Biotic Integrity (PIBI) value generated from a multiple regression equation.

Illinois is in the process of developing multimetric biocriteria through an existing Biocriteria Workgroup. Although IEPA biologists have been characterizing streams for years using various biological criteria, no existing state water quality standard addresses the quality of the aquatic life community in Illinois. Biocriteria as state water quality standards would set narrative and numeric goals for the quality of individual ecosystems throughout the state. The present schedule for adoption of biocriteria as Illinois Pollution Control Board standards targets the 1996 Triennial Standards Review.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **ILLINOIS**

Contact: Mike Branham

Address: Illinois EPA
Division of Water Pollution Control
P.O Box 19276
Springfield, IL 62794-9276

Phone/Fax: (217) 782-3362/785-1225

1. Miles assessed as:

Non-impaired	3,865
Impaired	3,839
Excellent	—
Good	—
Fair	—
Poor	—
Total	7,704

2. Number of sites sampled: 700 intensive basin sites (chemical, biological and habitat)

3. Miles per site: Approx. 11 miles, on average.

4. Assemblage(s): Fish; Benthic macroinvertebrates

5. Sampling gear or Method: Illinois EPA (benthos), Illinois DOC (fish)
MBI - Macroinvertebrate Biotic Index
IBI - Fish Index of Biotic Integrity

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - X Other Explain: statewide criteria apply

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological; Habitat

   Fish - IBI

   Macroinvertebrates- Macroinvertebrate Biotic Index (modified Hilsenhoff Biotic Index)

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	—	X	X
Numeric (in place)	—	X	X
Under development	X	—	—

9. Pertinent citations: Branham (1994, 1995);Illinois EPA (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers represent 1994 305(b) reporting period and include monitoring conducted over a 5-year period (1989-1993).

INDIANA

The Indiana Department of Environmental Management (DEM) biological monitoring programs involve the intermittent sampling of Indiana lakes, rivers, and streams to assess various components of the biological community including fish, macroinvertebrates, algae, and bacteria. Periodic comprehensive studies of entire watersheds have been conducted as needed to evaluate the status of the entire cross section of biological communities. Typically, DEM biological studies have involved upstream-downstream comparisons of point source discharge effects.

DEM biological assessments of streams and wadable rivers focus on fish and macroinvertebrate communities. The department has been working cooperatively with U.S. EPA Region 5 to evaluate the biological integrity of Indiana streams using the fish community. A total of 197 headwater and wadable stream sites have been sampled in the Central Corn Belt Plain ecoregion in order to develop and calibrate an Index of Biotic Integrity (IBI) for use in Indiana. The results of the IBI study are being used to: identify areas of least disturbance within ecoregions for use as reference sites; verify Indiana ecoregion boundaries; develop expectation criteria for each IBI metric considering stream order and proximity to Lake Michigan; and develop biological criteria for the ecoregions using IBI scores and habitat classifications.

Indiana streams and wadable rivers are also assessed using macroinvertebrates as water quality indicators. DEM is using U.S. EPA's Rapid Bioassessment Protocols (RBPs) to direct the technical methods for macroinvertebrate sampling and habitat assessment. This long-term effort will eventually lead to the development of a database which will allow the evaluation of nonpoint source impacts. A total of 341 sites on 244 rivers and streams have been sampled, to date. Habitat assessments are performed at all biological monitoring sites. Numerical habitat evaluations include physical, chemical, and riparian/watershed characteristics, and are combined with bioassessments to determine overall ecological integrity. This multiphase program entails a long-term commitment of DEM to accumulating an extensive unified biological database from which comparisons of ecological integrity can be made both now and in the future.

Indiana has addressed and included narrative biological criteria in its water quality standards to prevent degradation of biological resources. Both warm water and cold water aquatic communities are recognized within a multiple use classification and protected under narrative criteria. An "exceptional use" classification has been established to provide stringent protection to waters possessing unusual aquatic habitat or support unique assemblages of aquatic organisms. Some Indiana streams have been found incapable of supporting diverse aquatic communities during much of the year simply because there is not enough water, food, or sustainable habitat present to support them (even under excellent water quality conditions). A "limited use" designation has been established for these streams.

DEM criteria for evaluating support of designated uses include classification guidelines based on bioassessments. Full support of designated uses is indicated when there is no evidence of modification to the biological community within the natural range of control (or ecoregion). If there is some uncertainty about use support or if some modification of the biological community is noted, partial support is indicated. Streams exhibiting a definite modification of the aquatic community are classified as not supporting designated uses.

STATE: **INDIANA**

Contact: Lee Bridges

Address: Indiana Dept. of Environmental Management
105 S. Meridian
P.O. Box 6015
Indianapolis, IN 46206-6015

Phone/Fax: (317) 243-5030/5056

1. Miles assessed as:

Non-impaired	1,094
Impaired	729
Excellent	—
Good	—
Fair	—
Poor	—
Total	1,823

2. Number of sites sampled: 341 benthic macroinvertebrate sites
197 fish community sites

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates; Algae (not reported)

5. Sampling gear or Method: Benthic macroinvertebrates-Rapid Bioassessment Protocol II/III
Fish-Index of Biotic Integrity
Habitat - Qualitative (QHEI, RBP)

6. Decision criteria based on:
   - X Reference sites
   - X Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Macroinvertebrates - RBP II/III; Fish - IBI.

   Benthic Macroinvertebrates: Hilsenhoff Biotic Index; EPT Count; Chironomid Count; EPT/Chironomic ratio; Number of Individuals.

   Fish (IBI): LARGE RIVER: total number species; number of darter/sculpin/madtom species; number sunfish species; number round-bodied suckers species; number sensitive species; percent tolerant species; percent omnivores; percent insectivores; percent carnivores; catch per unit effort; percent simple lithophils; percent DELT anomalies.
   GREAT RIVER: total number species; percent large river taxa; number sunfish species; number round-bodied suckers species; number sensitive species; percent tolerant species; percent omnivores; percent insectivores; percent carnivores; catch per unit effort; percent simple lithophils; percent DELT anomalies.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	—	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Indiana DEM (1992); Newhouse (1994); Sabock (1994); Simon (1992, 1994, 1995); U.S. EPA (1994a).

10. Comments: Numbers represent 1992 305(b) reporting period -- 1990-1991. Modification of the IBI has been made for different ecoregions (see Simon 1992, 1994, 1995).

IOWA

The Iowa Department of Natural Resources (DNR) uses bioassessments as part of special studies (such as nonpoint source pollution control projects), as well as for the determination of aquatic life designated use support. Recently, DNR has been refining classifications for stream use designations. Since streams designated for warm water aquatic life in Iowa Water Quality Standards are defined on the basis of the characteristics of the aquatic community (primarily fish),

DNR has begun to use bioassessments for the evaluation of stream uses. Biological and habitat assessment methods are based on the guidance of U.S. EPA Rapid Bioassessment Protocols (RBPs). At present, the state does not include biological criteria in the Iowa Water Quality Standards program, however, pilot studies are underway to build a database for the development of biocriteria for wadable streams and rivers. The Iowa Ecoregional Subdivision Project was initiated in July 1991 to establish a framework from which ecoregionally-based biological criteria can be developed for Iowa streams. Aquatic habitat, physiochemical water quality, fish community, and macroinvertebrate community data are being collected from candidate ecoregional reference sites.

An evaluation of physical habitat is being completed at all reference sites to define attainable habitat quality for streams in each ecoregion or subecoregion. The fish assemblage is being surveyed using standardized electrofishing methods, and fish community data are being used to develop a multi-metric biological index similar to the Index of Biotic Integrity. Macroinvertebrates are being collected from both artificial and natural substrates. Artificial substrate data will be used in biometrics that require estimates of taxa proportional abundances. Natural substrate data will be used in qualitative-type biometrics, and will allow a more comprehensive appraisal of macroinvertebrates than artificial substrate data would alone.

DNR anticipates a total 5-year (through 1997) field survey period, during which both reference and monitoring sites will be sampled. The sampling of approximately 110 reference sites (representing ten ecoregions or subecoregions) has been proposed. A rotational schedule for revisiting reference locations may be established for trend monitoring purposes, and the reference sites in each region will be evenly distributed across sampling years to protect against sampling year bias. Sampling of approximately 40 monitoring site locations is also proposed. These sites represent streams with known or suspected impacts ranging from habitat alteration to point source discharges. A variety of statistical tools are being used to analyze the biological data. Scatter plots have been used to initially examine data patterns and will be used to illustrate relationships between physical or habitat data and biological attributes. Analysis of variance methods will be used to test for significant effect of independent variables such as ecoregion, sampling season, and sampling year on dependent biological variables. The relationships between biological, habitat, and physiochemical variables will be explored to the extent possible using correlation and multiple regression analyses.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **IOWA**

Contact: John Olson

Address: Iowa Dept. of Natural Resources
Water Resources Section
Wallace State Office Building
Des Moines, IA 50319

Phone/Fax: (515) 281-8905/8895

1. Miles assessed as:

Non-impaired	2,776
Impaired	2,413
Excellent	—
Good	—
Fair	—
Poor	—
Total	5,189

2. Number of sites sampled: 390 stream use assessments

3. Miles per site: Average length of stream assessments is 13.4 miles (standard deviation = 15.2 miles; minimum stream length = 0.26 miles; maximum stream length = 125.4)

4. Assemblage(s): Fish; Benthic macroinvertebrates (under development)

5. Sampling gear or Method: Modified Rapid Bioassessment Protocols III & V

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological; Habitat

   Fish: Number of species; percentage of species with over 20 specimens per species; percentage of pollution tolerant species; percent of individuals with DELTs, exteranl parasites and fungus.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Iowa DNR (1991, 1994); Olson (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers presented represent 1994 305(b) 2-year reporting cycle. Biocriteria program beginning to be developed using fish, benthic macroinvertebrates, and habitat. Benthic macroinvertebrate pilot projects underway per Tom Wilton, Personal communication.

KANSAS

The Kansas Department of Health and Environment (DHE) initiated a stream biological monitoring network in 1972. The initial program involved a total of 33 stations that were located to monitor major river basins, major tributaries, interstate streams, and to bracket selected municipal point sources. The original monitoring locations were selected to provide long-term water quality trend information for Kansas streams, and were coincident with the ambient stream chemical monitoring network. During the 1989 to 1993 monitoring period, the number of biological network sites was increased to 59. These stations continue to be sampled annually on a seasonal rotation (i.e., a station is sampled in spring the first year, summer the second, and fall the third).

Biological monitoring network surveys focus on macroinvertebrates, and the pollution tolerance of the dominant taxa is used to indicate relative water quality at each monitoring location. Macroinvertebrates are sampled using a method that facilitates sampling of all available habitat types and the collection of the majority of species present at each station in numbers relative to their abundance. The resulting data are summarized using biological metrics including the Macroinvertebrate Biotic Index and the Kansas Biotic Index. The index values are used to characterize the overall pollution tolerance of the macroinvertebrate community, and help to distinguish the degree of aquatic life use support attainment (i.e., non-support, partial support, or full support). DHE primarily uses these bioassessments to assess water quality impacts on stream biota in relation to point source discharges.

The Kansas rapid biological assessment (RBA) program is specifically designed to: rapidly screen instream water quality conditions for problem identification; provide data to assess conformity with water quality standards; and provide basic data to evaluate use attainment (especially aquatic life use). RBAs are used primarily to assess water quality impacts on the biota of streams receiving effluent discharges. They are often performed by KDHE in association with water quality certification reviews required under K.A.R. 28-16-28f(c). When biological data indicate that a stream is fully supporting a balanced aquatic community, full support of designated use is implied. If, after evaluating the data, there is some uncertainty as to whether or not a balanced aquatic community is supported, the waters are deemed as partially supporting designated uses. In these cases, some species may not be able to propagate in the stream, although a put-and-take fishery may exist. Non-support of aquatic life use is indicated when the aquatic community is definitely imbalanced and/or severely stressed (e.g., few or none of the expected species exist in the waterbody).

The Kansas Department of Wildlife and Parks proposed a Stream Monitoring Program as a long term survey designed to describe the status and trends in the condition of the State's stream resources. The program planned to integrate information about fish and macroinvertebrate communities, water quality, instream habitat, riparian condition and human uses.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **KANSAS**

Contact: Mike Butler

Address: Kansas Dept. of Health & Environment
Bureau of Water Protection
Forbes Field, Building 740
Topeka, KS 66620

Phone/Fax: (913) 296-5580/291-3266

1. Miles assessed as:

Non-impaired	292
Impaired	100.5
Excellent	—
Good	—
Fair	—
Poor	—
Total	392.5

2. Number of sites sampled: 36 sites near municipal facilities (59 fixed network stations not included)

3. Miles per site: approx. 10 miles per site; 30 for the fixed stations (20 miles upstream and 10 miles downstream)

4. Assemblage(s): Benthic macroinvertebrates; Fish (conducted by Kansas Department of Wildlife and Parks- not available)

5. Sampling gear or Method: Rapid Bioassessment Protocol - based Macroinvertebrate Biotic Index. D-frame net with hand-pciking of all available habitat types.

6. Decision criteria based on:
   - X Reference sites
   - __ Ecoregional reference conditions—Number of reference sites __
   - __ Other Explain:

7. Data Analysis/Interpretation:
   - __ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - Macroinvertebrate Biotic Index (MBI); EPT Index; Taxa richness; Total taxa; Kansas Biotic Index (KBI).

   Habitat - Habitat Development Index

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	—	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Butler (1994); Carney (1994); Cooter (1994); Kansas DHE (1992, 1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers represent 1992 and 1994 305(b) reporting period -- surveys conducted 1989-1993. Results from two reports were added together. Fixed station surveys using a macorinvertebrate biotic index (single metric results not included in this study) showed 1110 miles in full support and 600 miles impaired.

KENTUCKY

The Kentucky Department for Environmental Protection (DEP) uses bioassessments for special water research management studies as well as for surveying fixed-station biological monitoring sites. Algae, macroinvertebrates, and fish are sampled, and several community structure and function metrics are analyzed for each indicator assemblage. The biological metrics are used to determine biotic integrity and water quality designated use support for each monitored stream reach. Biological metric expectations are based on streams size, ecological region, and habitat quality. Warm water aquatic habitat use support decisions are based on these expectations.

During 1991, DEP began implementation of a Reference Reach Program. Biological sampling protocols and habitat assessment methods were developed and tested at six locations in the Appalachian ecoregion during a summer index period. Habitat and bioassessment methods followed the technical guidance of USEPA's Rapid Bioassessment Protocols (RBPs). Bioassessments integrated physicochemical data, habitat data, data from each assemblage, and professional judgement of DEP biologists.

Algae, macroinvertebrates, and fish have been collected from more than 60 sites since the inception of the Kentucky RBP program. Algae samples were collected from each station using both artificial substrates and natural substrates to obtain biomass and relative abundance information, respectively. Algal community integrity was determined using the periphyton biotic index (PBI), which integrates the scores of six biological metrics. The PBI is used to rank periphyton communities as excellent (supporting Warm water aquatic habitat), good (supporting), fair (partially supporting), or poor (not supporting).

DEP collects macroinvertebrates from artificial substrates and all available natural substrate habitats at each monitoring location. Macroinvertebrate data analysis for wadable streams is accomplished by using a multi-metric approach. A base core of four metrics are always used. Additional metrics vary, depending on type of impact or ecoregion. A minimum of six metrics are used for each analysis. The individual metric scores are averaged to produce a Macroinvertebrate Bioassessment Index (MBI). Warm water aquatic habitat use support is reflected if there are no alternatives in community structure or function, and if habitat conditions are relatively undisturbed. Locations are considered partially supporting uses when survey information indicates that community structure is slightly altered, that functional feeding components are noticeably influenced, and available habitats reflect alterations or reductions. Survey reaches are considered not supporting if survey information reflects sustained alterations in community structure, taxa richness and functional feeding groups, or if available habitats are severely reduced.

Fish are also collected at biological monitoring sites, and community condition is determined by using the Index of Biotic Integrity (IBI). Twelve community attributes are used to categorize fish communities as excellent, good, fair, poor, very poor, or no fish present. Monitoring locations with IBI ratings of excellent or good are considered to fully support uses. Partial support of designated uses is indicated by the IBI rating of fair, whereas, IBI categories of poor, very poor, and no fish reflect nonsupport of uses.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **KENTUCKY**

Contact: Tom VanArsdale

Address: Kentucky Dept. for Environmental Protection
Division of Water
14 Reilly Road
Frankfort Office Park
Frankfort, KY 40601

Phone/Fax: (502)564-3410

1. Miles assessed as:

Non-impaired	1,359
Impaired	260
Excellent	—
Good	—
Fair	—
Poor	—
Total	1,619

2. Number of sites sampled: 42 (1990-1991 biological monitoring program)
24 (1992-1993 biological monitoring sites)

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates; Algae

5. Sampling gear or Method: Fish Index of Biotic Integrity
Macroinvertebrates - Traveling kick-net; Hester-Dendy Samplers

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - X Other Explain: statewide (45 reference streams)

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological; Habitat (UD)

   Macroinvertebrates - Total Number of Individuals; Taxa Richness; EPT; Jaccard Coefficient of Community Similarity; Percent Community Similarity Index; Modified HBI; EPT/Chironomidae; Percent Contribution Dominant Taxa; Dominants in Common, Five; Dominants in Common, Ten; Percentage Circotopus plus Chironomus Abundance to Total Chironomidae; Percentage of Shredders to Total Abundance; Macroinvertebrate Bioassessment Index.

   Fish - Total species; Number and indentity of darter species, sunfish species, sucker species, intolerant species; Proportion of individuals as green sunfish, omnivores, insectivorous cyprinids, top carnivors; number of individuals with disease, tumors, fin damage, and other anomalies; number of individuals in sample; proportion of individuals as hybrids.

   Diatom Bioassessment Index: Total number of diatom taxa; Shannon diversity; percent community similarity; pollution tolerance index; percent sensitive species; other metrics as appropriate.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	—	X	X
Numeric (in place)	—	—	—
Under development	X	—	—

9. Pertinent citations: Kentucky DEP (1992, 1993, 1994); Sabock (1994); U.S. EPA (1994a); VanArsdale (1994).

10. Comments: Numbers represent cumulative total for 1990-1991 and 1992-1993 bioassessesments as per Tom VanArsdall.

LOUISIANA

The Louisiana Department of Environmental Quality (DEQ) is currently conducting pilot studies to describe ecoregional reference conditions for wadeable Louisiana streams. The studies for two ecoregions - South Central Plains and Upper Mississippi Alluvial Plains ecoregions have been completed. The macroinvertebrate and fish communities, water chemistry and physical habitat of 25 reference streams were sampled and analyzed over a three year period (1991 to 1994). The study results suggest the need to subdivide the South Central Plains ecoregion into two subregions for establishment of reference conditions. The southern subregion was characterized by higher velocity streams inhabited by rheophilic taxa the northern subregion was characterized by sluggish streams inhabited by fauna tolerant of low dissolved oxygen conditions. Louisiana is continuing the efforts to characterize reference stream communities by sampling 12 streams in the Western Gulf Coastal Plain and Terrace Uplands ecoregions. Macroinvertebrates and fish have been collected using standardized qualitative techniques, and stream habitat has been assessed by assigning relative scores for habitat attributes of a glide/pool system.

DEQ has not formally incorporated a state-wide bioassessment program into the water quality standard and assessment process; however, the Louisiana pilot studies represent the initial step in the process of developing recommendations for biocriteria.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **LOUISIANA**

Contact: Dugan Sabins

Address: Louisana Dept. of Environmental Quality
Office of Water Resources
P.O. Box 82215
Baton Rouge, LA 70884-2215

Phone/Fax: (504) 765-0511/0635

1. Miles assessed as:

Non-impaired	___
Impaired	___
Excellent	___
Good	___
Fair	___
Poor	___
Total	Pilot studies

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates

5. Sampling gear or Method:

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites 25 reference streams
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological; Habitat

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	___	___
Numeric (in place)	___	___	___
Under development	___	X	___

9. Pertinent citations: Sabins (1995); Sabock (1994); U.S. EPA (1994a, 1995).

10. Comments: Aquatic life use support assessments are currenly made with limited input of biological data.

MAINE

The Maine Department of Environmental Protection (DEP) conducts an extensive biological sampling program for the assessment of the overall health of stream biological communities. The program began in the early 1970s and used surber sampling to characterize benthic macroinvertebrate communities. Since 1981, the monitoring program has used artificial substrates (wire baskets filled with rocks) to enhance the comparability of samples collected from a variety of sites. Over 200 sites have been monitored using these methods, including stations located below all significant inland dischargers of wastewater. Reference stations have been established upstream of most of the discharges as well as on pristine (or relatively undisturbed) waters.

The standardized macroinvertebrate sampling program was developed to build a database to be used to establish the criteria that would allow DEP to classify a waterbody according to Maine's aquatic life standards. Since Maine recognized the need to assess biological integrity over a decade ago, they were in an excellent position to formally incorporate biological assessments into water quality practices, and by 1986 had passed a revised water classification law that included consideration of the condition of aquatic biota. The law states that it is the state's objective to restore and maintain biological integrity o fits waters, establishes a water quality classification system to allow the management of surface waters so as to protect their quality. The Maine aquatic life use standards establish, in narrative form, the characteristics of the aquatic community that are required to exist in order for a waterbody to attain a given classification, and the characteristics are specific and different for each waterbody classification. The biological standard for Maine surface waters specifies that waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and must maintain the structure and function of the resident biological community.

Numeric criteria and decision rules that precisely define the way that aquatic life uses are assessed are specified in the Water Bureau's Aquatic Life regulations. Examples of quantitative measures used to assess aquatic life use standard attainment include the abundance of selected (e.g., mayfly, stonefly, caddisfly) taxa, numbers of different types of organisms (e.g., taxa richness) and indices that summarize quantitative biological data into one number (e.g., diversity or similarity indices). The macroinvertebrate database is analyzed by examining a set of approximately 30 quantitative variables that summarize the identity and abundance of benthic community attributes. The decision-making thresholds of this approach begin with statistical models (e.g., linear discriminant analysis) that use some of the variables to make water quality classifications of an unknown sample by comparing it to characteristics of each classification identified in the baseline database.

The output from analyses using the primary statistical analysis model is a list of probabilities of membership for each of four classes (i.e., A, B, C, and non-attainment Class C). The use of a system based on probabilities of attainment of standards allows a determination to be made even in the "grey" area between classes, once the regulations establish the probability level required for attainment. The development of numeric criteria in support of the aquatic life standards has been a time-consuming process. It has required the collection and statistical analysis of a baseline data set of sufficient size and coverage (of time and space) to afford a high degree of certainty that valid generalizations can be drawn from the data. The final evaluation of the statistical outcome is accomplished by using professional judgment methods. This process provides a mechanism for adjustment of the decision models. It is the responsibility of DEP to decide if any adjustment of a decision should occur, based on analytical, biological, or habitat information. This final evaluation process relies on professional biological judgment as well as documented evidence of physical, chemical, and biological conditions.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **MAINE**

Contact: Dave Courtemanch

Address: Maine Dept. of Environmental Protection
Bureau of Water Quality Control
State House, Suite 17
Augusta, ME 04333

Phone/Fax: (207) 287-7789/7826

1. Miles assessed as:

Non-impaired	272
Impaired	28
Excellent	—
Good	—
Fair	—
Poor	—
Total	300

2. Number of sites sampled: 71 biomonitoring sites during 1992-1993 study period (165 test and 60 reference-total sites in program since 1981)

3. Miles per site: 4.2 mile average

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Artificial substrates (rock baskets) for benthic macroinvertebrates

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites __
   - X Other Explain: Statewide model (discriminant analyses) by use class of waters.

7. Data Analysis/Interpretation:
   - X Multivariate analysis—Statistical routines used: Linear discriminant analyses.
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates -Total abundance; species or selected group richness; EPT; EPT/Diptera; Oligochaetes/total, Gastropoda/total; Diptera/Generic richness; Tribelos/total; Glossosoma/total; % predator abundance; Number of functional feeding groups; Shannon-Wiener Diversity Index; generic richness; Plecoptera/total abundance; Ephemeroptera/generic richness; Plecoptera/total; Ephemeroptera/generic richness; Plecoptera/generic richness; EP richness/generic richness; Non EPT richness/generic richness; Hirudinea/total; Tanypodinae/total; Chironomus/total; Hydropsyche/total; Branchycentrus/total; Ratio collector-filterer+collector-gatherer/predators+shredders; HBI.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Courtemanch (1994a,b; 1995); Davies et al. (1993); Maine DEP (1992); Sabock (1994); Switzer (1995); U.S. EPA (1994a).

10. Comments:Numbers represent 2-year study period (1992-1993), as per D. Courtemanch personal communication. Please be sure to read Davies et al. (1993) for a thorough description of their program.

MARYLAND

The Maryland Department of the Environment (MDE) is conducting biological monitoring for use in their overall water resource management program. An additional program that is used to monitor the statewide status of stream resources, the Maryland Biological Stream Survey (MBSS), is administered by the Maryland Department of Natural Resources (MDNR), Chesapeake Bay Research and Monitoring Division. MBSS results are not currently included within Maryland's 305(b) report.

In 1990, MDE began conducting biological sampling (benthic macroinvertebrates) at approximately 300 locations (the Rapid Assessment Network) around the state using RBP II and compositing eight metrics. Assessments are completed by comparison with site-specific reference sites. Reference conditions are currently being developed. The sampling program is on a two-year rotation, with all targeted sites sampled to coincide with the National 305(b) cycle.

The MBSS is a probability-based, biological survey of 1st, 2nd and 3rd order streams and rivers in Maryland (collectively, these comprise more than 90% of the stream and river miles in Maryland. The primary objectives of the MBSS are to: 1) assess the current status of biological resources in non-tidal streams using biological integrity and fishability endpoints and 2) to establish a benchmark for long-term monitoring of trends. The secondary objectives of the MBSS are to: 1) examine water quality, physical habitat, and land use factors that may explain the current status of biological resources in streams, and 2) focus habitat protection and restoration efforts. The MBSS sampling sites (called segments) are selected on the basis of stream reach, stream order and drainage basin. As sites on a stream reach are randomly selected within a given strata, we are able to make statistically valid inferences or conclusions about the population of streams of a given order, or as a whole, either on a statewide or drainage basin basis. The MBSS involves a number of qualitative and quantitative technique that are based on the U.S. EPA Rapid Bioassessment Protocols. Fish, water chemistry, and certain aspects of physical habitat are quantified, while benthic macroinvertebrates, herpetofauna, aquatic vegetation and physical habitat are qualitatively sampled and described. Methods used are backpack electroshocking for fish; multihabitat, D-frame net sampling for benthics; herpetofauna by visual observation; and habitat quality using a modified RBP habitat assessment approach. The specific approach for analysis of MBSS data is currently being developed but will entail calculation of community level, multimetric indices and comparison with reference conditions.

The state is beginning to develop lines of communication among different biomonitoring entities to establish coordination, sharing of data, and use of comparable methods and indicators. The Maryland Monitoring Committee has been established by the Maryland Geological Survey to coordination the committee. The goal of this effort is to increase efficiency and the amount of data that can be integrated into an assessment of the state's natural resources.

MDE uses its biological assessment results in problem identification, to communicate them to the appropriate regulatory agencies, and to track the effectiveness of remedial actions. They are not used in directly determining aquatic life use attainment at this time. In the summer of 1995, MDE's monitoring and assessment functions were transferred to the MDNR. It is expected that this move will further help the coordination of the biological assessments done for the State 305(b) reporting and the MBSS, as well as other efforts.

STATE: **MARYLAND**

Contact: Niles Primrose/Paul Kazyak

Address: Maryland Department of Natural Resources
Tidewater Ecosystem Assessment/Monitoring and Nontidal Assessment
416 Chinquapin Round Road
Annapolis, MD 21401

Phone/Fax: (410) 974-3238/ (410) 974-3361

1. Miles assessed as:

Non-impaired	325
Impaired	1,175
Excellent	
Good	(325)
Fair	(950)
Poor	(225)
Total	1,500

2. Number of sites sampled: 300 sites (over a two-year period)

3. Miles per site: 5 mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates; fish (under development)

5. Sampling gear or Method: Rapid Bioassessment Protocol II

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Biological and Habitat; Probability-based design.
   Macroinvertebrates - Taxa richness; Modified HBI; Scraper/Filterer ratio; EPT; EPT/Chironomidae ratio; Percent Contribution dominant family; Community Similarity Index; Ratio of Shredders to total individuals.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	
Numeric (in place)			
Under development			X

9. Pertinent citations: Garrison (1994); Hall et al. (1995); Hartwell et al. (1995); Maryland DNR (1993); Primrose (1994); Ranasinghe et al. (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers represent two-year study period (1992-1993) as per Niles Primrose personal communication. The MBSS has an excellent newletter called "An Eye on Maryland Streams" that can be obtained by calling Ann Smith of MDNR at 410-974-3782.

MASSACHUSETTS

The Massachusetts Department of Environmental Protection (DEP) includes bioassessment as an integral component of the State's watershed-based water quality management program. DEP biologists perform habitat assessments and conduct biological sampling to supplement other water quality monitoring and management programs. A Biomonitoring Program Standard Operating Procedures manual documents all field and laboratory methods used to implement the various program elements.

USEPA's Rapid Bioassessment Protocols (RBPs) are used to monitor the health of benthic macroinvertebrate communities in Massachusetts' streams and wadable rivers. RBP samples are collected at monitoring sites for upstream-downstream comparisons, comparisons to regional or surrogate reference locations, or for long-term trend monitoring at fixed locations. Two different levels of bioassessments are employed (for example, RBP II or RBP III) depending on the survey objectives.

The RBP macroinvertebrate assessments are conducted at up to 25 monitoring sites per year, in conjunction with comprehensive water quality surveys. Macroinvertebrate data are summarized to rank water quality by calculating a series of seven biological metrics. The results are used to supplement traditional physicochemical analyses by demonstrating biological impact as well as assessing ambient water quality and habitat conditions throughout a particular watershed.

The bioassessment results identify three categories of impairment using RBP II (nonimpaired, moderately impaired, and severely impaired) and four categories using RBP III (nonimpaired, slightly impaired, moderately impaired, and severely impaired). These biological community analyses are used to aid in the aquatic life use support determination process. Full support of designated use is indicated where no significant community modifications are observed (for example, nonimpaired). Partial and non-support denotes the fact that some community modifications are present; however, the community is generally viable (for example, slight to moderate impairment). Adverse modification of the biological community is indicative of non-support of aquatic life use (severely impaired).

STATE: **MASSACHUSETTS**

Contact: Arthur Johnson

Address: Massachusetts Dept. of Environmental Protecetion
Office of Watershed Management
40 Institute Road
North Grafton, MA 01536

Phone/Fax: (508) 792-7470/839-3469

1. Miles assessed as:

Non-impaired	141
Impaired	134
Excellent	—
Good	—
Fair	—
Poor	—
Total	275

2. Number of sites sampled: 21 (RBP sites 1992-1993)

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Benthic macroinvertebrate 100 organism subsample
Rapid Bioassessment Protocol II and III

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - Taxa richness; Modified HBI; Functional feeding groups; scrapers/filtering collectors; EPT/Chironomidae; EPT Index; % similarity of community structure; percent contribution dominant taxon.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Johnson (1995); Massachusetts DEP (1994); Sabock (1994); Switzer (1995); U.S. EPA (1994a).

10. Comments: Numbers represent 1994 305(b) reporting period -- 1992-1993.

MICHIGAN

The Michigan Department of Natural Resources (DNR) uses bioassessments as one of the principal means of assessing progress toward achieving the goals of state and federal water quality control laws and to monitor the effectiveness of water pollution control efforts. Biological studies may involve surveys of an entire river system or may be oriented toward a site-specific problem evaluation. The majority of the bioassessments conducted by DNR are the problem evaluation type such as the assessment of point source discharges, the evaluation of remediation program success, or the investigation of a more general concern such as nonpoint source effects.

DNR employs three types of problem evaluation bioassessments—reference site evaluations, site investigations, and biosurveys—that are distinguished primarily by the level of effort involved. Reference site evaluations are limited in effort and generally involve only one station. Site investigations are more intensive, generally, including two to three stations. Biosurveys are the most comprehensive and usually include five or more stations. Qualitative biological assessment and habitat survey protocols have been developed by DNR for wadable rivers and streams and have been used in all types of problem evaluation surveys.

The DNR biological and habitat assessment protocols were developed in 1991 as the result of the increasing demand for a more vigorous and standardized evaluation of nonpoint source impacts. At present, one of the principal applications of biosurveys is to support Michigan's NPDES permit program which is managed on a 5-year cycle and on a river basin basis. DNR bioassessments can consist of an evaluation of any one or combination of three parts including the macroinvertebrate community, the fish community and habitat quality. The assessment data are analyzed using a group of selected biological metrics based on Index of Biotic Integrity and U.S. EPA Rapid Bioassessment Protocol (RBP) methods. In 1993, approximately 185 stations were surveyed using biological procedures, including 106 for nonpoint source and 79 for point source evaluations. In total, over 1,000 stream sites have been biologically evaluated since the inception of the program, accounting for over 80 percent of Michigan's streams.

The DNR biological information is analyzed using metrics selected from RBPs, Ohio EPA protocols, Illinois biological procedures, and measurements developed specifically for Michigan and tested by DNR biologists. The metrics represent a wide array of criteria for the majority of biological or habitat conditions known to occur in response to various stream quality conditions in Michigan. The accuracy and utility of the DNR protocols relies on the selection and evaluation of appropriate reference sites. Stream reference sites are selected from the most pristine or least impacted streams within each of Michigan's ecoregions. The reference site database included 21 sites in 1992, and was enlarged by 18 sites in 1993. These reference evaluations are becoming the standard against which all other stream biological and physical parameters are compared. Each ecoregion will have several reference sites categorized by stream order or watershed size.

Each DNR bioassessment site should be evaluated using the habitat and biological protocols; however, in some instances, only single evaluations are performed (in using only one assemblage). The overall application and integration process is accomplished via a weight of evidence approach, used to give a site a single classification. In general, the lowest category assigned to a single assemblage will be used alone to categorize the overall stations biological condition. Michigan's Qualitative Rapid Bioassessment Methods (Great Lakes and Environmental Assessment Section Procedure 51) and Fisheries Division fish community surveys are used to assess stream quality and to determine designated use status. Stream biological protocol results of excellent, good, fair, and poor translate to impairment designations of nonimpaired, slightly impaired, moderately impaired, and severely impaired, respectively. Those streams assessed as severely impaired (poor rating) based on the biota supported, are placed on Michigan's nonattainment list.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **MICHIGAN**

Contact: William Creal

Address: Michigan Dept. of Natural Resources
Surface Water Quality Division
Stevens T. Mason Building
P.O. Box 30273
Lansing, MI 48909

Phone/Fax: (517) 335-4181

1. Miles assessed as:

Non-impaired	1,140
Impaired	1,535
Excellent	(59 sites)
Good	(169 sites)
Fair	(253 sites)
Poor	(54 sites)
Total	2,675

2. Number of sites sampled: 535 sites rated for impairment/non-impairment (1990-1992)

3. Miles per site: 5 mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method: Benthic macroinvertebrates-Modified Rapid Bioassessment Protocol (II-III equivalent); Fish-Index of Biotic Integrity

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites __
   - __ Other Explain:

7. Data Analysis/Interpretation:
   - __ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - Total taxa; total mayfly taxa; total caddisfly taxa; total stonefly taxa; % mayfly; % caddisfly; percent contribution of dominant taxa; percent surface dependent; percent isopods, snails, leeches.

   Fish - Total species; total darter species; total sunfish species; total sucker species; % insectivorous cyprinids; % piscivores; density of individuals; % anomalie; % carp, green sunfish, white sucker; % omnivores.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	__	X	X
Numeric (in place)	__	__	__
Under development	__	__	__

9. Pertinent citations: Creal (1994); Michigan DNR (1991, 1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers represent bioassessments conducted from 1990 through 1992, as per W. Creal.

MINNESOTA

The Minnesota Pollution Control Agency (MPCA) has recently conducted surveys of fish, macroinvertebrate, and zooplankton communities to develop field techniques and interpretive tools needed to establish meaningful water quality evaluations. These pilot studies have involved sampling in a standardized fashion at least impaired reference sites. The MPCA, in cooperation with the Minnesota Department of Natural Resources, recently completed fish surveys in streams of the Minnesota River basin. The surveys were conducted primarily to develop a fish community index from biological data collected at 50 reference sites within the basin. The development of an index for this region (based on the Index of Biotic Integrity) represents a first product for MPCA's effort toward establishing working numerical biological criteria.

Fisheries field work began in 1993 with the sampling of 57 stations in the Redwood River and Blue Earth River watersheds of the Minnesota River basin. The objective of the fish community study was to develop biological criteria or goals (i.e., fish community health) that can be used as a benchmark for monitoring the biological condition of streams in the watershed. IBI metrics were evaluated and the original metrics were modified for application in the Minnesota River watershed. Both historical data and reference data from 1990 surveys were utilized in the development of metric expectation values. The adoption of biological criteria as part of Minnesota Water Quality Standards will require considerable additional effort and will only be undertaken after intensive study. The IBI pilot study represents an initial step in biocriteria development. Development of a macroinvertebrate protocol would help strengthen bioassessment capabilities and utility. Presently, Minnesota standards define three aquatic life use designations—one addressing cold water fisheries, one cool water, and one warm water. In establishing criteria for aquatic life use it should be noted that the IBI was developed for warm water streams. Therefore, an index and biocriteria will need to be developed for cold water streams.

The IBI pilot studies represent an important shift in approach for MPCA assessments. This method incorporates biological and habitat data with water chemistry data. Habitat information is being used to determine the biological impairment attributable to habitat degradation. Discrepancies between chemistry and biological assessments are being tracked and a weight of evidence approach is being employed to interpret differences in proposed use support between water chemistry data and biological data. Based on experience gained through the Minnesota River watershed pilot studies, MPCA has developed proposed IBI-designated use class associations. IBI scores resulting in integrity class ratings of no fish, very poor, poor, and fair all translate to the nonattainment designated use class category. Integrity classes of good and exceptional are proposed to represent warm water habitat and exceptional warm water habitat designated use classes, respectively.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **MINNESOTA**

Contact: Judy Helgen

Address: MPCA, Division of Water Quality
520 Lafayette Road
St. Paul, MN 55155

Phone/Fax: (612) 296-7240/296-7213

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Pilot Studies

2. Number of sites sampled: Fish: 57 sites in the Redwood and Blue Earth River watersheds (1992-1993)

3. Miles per site:

4. Assemblage(s): Fish

5. Sampling gear or Method: Fish-Index of Biotic Integrity

6. Decision criteria based on:
   - X Reference sites
   - X Ecoregional reference conditions—Number of reference sites Fish: 50 (Minnesota River basin)
   - __ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Fish - Total number of native fish species; number of darter species; number of sunfish species; number of minnow species (excluding carp, creek chub, fathead minnows) at sites < 100 sq. mi. drainage area; number of sucker species (excluding white sucker); number of intolerant species; proportion as tolerants; proportion as omnivores; proportion as specialized insectivores; proportion as top carnivores; number of top carnivore species - at sites < 200 sq. mi. drainage area; catch per unit effort; proportion as simple lithophils; proportion with deformities, eroded fins, and tumors.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Minnesota PCA (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Numbers represent 1994 305(b) reporting period -- Oct 1991-Oct 1993.

MISSISSIPPI

The Mississippi Department of Environmental Quality (DEQ) implements an ambient biological integrity program that includes biological sampling of the macroinvertebrate community. DEQ relies on the macroinvertebrate bioassessments, and upon the ecoregional approach for biological criteria development. Macroinvertebrate rapid bioassessments, based on USEPA's Rapid Bioassessment Protocols (RBPs) and North Carolina methods, are performed at reference sites three times per year. Macroinvertebrate RBPs are used in all DEQ monitoring work including long-term intensive studies, ambient monitoring, and to investigate complaints. In order to adequately characterize ecoregional reference streams and ultimately develop biocriteria language, DEQ is striving toward the development of species-specific information.

A multiagency Alabama/Mississippi project has provided DEQ with a framework for biocriteria development, with approximately 15 reference sites sampled within the two states. Currently, three to four years of data are being analyzed, and the results will lead to the establishment of a series of expectations for biological parameters of the subecoregions. An Alluvial Plains ecoregion project with Louisiana DEQ and historical records from Arkansas Department of Pollution Control and Ecology have yielded seven reference sites within the region. Currently no Mississippi site samples meet least-disturbed (reference) expectations, therefor, DEQ is faced with developing biocriteria for Mississippi based solely upon data obtained from streams outside of State borders. DEQ continues to explore National Forests and Wildlife Management Areas for suitable reference streams, and have located two potential candidates. These will be studied intensively to determine their suitability. DEQ also recognizes the need to expand the search for reference sites into the freshwater portion of the Southern Coastal Plains. At present, the feasibility of how to derive biocriteria is being studied. The two current prospects are to take all biological characteristics of reference sites within a subecoregion and calculate percentiles for each similar to Ohio EPA methods. A second approach would involve examination of all reference sites and then using the highest or best metric value from each to develop an ultimate set of expectations.

A total of 25 sites were monitored in 1994 using bioassessments, and 49 were surveyed in 1993. Under the RBP macroinvertebrate assessment approach each site in the monitoring network is visited once per sampling season. Specific methods are a synthesis of RBP and North Carolina Division of Environmental Management Water Quality Section protocols. All habitat types present at a monitoring site are sampled, and a habitat evaluation is completed to identify all major habitats available at each site. Macroinvertebrate samples are analyzed using measures of abundance and species richness, biotic indices, and metrics of diversity and trophic community structure.

Currently, neither narrative nor numeric biocriteria language is included in Mississippi water quality standards; however, bioassessment method standardization and ecoregional reference condition development represent the initial steps necessary to develop applicable biocriteria.

STATE: **MISSISSIPPI**

Contact: Mike Beiser

Address: Mississippi Dept. of Environmental Quality
Biological Services Section
1542 Old Whitfield Road
Pearl, MS 39208

Phone/Fax: (601) 939-8553/8773

1. Miles assessed as:

Non-impaired	301
Impaired	63
Excellent	—
Good	—
Fair	—
Poor	—
Total	364

2. Number of sites sampled: 49 in 1993; and 25 in 1994

3. Miles per site: Five mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol III and NC DEM Water Quality Section Protocol. Gear: Primarily D-frame net and petite ponar dredge; occasionally a surber sampler and artificial substrate samplers

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites 15 (between MS and AL)
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Taxa richness, EPT, North Carolina Biotic Index, % contribution of dominant taxon, trophic structure, similarity index; HBI; EPT/Chironomidae.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Beiser (1994, 1995); Sabok (1994); U.S. EPA (1994a).

10. Comments: Miles represent 1993 and 1994 monitoring results.

MISSOURI

The Missouri Department of Natural Resources (DNR) uses chemical sampling and only cursory biological survey information in the biennial water quality assessment reporting process. Biological survey methods involve rapid assessment/stream walk procedures equivalent to U.S. EPA Rapid Bioassessment Protocol (RBP) I, and are used primarily for water resource management purposes. DNR is, however, in their third year of developing biological criteria. A total of 45 reference streams have been sampled (in the first 2 full years), and resulting information will be used in the development of biocriteria by ecoregion. The University of Missouri is analyzing the reference data.

DNR and University of Missouri staff began biological sampling in 1993 to test sampling methodologies and habitat evaluations. Habitat surveys were based on a modified RBP approach and biological surveys were limited to invertebrates (i.e., no fish sampling in the initial phase). Invertebrate sampling also involved RBP-based methods consisting of kick net sampling and hand-picking or brushing of specific habitats. The 1993 sampling included 45 streams with four sites per stream. Spring 1994 sampling (eight streams) focused on evaluating the adequacy of the sampling protocols and the need for multiple sampling sites within each stream. Metric scores indicated that virtually all metrics did not change significantly after sampling two to four sites. As a result, during fall 1994, only two sites per stream were sampled. In addition, selected sites known to be impaired were sampled to compare metric scores with reference sites. Site degradation was then identified as water quality or habitat related.

These initial assessments, consisting primarily of candidate reference site investigations, have concentrated on three ecoregions—the Central Irregular Plains, Ozark Highlands, and Mississippi Alluvial Plain. The various sites have been grouped by drainage basin size and have been selected from areas free from point-source influences. The macroinvertebrate data are being analyzed for the surveyed ecoregions and the University of Missouri has been supported to incorporate fish sampling into current evaluations of the Ozark Highlands ecoregion. These efforts represent the initial steps in the development of statewide ecoregional reference expectations and resulting biocriteria for Missouri.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **MISSOURI**

Contact: John Ford

Address: Missouri Dept. of Natural Resources
Water Pollution Control Program
P.O. Box 176
Jefferson City, MO 65102

Phone/Fax: (314) 751-7024

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Not Applicable

2. Number of sites sampled: 180 (45 streams with four sites per stream during 1993)

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; fish (under development)

5. Sampling gear or Method: Rapid Bioassessment Protocol I (does not meet minimum requirements)

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites 45 reference streams
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - UD Multimetric approach—Metrics used or under development: Biological and Habitat - under development

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	___
Numeric (in place)	UD	___	___
Under development	___	___	___

9. Pertinent citations: Ford (1994, 1995); Missouri DNR (1992); Sabock (1994); Shepard (1994); U.S. EPA (1994a).

10. Comments: Despite narrative biocriteria and promising reference condition development by the Univesity of Missouri, DNR does not appear to be interested in promoting biological assessments as a primary monitoring tool.

MONTANA

The Montana Department of Health and Environmental Science Water Quality Bureau (WQB) has conducted studies to describe the composition and structure of benthic macroinvertebrate, periphyton, and fish communities inhabiting selected least-impaired reference streams in six ecoregions. Objectives for establishing benchmark biological conditions for the state include: contributing valuable information to the Nonpoint Source Program (ranking prospective watershed demonstration projects and measuring the effectiveness of best management practices); providing the basis for development of narrative and numerical biological criteria and enforceable biological standards in streams; and describing the natural biodiversity of algal and macroinvertebrate communities found in Montana streams.

The benchmark biology study of Montana reference streams included sampling of 38 streams (or 6-7 streams in each ecoregion) during the summer of 1990. Sampling sites were located upstream from impoundments and areas of human disturbance, or at the boundaries of roadless areas or National Forests. Periphyton, macroinvertebrates, and fish were the chosen indicator assemblages since: WQB has expertise in using periphyton and macroinvertebrate communities as indicators; standardized protocols (USEPA's Rapid Bioassessment Protocols [RBPs]) are available for the assemblages; and fish are elevated to importance in environmental law ("fishable and swimmable" goals).

WQB has employed a multi-metric approach to their analysis of stream biological information based on the technical guidance of RBPs. Included with the Montana stream biological survey information is supporting information that is needed to understand the factors that regulate the communities and determine the value of the metrics. Three types of supporting information are gathered: a suite of chemical and physical water quality variables; an assessment of physical habitat (adapted from RBPs); and an assessment of overall stream conditions using the WQB's Nonpoint Source Stream Reach Assessment technique and ranking criteria. This information is currently being examined in concert with the biological data, to help classify ecoregional reference streams and to explain variation in the biological metrics.

The WQB has prepared a manual for using the periphyton community to assess biological integrity and biological impairment of Montana streams. Much of the manual is based on the findings of the Montana Reference Stream Study, and only structure and composition of stream periphyton communities is addressed. WQB uses the numeric periphyton biocriteria developed from the protocols as assessment tools but has yet to incorporate them into legally enforceable standards.

A variety of information sources are used by the WQB in developing waterbody assessments for the biennial water quality reporting process. Approximately 10 of the original 30 reference streams are visited annually. Fixed station, long-term monitoring networks supported by WQB have emphasized the Clark Fork River Basin and Flathead Lake. Ambient monitoring sites total 63, and include 27 in the Clark Fork River Network and 36 in Nonpoint Source projects. The Montana aquatic life use support category includes fishery use and associated aquatic life use. Monitored and evaluated assessments are made using biological data, water chemistry data, and stream habitat assessments. These extensive contemporary methods and resulting data sets are valuable tools for monitoring aquatic life use support, as well as, trends in priority water bodies in Montana.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **MONTANA**

Contact: Bob Bukantis

Address: Montana Dept. of Health and Environmental Science, Water Quality Bureau
Cogswell Building, 1400 Broadway
Helena, MT 59620

Phone/Fax: (406) 444-4684/1374

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Pilot studies

2. Number of sites sampled: 63 total ambient sites (27-Clark Fork River network; 36-Nonpoint Source projects) 38 reference sites

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; periphyton; fish

5. Sampling gear or Method: Benthic macroinvertebrates; D-frame net-travelling kick technique; Periphyton-composited rock scrapings

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites 38 total with approximately 10 visited annually
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Periphyton-PRA dominant diatom taxon; Diatom Species Diversity; PRA Tolerant and Sensitive Species; Pollution Index.

   Macroinvertebrates-percent dominants taxon; taxa richness; EPT; % chironomidae; HBI; % collectors; % scrapers; scrapers/scrapers+filter feeders; community tolerance quotient; quantitative similarity index for taxa; quantitative similarity index for functional feeding groups; five dominants in common.

   Fish - total species; native species; introduced species.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	X	X
Numeric (in place)	UD	___	___
Under development	___	___	___

9. Pertinent citations: Bahls(1993,1994); Bahls et al. (1992); Levine (1994); Sabock (1994); U.S. EPA (1994a.).

10. Comments:

NEBRASKA

The Nebraska Department of Environmental Quality (DEQ) developed the Nebraska Stream Inventory and Biological Stream Classification in 1991 to: provide a systematic, scientific approach to classifying stream resources according to existing or attainable uses; develop bioassessment techniques to measure community condition based on regional expectations; collect current data applicable to standards revisions, construction grants prioritization, nonpoint source programs, and reporting of impaired waters as in the biennial Water Quality Report; and identify faunal regions based on the macroinvertebrate and fish communities. The stream inventory and biological stream classification represent comprehensive surveys of all major streams in the thirteen river basins of the state.

The stream inventory was conducted to compile information on the physical characteristics of each perennial stream in the state, and included watershed characteristics, riparian characteristics, and instream habitat information. The biological stream classification involves direct field measures of physical, chemical, macroinvertebrate, and fish assemblages at sites representing cold and warm water streams. Streams are categorized by flow class and are analyzed by ecoregion. Reference sites are selected for each ecoregion using sampling locations that are representative of areas that are relatively undisturbed and have diverse fauna.

The Nebraska ambient biological network is based on 100 locations sampled once per year (during a May-September index period) for macroinvertebrates, fish, and habitat condition. Seventeen fixed reference sites are located statewide, divided among river basins, with larger basins having two reference sites. Data collected through the network are used to provide a database for the 305(b) report, nonpoint source activities, and to provide an inventory for long-term monitoring. The measurements of overall stream fish and macroinvertebrate community condition are determined using modifications of the Index of Biotic Integrity (IBI) and Invertebrate Community Index (ICI), respectively. The IBI and ICI biological metrics assess the species richness, diversity, and health of major taxonomic groups. For each of the metrics, plots of macroinvertebrate and fish associations in least disturbed ecoregional reference streams are used to define the standards for healthy conditions.

The IBI and ICI (modeled after U.S. EPA Rapid Bioassessment Protocols) metrics are combined into a Community Biotic Index (CBI) to provide a measure of the distance a stream segment is from an ideal point or best expected aquatic life conditions within an ecoregion. This reference site approach is a more realistic approach to assessing the integrity of aquatic life than a single diversity or biotic index. The CBI results are used to classify aquatic life use support. Categories of excellent, good, fair, and poor for the indices translate to full support, partial support, and nonsupport of designated use, respectively. Excellent or full support conditions are comparable to the best expected aquatic communities (i.e., all regionally expected species are present for habitats and stream size). Good or full support ratings are characterized by streams with species richness somewhat below expectations, especially due to loss of intolerant forms. Attributes of streams scoring fair or indicating partial support include reduced species richness, skewed trophic structure, and reduced abundance of certain taxa. Nonsupport of designated use (as indicated by poor index scores) is characterized by streams with few or no taxa, unbalanced trophic structure, and biotic communities dominated by tolerant taxa.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **NEBRASKA**

Contact: Ken Bazata

Address: Nebraska Dept. of Environmental Quality
301 Centennial Mall
Lincoln, NE 68509

Phone/Fax: (402) 471-4700

1. Miles assessed as:

Non-impaired	2,006
Impaired	4,515
Excellent	—
Good	—
Fair	—
Poor	—
Total	6,521

2. Number of sites sampled: Ambient biological network-100 sites sampled once per year

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; fish

5. Sampling gear or Method: Benthic macroinvertebrates-Invertebrate Community Index (modified RBP III); Fish-Index of Biotic Integrity

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites 17 (annually)
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - total taxa; HBI; % dominant taxon; EPT taxon index; Jaccard coefficient; Ratio scrapers/filterers; Ratio EPT density/total density; Ratio of shredder density/total density.

   Fish - Total species; Number of benthic insectivores; number of sunfish species; number of native cyprinid species; % tolerant species; Number of intolerant species; % omnivores; total insectivores; % carnivores; % of individuals as hybrids; % of individuals with anomalies; fish captured per minute.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Bazata (1995); Nebraska DEQ (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Miles presented represent 1994 305(b) reporting period (data for 1989-1993 assessments)

NEVADA

The Nevada Department of Environmental Protection does no routine biological sampling. Some whole effluent toxicity (WET) testing is done at selected locations; routine bacteriological sampling is done at several locations. All aquatic life use determinations are made using chemical data and there is no indication that a change will occur.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **NEVADA**

Contact: Jim Cooper

Address: Bureau of Water Quality Planning
Division of Environmental Protection
123 West Nye Lane
Carson City, NV 89710

Phone/Fax: (702) 687-4670/885-0868

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Not Applicable

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s):

5. Sampling gear or Method:

6. Decision criteria based on:
   - ___ Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - ___ Multimetric approach—Metrics used or under development:

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	___	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Cooper (1995); Hashimoto (1995); Sabock (1994); U.S. EPA (1994a).

10. Comments:

NEW HAMPSHIRE

The New Hampshire Department of Environmental Services is in the first year of developing a biological monitoring program for the State. Initial efforts are being conducted through a pilot study basin, consisting of nine stations, and is in process for the development of protocols for fish and macroinvertebrates utilizing kick nets, artificial substrates, and electrofishing equipment. Ambient water chemistry has also been conducted to complement the biological data. Pilot project results will assist in the development of field and laboratory protocols appropriate for the State of New Hampshire and it's development of biological criteria.

Upstream reference sites have been selected for this pilot study, but development of long term biomonitoring reference stations is anticipated for future efforts and for the establishment of baseline conditions in the State.

STATE: **NEW HAMPSHIRE**

Contact: Bob Estabrook

Address: New Hampshire Department of Environmental Services
P.O. Box 95
Concord, NH 03301-6528

Phone/Fax: (603) 271-3503/2867

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Under Development/Pilot Studies

2. Number of sites sampled: Nine macroinvertebrate sites and 9 fish sites sampled during 1995 in Souheyn watershed, Merrimack River Basin

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method: Rapid Bioassessment Protocol II under development

6. Decision criteria based on:
   - X Reference sites - upstream stations
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological and Habitat

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	X	X
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Sabock (1994); Switzer (1995); Snook (1995); U.S. EPA (1994a).

10. Comments:

NEW JERSEY

The New Jersey Department of Environmental Protection and Energy (NJDEPE) Office of Land and Water Planning uses both monitored and evaluated assessment methodologies to assess surface water quality and pollution sources. Comparisons of current use attainment observations with prior NJDEPE assessments is not encouraged due to the different assessment methodologies, past versus present. Extensive macroinvertebrate assessments have replaced many of the older fisheries survey methods, which had in turn replaced methodologies based exclusively on water chemistry.

All New Jersey surface waters have been assigned a set of designated uses as defined in the State's Surface Water Quality Standards regulations, which are generally based on a set of numeric and narrative water quality criteria. The designated uses correspond to the swimmable and fish propagation and maintenance goals of national clean water legislation. The fish propagation and maintenance goal is designed to have all surface waters supporting healthy and reproducing biota.

Biological assessments of macroinvertebrate and fish communities are used to supplement ambient chemical monitoring in New Jersey. These bioassessments are useful in revealing the impact of contaminants as well as detecting chronic water quality conditions that may be overlooked by the "snapshot" results provided by ambient chemical sampling. Beginning with the 1992 water quality inventory reporting period, watershed-specific intensive macroinvertebrate monitoring surveys have been used, whenever possible, to assess the aquatic life designated use. From these Ambient Biomonitoring Program surveys (at nearly 200 monitoring sites) evaluations regarding the overall health of instream biota are estimated. Macroinvertebrate community and stream habitat assessments follow the methods and recommendations of U.S. EPA's Rapid Bioassessment Protocols (RBPs), and fish are assessed using the Index of Biotic Integrity. NJDEPE has incorporated habitat quality assessments into the macroinvertebrate community assessment process, and has established ecoregion biological reference sites (over 40) for New Jersey streams.

Bioassessment results (and comparisons to ecoregional reference conditions) allow the NJDEPE to estimate the overall health of instream biota and determine attainment of aquatic life uses.
Prior to the 1994 water quality inventory reporting period, fisheries resource information was used as an assessment tool for determining aquatic life use. The fish assessments were (and are) provided by NJDEPE Division of Fish, Game and Wildlife, and describe the diversity and health of fish communities. Health classifications were defined as healthy, moderately degraded, degraded or threatened. This assessment scheme is still being used for areas where RBPs have not yet been performed. Data from the RBP-based bioassessments, in concert with the Division of Fish, Game, and Wildlife fish community data, provide the basis for the determination of aquatic life support within New Jersey rivers and streams. RBP ratings of "no impairment" are judged to be fully supporting aquatic life use. Locations rated as "moderately impaired" are judged to be partially supporting use, and no support of use is based on a protocol rating of "severe impairment". The New Jersey rapid bioassessments are available for 13 watersheds, and NJDEPE hopes that their use will continue to increase and that they will continue to supplement fishery surveys as determinants of aquatic life use.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **NEW JERSEY**

Contact: Kevin Berry

Address: New Jersey DEPE
Office of Land and Water Planning
401 East State Street, 4th Floor
Trenton, NJ 08625

Phone/Fax: (609) 633-1179

1. Miles assessed as:

Non-impaired	222
Impaired	348
Excellent	—
Good	—
Fair	—
Poor	—
Total	570

2. Number of sites sampled: 190 benthic macroinvertebrate monitoring stations in ambient biomonitoring network. 54 streams and rivers monitored for aquatic life support (1992-1993).

3. Miles per site: Average 10.5 miles per stream/river

4. Assemblage(s): Fish; Benthic macroinvertebrates

5. Sampling gear or Method: Benthic macroinvertebrates-Rapid Bioassessment Protocol II
Fish-Index of Biotic Integrity

6. Decision criteria based on:
   - X Reference sites
   - X Ecoregional reference conditions—Number of reference sites Approximately 40
   - __ Other Explain:

7. Data Analysis/Interpretation:
   - __ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - Total family richness, EPT richness, %EPT, % contribution of dominant family, Family Biotic Index.

   Fish - Total number of fish species (excluding trout), number and identity of benthic insectivorous species, number and identity of trout or sunfish species (excluding stocked trout), number and identity of intolerant species, proportion of individuals as white sucker, proportion of individuals as omnivores, proportion of individuals as insectivorous cyprinids, proportion of individuals as trout (non-stocked) and/or proportion of individuals as piscivores, proportion of individuals with disease or anomalies, number of individuals in sample.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Berry (1994); Kurtenbach (1995); Leu (1995); New Jersey DEPE (1994); Olsen, et al. (1994); U.S. EPA (1994a).

10. Comments: Numbers presented represent 1994 305(b) reporting period (1992 and 1993).

NEW MEXICO

The New Mexico Environment Department (NMED) has not established criteria for use in water quality standards at the present time. NMED has, since 1974, used bioassessment sin addition to chemical and physical data to investigate point and nonpoint source pollution and to determine water quality trends. These bioassessments are useful in determining the impact of contaminants as well as detecting chronic water quality conditions that may not be discovered by ambient chemical and physical grab samples. from 1979 to 1987, NMED evaluated benthic community structure in streams and wadable rivers using the U.S. Forest Service's Biological Condition Index (BCI). From 1988 to the present, NMED has used USEPA's Rapid Bioassessment Protocols (RBPs) in conjunction with assessments of stream habitats to appraise benthic community structure in streams and wadable rivers. Occasional assessments of fish populations have also been conducted, although the limited diversity of fish species in many waters of New Mexico diminishes the value of such assessments. All bioassessment data obtained are entered into the USEPA BIOS database.

NMED has conducted intensive water quality surveys on reservation lands in cooperation with Tribes and Pueblos in an effort to: add valuable information to the statewide database; give Tribes and Pueblos background data for the development of water quality standards; and train Tribal and Pueblo environmental personnel. Benthic invertebrate data have been collected from all of these studies, and fish data have been collected from certain stream reaches in cooperation with the U.S. Fish and Wildlife Service and the New Mexico Game and Fish Department.

In all of these studies, benthic macroinvertebrate community data are compared to data generated from reference sites in each watershed or ecoregion, and habitat assessments are used to determine whether detected differences between stream sites and reference sites are due to habitat, water quality, or both. Data are compared between various sampling stations on a watercourse and are also compared to past biological data collected from the same stations. The benthic macroinvertebrate assessments are usually conducted during intensive water quality surveys and are usually times to coincide with annual periods of stress for the fish and macroinvertebrates of the waterbody, such as periods of annual low stream flow or highest ambient temperature.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **NEW MEXICO**

Contact: Erik Galloway

Address: New Mexico Environment Department
Surface Water Quality Bureau
P.O. Box 26110
Santa Fe, NM 87502-6110

Phone/Fax: (505) 827-2923/0160

1. Miles assessed as:

Non-impaired	314
Impaired	304
Excellent	—
Good	—
Fair	—
Poor	—
Total	618

2. Number of sites sampled: 58

3. Miles per site: Average 10.7

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method: Benthic macroinvertebrates-Rapid Bioassessment Protocol III
Fish-Index of Biotic Integrity

6. Decision criteria based on:
   - X Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Fish - Index of Biotic Integrity

   Macroinvertebrates-per RBP III

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	X	—
Numeric (in place)	—	—	—
Under development	—	—	X

9. Pertinent citations: Galloway (1994a,b, 1995); Sabock (1994); U.S. EPA (1994a).

10. Comments: Miles presented represent bioassessments conducted 1990 to 1994 per Erik Galloway.

NEW YORK

The New York State Department of Environmental Conservation (DEC) has been using surveys of biological communities to monitor and assess water quality since 1972. During the period from 1972 to 1992, 721 sites were sampled for macroinvertebrates on 170 streams. The sampling site location selection process has focused, and continues to focus on affected stream reaches. A total of 216 of the currently monitored sites have prior or historical data, allowing temporal trend analyses.

DEC uses kick sampling techniques to sample macroinvertebrates in wadable streams and rivers. The resulting data are analyzed using four indices or metrics, and the indices are plotted on a common scale to provide a biological profile. The DEC Stream Biomonitoring Unit developed impairment criteria for New York State streams in 1990, and since that time they have been used in an unofficial capacity (i.e., they have not been made part of state standards). Regardless of their placement, they have seen increasing use since their development, for the process of defining significant biological impairment.

The overall biological water quality assessment is computed using an average of the four metric values, normalized on a common zero to ten scale of water quality. Each metric measures a different aspect of the community and contributes a different piece of information to the final assessment. This diagnosis of stream water quality uses a four-tiered system of classification, and reflects both an attempt to facilitate the interpretation of bioassessments and a realization of the limitations of assessments based on non-replicated biological sampling. General descriptions of the four levels of impact are as follows:

- Non-impacted -- Indices reflect excellent water quality. The macroinvertebrate community is diverse with several major groups present. Most species are intolerant or facultative. Water quality is not limiting to fish survival or propagation.
- Slightly impacted -- Indices reflect good water quality. Macroinvertebrate species richness is lower than found at non-impacted sites. The fauna are composed mostly of facultative organisms. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.
- Moderately impacted -- Indices reflect fair water quality. Macroinvertebrate species richness is restricted. The fauna are dominated by facultative or tolerant organisms. Water quality often is limiting to fish propagation, but usually not to fish survival.
- Severely impacted -- Indices reflect poor water quality. The macroinvertebrate community is limited to a few tolerant species. The dominant species are almost all tolerant. Water quality is often limiting to both fish propagation and fish survival.

The New York State Museum routinely collects fish for purposes of distributional studies. A draft IBI for fish communities in New York State has been developed, and is under review and possible revision. Currently, however, no fish collections are being made for the purposes of water quality assessment.

STATE: **NEW YORK**

Contact: Robert Bode

Address: New York Dept. of Environmental Conservation
50 Wolf Road
Albany, NY 12233-3503

Phone/Fax: (518)285-5682/5601

1. Miles assessed as:

Non-impaired	367
Impaired	713
Excellent	—
Good	—
Fair	—
Poor	—
Total	1,080

2. Number of sites sampled: 216

3. Miles per site: 5 mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Benthic macroinvertebrates-multiple samplers and kick sampling techniques

6. Decision criteria based on:
   - X Reference sites: for impact assessment
   - __ Ecoregional reference conditions—Number of reference sites __
   - X Other Explain: State-wide temporal trends analysis. Statewide biological impairment criteria and biological impairment detection criteria procedures are established.

7. Data Analysis/Interpretation:
   - __ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates-species richness; Shannon-Wiener species diversity; Hilsenhoff's Biotic Index; EPT; Percent Model Affinity.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	—
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Bode (1995); Bode et al. (1993); Bode and Novak (1995); Hansen (1994); Leu (1995); Sabok (1994); U.S. EPA (1994a).

10. Comments: Miles presented represent 1994 305(b) 2-year reporting period. Fisheries studies may result in development of an Index of Biotic Integrity for the State.

NORTH CAROLINA

The North Carolina Division of Environmental Management (DEM) uses numerous assessment tools in evaluating prevailing water quality conditions and stream biological integrity, including, among others, macroinvertebrate surveys and fish community structure analyses. Uses of biological information range from identifying appropriate classifications for waters within entire North Carolina watersheds, to determining compliance of specified discharges with narrative standards for protecting aquatic life. Biological ratings from 1983 to 1993, as determined from benthic macroinvertebrate surveys, constitutes a valuable source of data for the most recent state biennial water quality assessment report.

The 1991 macroinvertebrate survey represents the last report that includes comprehensive statewide data. Results of these investigations have been summarized in Benthic Macroinvertebrate Ambient Network (BMAN) reports. Under the new basin-wide management program, benthic macroinvertebrate and fish community data are presented in individual basin-wide assessment reports prepared by the Biological Assessment Group. Plans are being developed for all 17 of the state's major river basins based on a five-year cycle. Macroinvertebrate and fish community surveys, special studies, and other water quality sampling activities are conducted in the second and third years of the cycle to provide information for assessing water quality status and trends throughout the basin. In addition, DEM is evaluating ecoregions, stream size, and seasonal variability as means of refining present bioclassifications. Macroinvertebrate data from North Carolina's basinwide network and special investigations are ranked on a five-point scale; excellent, good, good-fair, fair, and poor. The scale in prior years (1983-1990) had been based on taxa richness for the three pollution intolerant groups; Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), referred to as EPT. At present, in addition to taxa richness, biotic index (BI) values are being calculated for each sample. Biotic indices are calculated for both the full scale, or standard, qualitative collection technique and the abbreviated EPT collection technique. However, the biotic index is used only in full scale collections to assign a bioclassification. Classification criteria have been derived by examining EPT taxa richness and biotic index values for each combination of bioclassification, ecoregion, and season. Fish community structure data are analyzed using the North Carolina Index of Biotic Integrity (NCIBI). This index uses twelve metrics to categorize the ecological health of the waterbody as excellent, good-excellent, good, fair-good, fair, poor-fair, poor, very poor - poor, very poor, and no fish.

Specific biological indices, metrics, or numeric biocriteria are not included in North Carolina water quality regulations. Biological data and narrative biocriteria are, however, intrinsically linked to designated use classifications and to standards that protect those uses. Narratives for the protection of aquatic life are incorporated into the regulations, and the standardized biological methods are used to assess water quality impairments. All use classes in North Carolina regulations require protection of aquatic life. Both High Quality waters and Outstanding Resource waters require a rating of excellent based on biological data. In general, for use support ranking purposes, locations rated as poor with regard to biological information are not supporting, and stations rated fair are partially supporting. Stations rated as good-fair translate to support-threatened and those having good to excellent ratings are classified as supporting their designated uses.

STATE: **NORTH CAROLINA**

Contact: Dave Penrose

Address: North Carolina Division of Environmental Management
Water Quality Section
4401 Reedy Creek Road
Raleigh, NC 27607

Phone/Fax: (919) 733-6946/9959

1. Miles assessed as:

Non-impaired	5,104.7
Impaired	1,914.9
Excellent	—
Good	—
Fair	—
Poor	—
Total	7019.6

2. Number of sites sampled: 17 river basins; biological rating for 737 sites (1989-1992)

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; Fish (not reported); Periphyton (pilot studies)

5. Sampling gear or Method: Rapid Bioassessment Protocol III, North Carolina IBI

6. Decision criteria based on:
   - X Reference sites
   - X Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Benthic Macroinvertebrates: Taxa richness; EPT taxa richness; Biotic index (BI); EPT Biotic Index (BIEPT)

   Fish: IBI metrics: Number species; number of individuals; number of darter species; number of sunfish and salmonid species; number of suckers species; number of intolerant species; percent tolerant; percent omnivores; percent insectivores; percent piscivores; percent diseased; percent length distribution.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Metz (1994); NCDEM (1992,1994, 1995); Penrose (1992, 1995); Sabock (1994); U.S. EPA (1994a).

10. Comments: 5-year monitoring cycle, therefore, results span two consecutive 305(b) reporting periods (1992 and 1994 reports), and only basins sampled during 1991-1993 are updated in the 1994 report.

NORTH DAKOTA

In July of 1993 the North Dakota Department of Health (NDDH) began its biological monitoring efforts in the Red River of the North basin. This was initiated with a grant form the US Environmental Protection Agency (EPA) and involved a number of state and federal agencies. Participants included Regions V and VIII of EPA, the US Geological Survey, National Water Quality Assessment (NAWQA) Program, the Minnesota Pollution Control Agency (MPCA), the Minnesota Department of Natural Resources (MNDNR), and the North Dakota Game and Fish Department (NDG&F). The main focus of the project was to conduct biological assessments in the Red River and its tributaries to establish biological criteria for the Red River Ecoregion.

The methodology includes assessment of the fish community and the use of the Index of Biological Integrity (IBI) modified for the Red River Ecoregion. This consisted of evaluating metrics specific to the area and suitable for application in the Red River Ecoregion. Use of EPA's Rapid Bioassessment Protocols modified by M. Barbour for low gradient streams is also incorporated into the assessment

During 1993 and 1994, 54 sites were surveyed in North Dakota. Potential reference sites for the Red River Ecoregion will be established through evaluation of all the data collected in North Dakota as well as in Minnesota. Another 59 sites are located on the Minnesota side of the Red River which are also being assessed for this project.

For 1995 the NDDH has continued the fish community assessment and has added macroinvertebrate community sampling to compliment the fish data. 50 sites were sampled in the upper Red River basin including the Sheyenne, Bois de Sioux, Wild Rice, Maple, Rush and Red rivers. Objectives of this separate study are to develop field sampling procedures for stream macroinvertebrate communities, develop laboratory procedures for macroinvertebrate identification and enumeration, and to develop potential metrics for macroinvertebrates and evaluate their usefulness in developing biological criteria along with the IBI as a stream water quality protection and assessment tool.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **NORTH DAKOTA**

Contact: Mike Ell

Address: North Dakota Department of Health
Division of Water Supply and Pollution Control
P.O. Box 5520
Bismarck, ND 58502-5520

Phone/Fax: (701) 328-5210/5200

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Pilot Studies

2. Number of sites sampled: Pilot studies in Red River ecosystem. 54 sites sampled during 1993-1994 and 50 sites added in 1995

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates (under development)

5. Sampling gear or Method: Index of Biotic Integrity (under development)

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Fish - Index of Biotic Integrity, and habitat under development

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	___	___
Numeric (in place)	___	___	___
Under development	X	X	___

9. Pertinent citations: Ell (1994); Fewless (1995); Pearson (1995); Sabock (1994); U.S. EPA (1993a, 1994a).

10. Comments: Fish IBI-Joint agency participation in identifying potential reference sites and evaluating metrics for the Red River basin.

OHIO

The Ohio Environmental Protection Agency (EPA), Division of Surface Water, Monitoring and Assessment Section, Ecological Assessment Unit uses biological monitoring and assessment data to support their water quality standards program. Narrative biocriteria were established in 1980 and reflected the ecological components of the narrative aquatic life use designations. The purposes of the early narrative biocriteria were to provide a logical process for assignment of aquatic life use categories and provide a consistent approach for determining and communicating the severity of impairment to the aquatic biota. However, considerable "best professional judgement" was necessary for these assignments to be made. Biological monitoring and assessment using standardized sampling, analysis, and interpretive approaches (multimetric approach and ecoregional reference conditions) allowed development of scientifically-rigorous biological decision thresholds. These thresholds became a formal component of Ohio's water quality standards program when they were adopted as numerical biological criteria in 1990.

Ohio EPA samples both fish and benthic macroinvertebrates using electroshocking for fish and artificial substrates (Hester-Dendy Multiplate Samplers) supplemented with a qualitative, natural substrate sample for benthic macroinvertebrates. Twelve fish metrics are used for the Index of Biotic Integrity (IBI) and ten are used in the Invertebrate Community Index (ICI). A multiparameter physical habitat assessment approach, the Qualitative Habitat Evaluation Index (QHEI), is used to assess and document degradation of physical habitat that may be preventing attainment of the aquatic life use.

The determination of aquatic life use attainment status is the most common application of biological assessments. Individual locations can be assessed as in "full", "partial", or "non-attainment" using a combination of fish and benthic macroinvertebrate indices. The biomonitoring results are also used for reporting the status of a water resource relative to biological integrity or reference conditions. Results indicate that biological integrity is either being maintained or that it needs to be restored (as per the Clean Water Act), and are used to track progress towards meeting that goal.

There are five primary uses of the biomonitoring and assessment results in the realm of water resource management in Ohio:

- the Ohio Water Resource Inventory (CWA Section 305b report),
- nonpoint source assessment and management,
- dredge-and-fill (401 Certifications),
- the National Pollution Discharge Elimination System (NPDES) Permit Program, and
- risk assessment to aquatic life from hazardous waste sites.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **OHIO**

Contact: Chris Yoder

Address: Ohio EPA
Ecological Assessment Unit
1685 Westbelt Drive
Columbus, OH 43228

Phone/Fax: (614) 728-3382

1. Miles assessed as:

Non-impaired	3,432
Impaired	4,905
Excellent	—
Good	—
Fair	—
Poor	—
Total	8,337

2. Number of sites sampled: Approximately 1830 sites sampled from 1989 through 1993

3. Miles per site: Approximate 4.6 site/mile average

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method:

Benthic macroinvertebrates- Invertebrate Community Index; Hester-Dendy Artifical Substrates and Dip-Net/Hand-Pick of natural substrate.

Fish- IBI, modified index of well-being; electrofishing.

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites over 246
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

Fish - IBI and modified IWB (including number of indigenous species, darter species, sunfish species, headwater species, sucker species, minnow species, intolerant species, sensitive species; Proportion as round-bodied Catostomidae; % as tolerant species; proportion as omnivores, insectivores, top carnivores, pioneering species, simple lithophils; number of individuals in sample; number of simple lithophilic species; proportion of individuals with deformities, eroded fins, lesions, tumors).

Macroinvertebrates - total taxa; total mayfly, caddisfly, dipteran taxa; % mayflies; % caddisflies; % tolerants; EPT; % Tribe Tanytarsini; % Other Dipterans and other non-insects; Community Similarity Index.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	X	X	X
Under development	—	—	—

9. Pertinent citations: DeShon (1995); Ohio EPA (1994a,b); Rankin (1995a,b); Sabock (1994); U.S. EPA (1994a); Yoder and Rankin (1995a,b).

10. Comments: Miles presented represent the 1994 305(b) reporting period (1989-1993 biosurveys).

OKLAHOMA

The Oklahoma Department of Environmental Quality (DEQ) uses bioassessment results to measure nonpoint source implementation effectiveness and to identify impaired waters for biennial reporting in the Water Quality Assessment Report. A multimetric approach based on the technical guidance of U.S. EPA's Rapid Bioassessment Protocols (RBPs) and the Index of Biotic Integrity (IBI) is used to assess the community condition of Oklahoma macroinvertebrate and fish assemblages for water resource management purposes. DEQ is beginning to examine ecoregional differences in biota and initiating the process of developing regional reference expectations.

The Oklahoma Conservation Commission (OCC) has developed and is refining protocols for rapid bioassessments using diatom communities. In the process of developing the protocol, OCC sampled approximately 25 streams in three geographic areas of Oklahoma. Bioassessments using existing RBPs were conducted twice per year for macroinvertebrates, once per year for fish, and simultaneously (i.e., along with each fish and macroinvertebrate collection) for diatoms. The streams selected for bioassessment primarily draining rural watersheds; however, some drain urban areas, and of these, some receive discharge from municipal wastewater treatment plants. The goals of the OCC research have included: the identification of optimal sampling substrates and seasons, the investigation into the relationship between chemical parameters and community response, and the investigation into ecoregional differences in biotic (especially diatom) communities.

At present, Oklahoma has not developed numeric biocriteria or formally incorporated bioassessment scores or ratings into their water quality standards. Biological narratives are however included as an aquatic life use designation component. Aquatic life use support is composed of warm water aquatic community, habitat limited aquatic community, cool water aquatic community, and trout fishery subcategories. Criteria for support status include biological components of: evidence of habitat or community modification; point or nonpoint source effects on habitat or community; and no algal blooms, surface scum, mats, nuisance macrophyte growth, or periphyton growth. Water bodies with no evidence of habitat or community modification; no nonpoint or point source affects on habitat or communities; and no nuisance algal periphyton or macrophyte growths possess attributes that are indicative of full support of designated aquatic life use.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **OKLAHOMA**

Contact: John Dyer

Address: Oklahoma Dept. of Environmental Quality
Water Quality Division
1000 Tenth Street
Oklahoma City, OK 73117-1212

Phone/Fax: (405) 271-5205

1. Miles assessed as:

Non-impaired	___
Impaired	___
Excellent	___
Good	___
Fair	___
Poor	___
Total	Not Reported

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates; periphyton; diatoms (UD)

5. Sampling gear or Method: Benthic macroinvertebrates-Rapid Bioassessment Protocol III
Fish-Rapid Bioassessment Protocol V

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - taxa richness; modified HBI; ratio of scrapers to scrapers and filtering collectors; ratio EPT/Chironomid + EPT; percent contribution of dominant taxa; EPT index; community loss index.

   Fish - Total species; number of sensitive benthic species; number of sunfish species, minnow species, intolerant species; proportion of individuals as tolerant species, omnivores, insectivorous cyprinids, top carnivores; number of individuals in sample.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Butler (1994); Dyer (1994); Oklahoma Conservation Commission (1993); Oklahoma Department of Environmental Quality (1994); Sabock (1994); Smithee (1994); U.S. EPA (1994a).

10. Comments:

OREGON

The Oregon Department of Environmental Quality (DEQ) has developed a state-wide biological monitoring and assessment strategy. Objectives of the DEQ bioassessment strategy include

- assessment of monitoring techniques and development of guidelines for the entire state,
- determination of the sensitivity of different monitoring techniques to nonpoint source (NPS) pollution effects,
- evaluation of the effectiveness of monitoring techniques for different NPS problems (e.g., logging, agriculture), and
- collection of reference site data to allow the development of biocriteria.

The DEQ biological monitoring programs include macroinvertebrate and fish community assessments, and periphyton growth studies. The methods currently used by DEQ for macroinvertebrate and fish assessments are U.S. EPA's Rapid Bioassessment Protocols (RBPs). Algae are an important component of aquatic systems; however, their use in monitoring water quality impacts is not as widespread as the use of macroinvertebrate periphyton growth studies in a project-specific application to monitor changes in nutrient concentrations in the Grande Ronde River in eastern Oregon.

Oregon state bioassessment protocols represent an integrated, comprehensive approach to water quality monitoring that involves the analysis of stream habitat, physicochemical parameters, and the biological community. The characterization of physical habitat includes 26 habitat parameters and follows the technical guidance of the RBPs. The application of this integrated bioassessment approach focuses on determination of NPS effects. In that context, DEQ completed 83 stream biosurveys during the 1994 Water Quality Status Assessment reporting period. During the same time period, DEQ initiated studies to establish background data at reference sites within subecoregions of the Oregon Coast Range, and implemented a long-term watershed assessment study in the Grande Ronde Basin.

DEQ refinement of bioassessment field monitoring and analysis methods continue. Analysis of macroinvertebrate and fish community data and the assessment of biological condition is based on a number of biological metrics or population characteristics. The biological metrics are scored for each monitoring site according to their percent of variation from the reference condition, and are summed to provide an overall site assessment (as per RBP guidance). DEQ uses the assessment results to evaluate areas that allow conditions of concern, including point source discharges as well as areas of potential NPS impact.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **OREGON**

Contact: Rick Hafele

Address: Oregon Dept. of Environmental Quality
1712 S.W. 11th Street
Portland, OR 97201

Phone/Fax: (503) 229-5983

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Pilot Studies

2. Number of sites sampled: 45 sites for benthic macroinvertebrates in 1991
   83 stream biosurveys in 1992-1993 (fish, macroinvertebrates and habitat)

3. Miles per site:

4. Assemblage(s): Fish; Benthic macroinvertebrates; Periphyton (under development)

5. Sampling gear or Method: Benthic macroinvertebrates-Rapid Bioassessment Protocol III
   Fish-Rapid Bioassessment Protocol V (under development)

6. Decision criteria based on:
   - ___ Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Macroinvertebrates - taxa richness; HBI; ratio scrapers/filtering collectors; ratio EPT and Chironomid abundance; percent contribution dominant taxa; EPT Index; Community Loss Index.

   Fish - Number of native species; Number of salmonid age classes; Number of sculpin species; Number of salmonid yearlings; Number of cyprinid species; Number of sucker species; Number of adult trout species.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Hafele (1994); Hayslip (1993); Oregon DEQ (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Information on number of sites sampled taken from 1994 305(b) report.

PENNSYLVANIA

The Pennsylvania Department of Environmental Protection (DEP) has operated an ambient, fixed station surface water quality monitoring system, the Water Quality Network (WQN) since 1950. DEP has been conducting biological assessments since 1968. The WQN data, which has included benthic macroinvertebrate data since 1972, is used primarily for trends assessment and as background data for permitting. Other biological assessments focus primarily on benthic macroinvertebrates and are used to establish cause and effect relationships, evaluate aquatic life use attainability, and to evaluate candidate waters for special water quality protection (antidegradation).

Traditionally, biological assessment have been based on qualitative (kick screen) or quantitative (Surber sampler) benthic macroinvertebrate data. However, PA DEP has recently begun development of a multimetric approach based upon modification of the U.S. EPA Rapid Bioassessment Protocols (RBPs). Pennsylvania has been divided into nine ecoregions and 27 sub-ecoregions by Omernik, allowing for possible establishment of ecoregion reference stations.

DEP Central Office biologists have been using a modification of RBP III since 1992 in evaluating candidate waterbodies for special water quality protection. Habitat is assessed using the RBP methodology to ensure that habitat is not a limiting factor in the bioassessment. Benthos samples come from two D-frame nets, with 100 organism subsamples identified and enumerated for calculating metrics (see opposite page). In addition to this application, some regional biologists are using RBP III in cause and effect surveys.

DEP is working to further apply RBP benthic macroinvertebrate methods and ecoregions in the bioassessment program, and possibly may move toward numeric biocriteria. A U.S. EPA funded project is underway to evaluate metrics, determine the best metrics to classify various stream types (i.e., coldwater, warmwater, freestone, limestone, various drainage areas), and possibly define ecoregion reference stations.

DEP recognizes the need to incorporate assessment of fish populations into the program. A U.S. EPA funded project conducted by the Pennsylvania Fish and Boat Commission (PFBC) will soon begin to evaluate metrics for various types of fish communities.

STATE: **PENNSYLVANIA**

Contact: Robert Frey

Address: Pennsylvania Department of Environmental Protection
Bureau of Water Quality Management
P.O. Box 8465, 10th floor
Harrisburg, PA 17105-8465

Phone/Fax: (717) 783-3638/5156

1. Miles assessed as:

Non-impaired	1296.6
Impaired	674.9
Excellent	—
Good	—
Fair	—
Poor	—
Total	1971.5

2. Number of sites sampled: 168 fixed annual monitoring stations

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Modified Rapid Bioassessment Protocol III

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Evaluating RBP macroinvertebrate metrics: taxa richness, modified EPT index, modified Hisenhoff Biotic Index, % dominant taxon, and modified % mayflies.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Frey (1994, 1995a,b); Sabock, (1994); Shertzer (1994); U.S. EPA (1994a).

10. Comments: Miles represent 5 years of data (1989-1993) per 305(b) guidance and R. Frey personal communication.

RHODE ISLAND

The importance of biological assessments in the evaluation of water quality has long been recognized in Rhode Island. The Rhode Island Department of Environmental Management, Division of Water Resources (RIDEM/DWR) uses two types of benthic macroinvertebrate monitoring programs: artificial substrates to evaluate deep freshwater habitats, and EPA's Rapid Bioassessment Protocols (RBPs) for shallow freshwater habitats.

Artificial substrate sampling has been part of the State program since 1974. Fullner multiplate samplers with 14 plates are used and the macroinvertebrates are classified according to their tolerance to organic wastes by the following categories: tolerant, facultative or intermediate, and intolerant or sensitive. Stations selected for this sampling included those used for the U.S. Geological Survey chemical trend assessments.

RBPs involve an integrated assessment, comparing habitat (physical structure, flow regime) and biological measures with defined reference site conditions. Since 1990, a network of 42 stream riffles have been surveyed by Roger Williams University in cooperation with, and contracted, by RIDEM. Each site is visited during the spring-summer season and macroinvertebrates are sampled for a minimum of 100 organisms per site (where feasible). Data are analyzed using RBP I, II, and/or III which include varying degrees of field and laboratory identification.

The streams sampled within the state range in stream order from first order to fifth order. Eight of the streams are considered to be first order, 18 second order, 12 third order, four fourth order and three fifth order. The 1993 data collection occurred during drought conditions that may have resulted in fewer riffles, lower dilution and lack of runoff. This probably affected the types of organisms collected and resulted in an altered picture of the stations based on the metrics, from that seen in 1991 and 1992.

Initial bioassessment work involved establishing and field testing the RBPs, and the Fall River was selected as the reference station in 1992. Further evaluation resulted in using the Wood River station as the reference site for 1993. Refinements of the protocols has established the presence of two sub-ecoregions within the State: coastal areas and inland areas. Incorporation of the presence of these two sub-ecoregions into selection of reference sites and application of the protocols continued in 1994.

STATE: **RHODE ISLAND**

Contact: Carlene Newman

Address: Rhode Island Department of Environmental Management
Division of Water Resources
291 Promenade Street
Providence, RI 02908-5767

Phone/Fax: (401) 277-3961

1. Miles assessed as:

Non-impaired	261
Impaired	79
Excellent	—
Good	—
Fair	—
Poor	—
Total	340

2. Number of sites sampled: 56

3. Miles per site: Average 6 miles per site.

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol II

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain: State-wide

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological and habitat

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Newman (1995); Rhode Island DEM (1994); Richardson (1995a,b); Sabock (1994); U.S. EPA (1994a)

10. Comments: Miles and site numbers taken from RI DEM -- R. Richardson and C. Newman, personal communication -- and represent the 1994 305(b) reporting period for 1992 and 1993.

SOUTH CAROLINA

The South Carolina Department of Health and Environmental Control (DHEC) conducts bioassessments as part of the state trend monitoring program and during special intensive project-specific investigations. Typically, DHEC has used bioassessments to document discharge permit violations of narrative biocriteria, primarily through upstream comparisons of macroinvertebrate communities.

The current DHEC biological monitoring network for wadable rivers and streams consists of a total of 125 stations. Macroinvertebrates are collected from the monitoring stations on a five-year rotating basis in conjunction with the DHEC watershed Water Quality Management Strategy. Approximately on-fifth (i.e., one watershed) of the stations are sampled each year. The biological sampling stations are located in headwater reaches of selected impoundments; in streams subject to possible pollution point and nonpoint sources; and in critical waters used for water supplies, recreation, and fish and wildlife propagation.

Qualitative collection techniques are used during macroinvertebrate surveys. Data collected from the biological monitoring program are summarized using measures of relative abundance and species richness. Reference data are collected at upstream locations or, in some cases, from neighboring catchments. In addition to macroinvertebrate community assessments, DHEC biologists have been conducting pilot studies of the fish community to test the utility of the Index of Biotic Integrity.

Narrative biological criteria in South Carolina provide for the survival and propagation of a balanced indigenous aquatic community. DHEC uses biological data to aid in processes to determine if water quality meets the standards established to protect state classified uses. In general, support of aquatic life uses is determined by the percentage of dissolved oxygen or pH excursions, heavy metal concentrations, and impacts to the macroinvertebrate community. In the process of determining classified use attainment in South Carolina, biological data will override chemical data. For example, if ambient chemical concentrations are higher than national criteria, the criteria are not considered violated if biological monitoring has demonstrated that the instream indigenous biological community is not adversely impacted. Conversely, an impacted macroinvertebrate community reduces use support to non-support status, even if chemical data indicate full support (i.e., ambient concentrations lower than national criteria).

STATE BIOASSESSMENT PROGRAMS FOR STREAMS

STATE: **SOUTH CAROLINA**

Contact: David Chestnut

Address: South Carolina Department of Health and Environmental Control, Bureau of Water Pollution Control
2600 Bull Street
Columbia, SC 29201

Phone/Fax: (803)734-5300

1. Miles assessed as:

Non-impaired	260	Full Support	52 sites
Impaired	40	Partial Support	3 sites
Excellent	___	NonSupport	5 sites
Good	___		
Fair	___		
Poor	___		
Total	300		

2. Number of sites sampled: 125 on 5-year rotating basis -- approximately 25 sampled annually

3. Miles per site: 5 mile (default) per station

4. Assemblage(s): Benthic macroinvertebrates; Fish (Under development)

5. Sampling gear or Method: Benthic macroinvertebrates - Qualitative collection techniques
Fish - Index of Biotic Integrity pilot studies

6. Decision criteria based on:
   - X Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - ___ Multimetric approach—Metrics used or under development:

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Penrose (1992); Renfrow (1995); South Carolina DHEC (1993, 1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Samples collected during 1991-1993 from the Savannah River basin (1991), Saluda and Edisto River basins(1992) and the Catawba/Wateree River bains (1993). An additional 56 sites from 1994 and 1995 are being evaluated from the Pee Dee River basin and Broad River basin.

SOUTH DAKOTA

The South Dakota Department of the Environment and Natural Resources (DENR) does not have a statewide bioassessment program. Cursory biological sampling, however, may be included as part of a diagnostic/feasibility study or a special study such as the sampling of macroinvertebrates for the Whitewood Creek Project in the Black Hills.

Fisheries surveys, conducted by the DENR Office of Water Quality, are used in conjunction with water quality surveys to evaluate wastewater point source impact on receiving streams. Although qualitative in nature, fish survey results (e.g., fish abundance and diversity trends) assist in the evaluation of water quality perturbations or impact. Typically, fisheries sample sites are situated upstream and downstream from wastewater treatment plant effluents, and surveys are conducted prior to and following facility construction and/or upgrades. Fisheries surveys are also conducted to evaluate the fish life propagation classification of streams or stream segments. South Dakota surface waters are classified for beneficial uses which include the following narrative fisheries standards: cold water permanent, cold water marginal, warm water permanent, warm water semipermanent, and warm water marginal fish life propagation waters.

STATE: **SOUTH DAKOTA**

Contact: Andrew Repsys

Address: South Dakota Department of the Environment and Natural Resources, Division of Water Resource Management
523 East Capitol, Joe Foss Building, Room 425 Pierre, SD 57501-3181

Phone/Fax: (605) 773-3696

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Not Applicable

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s):

5. Sampling gear or Method:

6. Decision criteria based on:
   - ___ Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - ___ Multimetric approach—Metrics used or under development:

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	___	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Repsys (1995); Sabock (1994); South Dakota DENR (1994); U.S. EPA (1994a).

10. Comments: No bioassessment program. A small study of benthic macroinvertebrates (Hess samples) was initiated in Black Hills streams but not completed. Narrative Fisheries Standards are used in water quality standards program.

TENNESSEE

The Tennessee Department of Environment and Conservation (TDEC) sponsored a habitat assessment and bioassessment workshop during 1994. The purpose of the workshop was to initiate a multiagency effort to: standardize habitat assessment, macroinvertebrate and fish sampling protocols; update and refine current methods; and develop a groundwork based on consensus for a written set of state standard operating procedures. Technical issues addressed during the workshop included selecting reference conditions, taking representative samples (i.e., standard field sampling methodologies), identifying source and cause (i.e., habitat versus chemical), and accounting for seasonal effects. The workgroup adopted use of: U.S. EPA's Rapid Bioassessment Protocol (RBP) modified habitat assessment procedures; modified RBP V fish protocols developed by the Tennessee Valley Authority (TVA) and Tennessee Wildlife Resources Agency (TWRA); and modified RBPIII for macroinvertebrates. The primary result of the workshop was the product of draft state bioassessment protocols, initially by TDEC, Department of Health, and TWRA, with other state agencies to be included as they are identified.

The State of Tennessee draft protocols for the bioassessments of fish and macroinvertebrates use the multimetric approaches of the Index of Biotic Integrity and RBPIII, respectively. With some modifications, the twelve IBI metrics may be applicable in most ecoregions of the state. Macroinvertebrate RBPIII is applicable to most of the state and utilizes riffle/run habitat as the most productive habitat, when riffle/run is characteristic in that stream system. In western Tennessee, however, many streams lack this habitat. Therefore, to ensure the accuracy of evaluating communities in that region, RBPIII has been modified to include sampling of other productive habitats including rocks, logs, banks and roots, macrophyte beds, pool sediments, etc. Effects among sampling locations are then evaluated using only comparable habitats.

The overall assessment of ecological condition derived using the draft protocols first focuses on the evaluation of habitat quality, then analyzes the biological components of the system in light of the habitat data. The matrix used for habitat assessment is based on physical characteristics of the waterbody and surrounding land. The assessment process involves rating the parameters as optimal, suboptimal, marginal, or poor based on the modified RBP guidance. A total score is obtained for each station and compared to a site-specific control and/or regional reference station. The ratio between the indicator station and reference provides a percent comparability measure, allowing the classification of each station based on its potential to support an acceptable level of biological health. The eventual understanding of ecoregional relationships in Tennessee and establishment of ecoregional reference sites will help to eliminate the limitations of assessing impairments that occur when site-specific or upstream-downstream comparisons are used.

Two ecoregional reference locations have been established as part of the state's nonpoint source pollution program. Effective July 1, 1995, the nonpoint source pollution program was transferred from TDEC to the Tennessee Department of Agriculture. Until additional statewide ecoregional reference sites are established, TDEC is using upstream reference sites to assess stream impacts on a case by case basis. On the average, twenty bioassessments and intensive stream surveys were conducted by DEC during the last five years. Prior to the development of the new draft bioassessment protocols (and until the protocols are refined) TDEC has used (and is using) biotic indices and tolerance estimates for invertebrates that have been modified from North Carolina and Hilsenhoff indices. The refinement and calibration of the new draft protocols is emphasized by TDEC as a priority need, and the eventual development of numeric biocriteria is a Department initiative.

The Tennessee Valley Authority also conducts biological assessments, and in 1994, sampled the Holston River watershed for fish assemblages and assessed quality using an Index of Biotic Integrity. The results from that study are presented for the Tennessee portion of the watershed.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **TENNESSEE**

Contact: Greg Denton

Address: Tennessee Department of Environment and Conservation, Division of Water Pollution Control
401 Church Street, L&C Annex, 6th Floor
Nashville, TN 37243-1534

Phone/Fax: (615)532-0699

1. Miles assessed as:

Non-impaired	36.2	Excellent	___
Impaired	70.3	Good/Excellent	10.3
Excellent	___	Good	15.3
Good	___	Fair/Good	10.6
Fair	___	Fair	29.4
Poor	___	Poor/Fair	22.3
		Poor	18.0
		Very Poor/Fair	0.6
Total	106.5 miles*		

2. Number of sites sampled: 20 rapid bioassessment/stream surveys conducted during FY 1991, and on an average over each of the past five years. 44 locations in the Holston River watershed were sampled by TVA in 1994 and reported here.

3. Miles per site: Approximately 2.4 miles per site.

4. Assemblage(s): Benthic macroinvertebrates; Fish (under development, conducted by TVA)

5. Sampling gear or Method: Benthic macroinvertebrates - qualitative techniques and Hester-Dendy multiplates
Fish - Index of Biotic Integrity. Currently developing statewide protocols for modified RBPIII and V.

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - UD Multimetric approach—Metrics used or under development:

   Macroinvertebrates - Taxa richness; EPT index; modified HBI; Ratio of EPT and Chironomidae organism abundance; Ratio of scraper and filtering collectors; Ratio of shredders to total individuals; Indicator Assemblage Index; % Contribution dominant taxon; Dominants in common; community loss index; Jaccard Coefficient.

   Fish - Total number of native species, darter species, sunfish species (less *Micropterus*), sucker species, intolerant species; % as tolerant species, omnivores, specialized insectivores, piscivores, hybrids; catch rate (catch per area or catch per effort); % of fish with disease, fin damage, and other anomalies.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	___	___
Numeric (in place)	UD	___	___
Under development	___	X	X

9. Pertinent citations: Broach (1995); Harrison (1995b); Penrose (1992); Sabock (1994); Tennessee DEC (1994, 1995a,b); U.S. EPA (1994a).

10. Comments: Results are based on Tennessee Valley Authority sampling during 1994.

TEXAS

The TNRCC Surface Water Quality Monitoring Program (SWQMP) uses biological monitoring (fish and macrobenthos) to provide integrated evaluations of water quality. Standard procedures for freshwater macroinvertebrate monitoring are being evaluated and may change to be modeled after the EPA Rapid Bioassessment Protocols (RBPs). Currently, Surber samplers are used in riffles and Ekman dredges in pooled areas. During 1994, macrobenthic community monitoring was conducted at 47 SWQMP fixed stations. Fish communities are also monitored, with electrofishing (both generator powered boat mounted rigs, and battery powered backpack units) the most common collection method. In areas where electrofishing is not feasible, seines, gill nets, and trawls may be used. During 1994, fish community monitoring was conducted at 47 SWQMP stations. The biological protocols are under review and may change when ecoregional studies are completed and evaluated.

Ecoregional monitoring is also conducted cooperatively, involving the TNRCC, Texas Parks and Wildlife, and U.S. EPA Region 6, to describe the characteristic water quality, habitat diversity, and biological communities of least impacted waters in ecoregions of the State. All TNRCC regional office boundaries are overlapped by at least two ecoregions and one has portions of four. Ecoregional monitoring was initiated in 1990 to encourage SWQMP personnel to explore realistically attainable conditions that exist in least impacted waterbodies within their regions. Fifteen sites are monitored for at least one year at quarterly frequencies to ascertain seasonal influences. Sites are usually rotated annually to different locations within the same ecoregions to allow better determination of the range of expectations within the region, or to a different ecoregion to ascertain differences among regions. Existing sites may be resampled several years later to provide evaluate trends. Ecoregion monitoring will generate regional reference databases that may be used to establish water quality standards, develop biological criteria, establish background conditions, and assist in the assessment of aquatic life uses in unclassified waters. At this point, the TNRCC has not developed formal biological criteria, but they have incorporated bioassessments into their aquatic life use assessments.

Recently TNRCC led a multi-agency team in a synoptic survey of the Rio Grande River as part of the Rio Grande Toxic Substances Agreement. The survey was designed to examine the presence, magnitude and impacts of toxic chemicals in the river. The study area extended from Brownsville/Matamoros to El Paso/Juarez, with sampling concentrated in eight river reaches where the greatest likelihood for toxic chemical contamination exists. A total of 19 Rio Grande and 26 tributary sites were sampled. Biological assessments of fish and macroinvertebrate were included as a major study component. Study results indicated that some concentrations of toxicants exceeded water quality standards, whereas the biological survey results indicated that if toxic impacts were occurring, the effects were relatively slight.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **TEXAS**

Contact: Charles Bayer

Address: Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087

Phone/Fax: (512) 239-4583 /4420

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Not Reported

2. Number of sites sampled: 47 fixed stations; 35 Rio Grande basin sites

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method: Benthic macroinvertebrates: Surber samplers in riffles, Ekman dredges in pools
   Fish: Site dependent; seines, electrofishers, gill nets, hoop nets

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites 14
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological

   Benthic Macroinvertebrates: species richness; standing crop; EPT index; diversity index; equitability; community trophic structure.

   Fish: Species richness; standing crop; diversity index; Index of Biotic Integrity. IBI Metrics: total number fish species; total number darter species; total number sunfish species; total number suckers species; total number intolerant species; proportion of individuals as tolerants; proportion of individualsas omnivores; proportion of individuals as insectivores; proportion of individuals as piscivores; number of individuals in sample; proportion of individualsas hybrids; proportion of individuals with disease or other anamoly.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	___	X	X
Under development	X	___	___

9. Pertinent citations: Bayer (1995a,b); Sabock (1994); Twidwell (1994); Twidwell and Davis (1989); U.S. EPA (1994a,c).

10. Comments: Bioassessments used to determine designated uses for NPDES permit applications.

UTAH

The Utah Department of Environmental Quality (DEQ) does not have a statewide bioassessment program. DEQ biological monitoring of streams has been limited to a study that was initiated approximately 20 years ago. The study was developed to monitor long-term trends in the benthic macroinvertebrate community, and was (and is) conducted using a Hess sampler at 20 sites (sampled twice per year). An additional 10 sites are sampled annually as part of the DEQ nonpoint source program; however, they are strictly project oriented. At present, DEQ does not use bioassessments or biological criteria in their water quality standards program.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **UTAH**

Contact: Richard Denton

Address: Utah Department of Environmental Quality
Division of Water Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870

Phone/Fax: (801)538-6859

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Not Applicable

2. Number of sites sampled:

3. Miles per site:

4. Assemblage(s):

5. Sampling gear or Method:

6. Decision criteria based on:
   - ___ Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - ___ Multimetric approach—Metrics used or under development:

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	___	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Denton (1995); Sabock (1994); U.S. EPA (1994a).

10. Comments: Undertaking habitat monitoring in addition to chemical sampling. Long-term benthic monitoring program started 20 years ago to monitor trends. An additional 10 stations sampled each year as part of nonpoint source program -- strictly project oriented. Much of the biological sampling in the state is conducted by various Federal agencies.

VERMONT

The Vermont Department of Environmental Conservation (DEC) has had an active biomonitoring program since 1982. It became formalized into the present Ambient Biomonitoring Network (ABN) Program in 1985. The ABN is the most extensive program implemented by the Biomonitoring and Aquatic Studies Unit. ABN goals are to:

- monitor long-term trends in water quality as revealed in changes over time to ambient aquatic biological communities,
- evaluate site-specific impacts of point and nonpoint discharges to aquatic biological communities, and
- establish baseline data to assist in establishing biological criteria for water quality classification attainment determinations.

Since the inception of the ABN, DEC has utilized standardized methods for sampling fish and macroinvertebrate communities, evaluating physical habitat, processing samples, and analyzing and evaluating data. The program has led to the development of a Vermont fish community Index of Biotic Integrity (IBI), as well as guidelines for determining water quality classification attainment using macroinvertebrate community biological metrics and the Vermont IBI. The DEC protocols represent a Vermont-specific modification of U.S. EPA's Rapid Bioassessment Protocols (RBPs).

A total of approximately 350 individual sites have been sampled sine the inception of the ABN in 1985. Presently, between 50 and 60 sites are evaluated each year during a 2-month summer-to-fall index period. Fifteen reference sites are sampled each year from a group of 30 reference sites that have been selected to define the biological potential of different stream types (as defined by gradient, drainage area, elevation and alkalinity).

Measures of biological integrity are used in the determination of aquatic life use attainment for Vermont streams. Both fish and macroinvertebrate communities are used to assess the overall community integrity. Fish biological integrity ratings are based on IBI scores, and macroinvertebrate community integrity is determined by evaluating the rating and degree of each metric and evaluating the number of metrics that are found to be in an acceptable versus unacceptable range. Biological integrity ratings of poor, fair, good and excellent indicate non-support, partial support, support, and support (equal to reference condition) of aquatic life uses, respectively.

STATE: **VERMONT**

Contact: Steve Fiske

Address: Vermont Dept. of Environmental Conservation
Agency of Natural Resources
Water Quality Division
103 S. Main Street
Waterbury, VT 05671-0408

Phone/Fax: (802) 244-4520/241-3308

1. Miles assessed as:

Non-impaired	890
Impaired	425
Excellent	—
Good	—
Fair	—
Poor	—
Total	1,315

2. Number of sites sampled: Average 50-60 per year; 263 during 1990-1993 reporting period

3. Miles per site: 5 mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method: Modified Rapid Bioassessment Protocols including modified Index of Biotic Integrity

6. Decision criteria based on:
   - X Reference sites
   - X Ecoregional reference conditions—Number of reference sites 30 total -15 sampled/year
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Biological and Habitat: Macroinvertebrates - relative abundance; Biotic Index; Shannon Weaver Diversity Index; Pinkham-Pearson Coefficient of Similarity; EPT taxa richness; % dominant genera; EPT/EPT +Chironomidae; functional group analysis (under development).

   Fish - number of species; number and identity of intolerant species; number and identity of benthic insectivore species; proportion of individuals as blacknose dace; proportion of individuals as generalist feeders; proportion of individuals as insectivores; proportion of individuals as top carnivores; proportion of individuals with disease, tumors, fin damage or other anomalies; abundance in sample.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	UD	—	—
Under development	—	—	—

9. Pertinent citations: Burnham (1994, 1995); Fiske (1994, 1995); McArdle (1994); Sabock(1994); U.S. EPA (1994a); Vermont DEC (1994).

10. Comments: Miles presented represent 1994 305(b) information for bioassessments conducted from 1990-1993. During 1995 and 1996, VT DEC will be considering all possible biological metrics (from the literature and other states). The metrics and the ecoregional reference condition approach will be used to define "expected" biological conditions for Vermont streams.

VIRGINIA

The Virginia Department of Environmental Quality (DEQ) Biological Monitoring Program is an integral component of the state's Surface Ambient Water Quality Monitoring Program. The Biological Monitoring Program utilizes the study of benthic macroinvertebrate communities to determine overall water quality. The program is composed of approximately 187 monitoring stations that are examined twice (spring and fall) annually.

DEQ has been conducting qualitative and semi-quantitative biological assessments since 1978. Beginning in 1990, DEQ adopted use of U.S. EPA's Rapid Bioassessment Protocols (RBPs) for bioassessments of Virginia streams. Technical guidance provided by RBP's is used for both macroinvertebrate community and stream habitat assessments. The habitat assessments are used to provide information on the comparability of each stream station to a reference site.

Virginia stream bioassessment data are used to assess water quality for support of designated uses and the Clean Water Act fishable and swimmable goals. In assessing the degree of support of the fishable goal, communities characterized as non-impaired, moderately impaired, or severely impaired via RBPs methodologies correspond directly to Clean Water Act goal categories of fully supporting, partially supporting, and non-supporting, respectively.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **VIRGINIA**

Contact: Lou Seivard

Address: Virginia Dept. of Environmental Quality
Water Division
P.O. Box 11143
Richmond, VA 23230-1143

Phone/Fax: (804) 762-4121/4522

1. Miles assessed as:

Non-impaired	460
Impaired	685
Excellent	—
Good	—
Fair	—
Poor	—
Total	1,145

2. Number of sites sampled: 229 (1991-1993)

3. Miles per site: 5 mile (default) per station

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol II

6. Decision criteria based on:
   - X Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological and Habitat per RBP

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Sabock (1994); Seivard (1995); U.S. EPA (1994a); Virginia DEQ (1994).

10. Comments: Miles represent the 1994 305(b) reporting period (1 Jul 1991 - 30 Jun 1993).

WASHINGTON

The Washington State Department of Ecology (DOE) uses biological assessments of surface waters to supplement traditional chemical evaluations. Bioassessments have historically been used in Washington State on a project-specific basis. Typically, an upstream-downstream approach has been used to document biological impacts during investigations of pollution point sources, or during regional projects to evaluate sampling and analytical protocols. An ambient bioassessment program was initiated by DOE in 1993 to investigate the biological integrity of Washington state streams and rivers. The biological condition of streams throughout the state had not previously been defined. The contemporary biological database is comprised of continuous monitoring information that describes the condition of aquatic resources in detail, and can be used to confirm or validate conclusions derived from physicochemical monitoring programs.

The primary goal of the DOE Freshwater Ambient Biological Assessment Program is to collect long-term information to refine knowledge of stream conditions (i.e., define baseline conditions of instream biology, and measure spatial and temporal variability of community attributes). The program uses representative multiple-habitat sampling of benthic macroinvertebrates and physical habitat to describe biological community condition., Sampling sites are selected non-randomly and stratified at either target reference locations or areas representative of impacted conditions. Macroinvertebrates are collected following a modified approach of U.S. EPA Rapid Bioassessment Protocols (RBPs), and the resulting data are analyzed using the RBP multi-metric approach. Each of the metrics is used as a component of a diagnostic tool that defines ecosystem condition. Qualitative and quantitative habitat characterizations are completed along with the characterizations of the macroinvertebrate community. Habitat measures follow RBP guidance and include site-specific, detailed instream measurements as well as riparian and upstream watershed information.

An ecoregion bioassessment project was initiated in 1991 to evaluate the usefulness of a monitoring protocol to detect water resource impacts due to forest practices. The initial study focused on three of Washington's eight ecoregions. Bioassessment activities are currently being conducted in all ecoregions of the state. Reference site selection in each ecoregion is based on historical habitat information and professional judgment of regional biologists. Final reference site selection is based on detailed aspects of candidate streams (e.g., elevation, gradient, substrate size, discharge) in order to select conditions that are most representative of each ecoregion.

Stream bioassessments are intended for use in Washington state to supplement the Statewide Water Quality Assessment Report, to prioritize streams for intensive surveys and development of total maximum daily loads, and to assess the success of pollution abatement programs. DOE anticipates that stream biological information will eventually support the development of narrative (and eventually numerical) biological water quality criteria in Washington state.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **WASHINGTON**

Contact: Robert Plotnikoff

Address: WA State Dept. of Ecology
P.O. Box 47710
Olympia, WA 98504-7710

Phone/Fax: (360) 407-6687

1. Miles assessed as:
   - Non-impaired ___
   - Impaired ___
   - Excellent ___
   - Good ___
   - Fair ___
   - Poor ___
   - Total Pilot Studies

2. Number of sites sampled: 47 during 1993; 20 during 1994; 20 during 1995

3. Miles per site: 40x average stream width (maximum of 500m)

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: D-frame kicknet; riffle and depositional (4 samples/habitat type)

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites 19
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - X Multivariate analysis—Statistical routines used: DCA and CCA
   - X Multimetric approach—Metrics used or under development: Biological and Habitat.

   Macroinvertebrates -species richness; modified HBI; Biotic condition index; Benthic Index of Biological Integrity; EPT index; relative abundance; Ephemerellidae and Heptageniidae richness; caddis and stonefly shredder richness; Rhyacophilidae richness; % contribution dominant taxon; % predators; % shredders; % scrapers; % collector-gatherers; % collector-filterers; % intolerant mayfly and caddisfly and stonefly; % Glossosomatidae; % Hydropsychidae; Voltinism.

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	___	X	___
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Hayslip (1993); Plotnikoff (1992, 1994a,b, 1995a,b); Sabock (1994); U.S. EPA (1994a).

10. Comments: Information on number of sites sampled -- from R. Plotnikoff, personal communication.

WEST VIRGINIA

The West Virginia Division of Environmental Protection (DEP) has traditionally used an Ambient Biological Monitoring Network (AMB) to detect long term biological trends. The ABM network was established in 1975, and after a few modifications has remained relatively unchanged since 1979. The initial objective of the ABM network was to establish baseline biological information using the macroinvertebrate community at 42 field locations throughout the state. The long-term goal of the program is to detect temporal trends at the monitoring locations. In addition, spatial comparisons of biological data are possible on streams with more than one station. These objectives support DEP's overall management goal of maintaining or improving the quality of waters in the state.

ABM network stations are sampled annually for aquatic macroinvertebrates. Samples are collected using Hester-Dendy artificial substrate samplers that are installed for a six to eight week colonization period. The ABM network was designed to provide biological information at fixed locations over time. It was not designed to provide specific information at points other than the fixes sites. A separate investigation is conducted when a problem is detected upstream. The fixed station biological network is utilized by DEP to: provide site-specific background data for a large number of sites over time; allow spatial and temporal comparisons of biological data; detect emerging problems as trends begin to develop; and detect and reflect improvements in water quality.

DEP uses biological assessments to document biological impacts during investigations of point sources of pollution. U.S. EPA's Rapid Bioassessment Protocols II and III are used for macroinvertebrate and habitat assessments of wadeable streams. Artificial substrates are employued to assess point source impacts in larger streams and rivers. Typically, an upstream-downstream approach is used in the comparison of refgerence and point source affected sampling locations.

The west Virginia DEP Watershed Assessment Program (WPAP, initiated in October 1995) was established in response to the developing trend of assessing and monitoring water resources through intensive investigations of individual watersheds. This program will supercede a majority of the sampliong activities used in the traditional ABM network; however, DEP will maintain the ABM on selected larger streams. The sampling methods used ion the WAP are qualitative and follow the RBP II methodology for sampling the macroinvertebrate community in wadeable rivers and streams. The technical guidance of RBP II will also be used to assess habitats and calculate associated community metrics.

The WAP will tentatively include the following components:

- A statewide screening process using existing data to establish a priority watershed list;
- The priority watershed list will reflect both resource protection (i.e., maintenance and protection of water quality in least impacted watersheds) and pollution priorities (i.e., watershed where work is necessary to attain improvements;
- Existing monitoring programs of all offices within DEP will be reviewed for integration into a watershed monitoring program; and
- All data will be stored in databases supported by DEP GIS.

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **WEST VIRGINIA**

Contact: Janice Smithson

Address: West Virginia Division of Environmental Protection
Office of Water Resources
1201 Greenbrier Street
Charleston, WV 2533-1088

Phone/Fax: (304) 558-2108/5905

1. Miles assessed as:

Non-impaired	155
Impaired	170
Excellent	___
Good	___
Fair	___
Poor	___
Total	325

2. Number of sites sampled: 65

3. Miles per site: 5 mile (default) per site

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol II and III

6. Decision criteria based on:
   - X Reference sites
   - ___ Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	UD	X	X
Numeric (in place)	___	___	___
Under development	___	___	___

9. Pertinent citations: Arcuri (1994); Bailey (1995); Smithson (1994); Sabock (1994); U.S. EPA (1994a).

10. Comments: Benthic surveys performed during period of 1 Jan 1989 - 18 Nov 1994.

WISCONSIN

Wisconsin Department of Natural Resources emphasizes biological monitoring as a major component of the state monitoring program. The kinds of the samples taken for this program include benthic macroinvertebrates, fish, and bacteriological.

WDNR also has a lake monitoring program that samples and interprets fish assemblages, rooted macrophytes, and plankton. They use sampling and analysis procedures similar to U.S. EPA Rapid Bioassessment Protocols (RBPs) and kicknet samples supplemented with artificial substrates in channels without riffles. Invertebrate samples are analyzed using the Hilsenhoff Biotic Index in combination with other indices; fish data are used to calculate an IBI. Habitat assessment data are used to assess use attainability. Triennial reviews are performed on "various streams" - channels that cannot attain narrative fishable/swimmable goals due to some natural characteristic(s).

PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **WISCONSIN**

Contact: Joe Ball

Address: Wisconsin Dept. of Natural Resources
Bureau of Water Resources Management
101 S. Webster Street, GEF II
Box 7921
Madison, WI 53707

Phone/Fax: (608) 266-7390

1. Miles assessed as:

Non-impaired	3,915
Impaired	1,419.8
Excellent	—
Good	—
Fair	—
Poor	—
Total	5,334.8

2. Number of sites sampled: More than 900 macroinvertebrate samples were collected and analyzed from 1992 to 1993. No number for fish is available.

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates; Fish

5. Sampling gear or Method: Macroinvertebrates - kicknet in riffles
Fish - backpack and boat-mounted electroshockers

6. Decision criteria based on:
   - ___ Reference sites
   - X Ecoregional reference conditions—Number of reference sites ___
   - X Other Explain: Benthic macroinvertebrates are assessed statewide using the same reference condition.

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development: Biological

   Fish Assemblage IBI: Total number of native species; number of darter species; number of sucker species; number of sunfish species; number of intolerant species; % intolerant species; % omnivores; % insectivores; % top carnivores; % simple lithophils; number of individuals per 300 square meters; % DELT (deformities, eroded fins, lesions, and tumors).

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	X	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Lyons (1992); Sabock (1994); U.S. EPA (1994a); Wisconsin DNR (1992, 1994).

10. Comments: Miles represent 1994 305(b) reporting period and represents monitored assessments. The IBI has a scoring range from 0-100 using corrections factors (negative scoring) for the last two metrics (subtract 10 from the overall IBI score for less than 50 fish or for more than 4% DELTs).

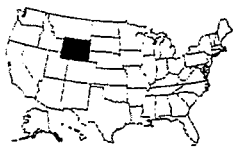
WYOMING

The Wyoming Department of Environmental Quality (DEQ) Water Quality Division is beginning to incorporate biological monitoring into the overall surface water monitoring and assessment process. Even though biological monitoring data will be of increasing importance, chemical monitoring will remain a primary critical component of DEQ's water quality program. Much of the monitoring work will be performed on a volunteer basis and will focus on macroinvertebrate sampling. Nonpoint source monies are being used to train conservation district/school district teams in water quality monitoring procedures. In the coming years, DEQ is hoping to increase coordination and consistency of data collection and analysis, and to include more biological information in the determination of water quality impacts.

DEQ stream bioassessment and habitat evaluation methods are based on the technical guidance of U.S. EPA's Rapid Bioassessment Protocols (RBPs). Macroinvertebrate bioassessments are used in Wyoming point source discharge and nonpoint source investigations, and monitoring approaches (i.e., upstream-downstream, paired stream, paired watershed, and downstream only) vary depending on specific study objectives. Macroinvertebrate data are processed using a multi-metric design. DEQ uses eight primary biological metrics as the basis to define water quality changes, and is evaluating 18 additional metrics for possible ecoregion use. Refined regional metrics (representing clean, moderately impaired, and poor water quality) involving specific organisms or indicator assemblages are being developed as regional and sub-regional data bases continue to be evaluated.

DEQ is currently in the process of defining ecological reference conditions. Candidate reference streams are being examined for macroinvertebrate species composition, species abundance and relative habitat condition. The data will be used for the purpose of: defining existing statewide habitat; assessing point source water quality changes; evaluating effectiveness of nonpoint source implementation projects; initiating attempts to describe macroinvertebrate biodiversity; and initiating attempts to develop biocriteria for streams. Once reference conditions are established, they will serve as a basis for assessing other streams in the same ecoregion, and will be critical to the development of a water quality impact prioritization process.

Beginning with the 1994 water quality assessment reporting period, DEQ developed a new use support/data-source decision matrix to broaden application of use support designations, and to shift water quality survey results from qualitative to more quantitative. In the new matrix, biological data aid in the determination of the degree of use support for fishery, public water supply, primary contact recreation and secondary contact recreation uses. Because of the subjectivity of evaluated data, DEQ will not assign a "not supporting" classification unless the decision can be justified via reliable chemical or biological data.



PROGRAM CHARACTERIZATION FACT SHEETS

STATE: **WYOMING**

Contact: Dick Johnson

Address: Wyoming Department of
Environmental Quality, Water Quality Division
Herschler Building, 4th Floor
122 West 25th Street
Cheyenne, WY 82002

Phone/Fax: (307) 777-6891

1. Miles assessed as:

Non-impaired	207
Impaired	506
Excellent	—
Good	—
Fair	—
Poor	—
Total	713

2. Number of sites sampled: 59

3. Miles per site:

4. Assemblage(s): Benthic macroinvertebrates

5. Sampling gear or Method: Rapid Bioassessment Protocol III

6. Decision criteria based on:
   - X Reference sites
   - UD Ecoregional reference conditions—Number of reference sites ___
   - ___ Other Explain:

7. Data Analysis/Interpretation:
   - ___ Multivariate analysis—Statistical routines used:
   - X Multimetric approach—Metrics used or under development:

   Biological and Habitat. Macroinvertebrates - taxa richness; Modified HBI; ratio scraper/filtering collectors; ratio EPT/Chironomidae; % contribution dominant taxa; EPT index; Community Loss Index; % Hydropsychidae/total Trichoptera

8. Biocriteria/Decision Thresholds:

Biocriteria	Water Quality Standards	Used in Water Resource Mgmt.	Aquatic Life Use
Narrative (in place)	—	X	X
Numeric (in place)	—	—	—
Under development	—	—	—

9. Pertinent citations: Gumtow (1994); King (1993); Sabock (1994); U.S. EPA (1994a); Wyoming DEQ (1994).

10. Comments: Miles represent 1994 305(b) 2-year reporting period. Data from various government agencies, as indicated in the state 305(b) report..

Section 4. Biocriteria Language and Definitions for States and Territories

This section presents information taken *directly* from the regulatory codes/documents of states and territories which have reported having biological criteria within their standards, and reproduces verbatim the language promulgated within state legislatures. There has been no interpretation of the language other than its identification as the narrative or numeric biocriteria language or as definitions published along with that language in the state water quality standards.

ARKANSAS

NARRATIVE BIOCRITERIA

Biological Integrity - All waters with specifically designated Fisheries uses must demonstrate aquatic life communities which are similar in variety and abundance to least-disturbed waters within the same ecoregion and with similar hydrologic conditions. Measurements of biological integrity should include fish community structure and other associated aquatic life e.g., macroinvertebrates, periphyton, plankton, etc. Measurements should be extensive and timely in order to compensate for the seasonal and natural variability of aquatic life communities. A distinguishable alteration of the abundance or variety of the aquatic life community constitutes a violation of these water quality standards.

SOURCE: Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas (Draft-July 94) Sec. 5(E).

CALIFORNIA

NARRATIVE BIOCRITERIA

Ch.II.E. Biological Characteristics

1. Marine communities, including vertebrate, invertebrate, and plant species, shall not be degraded.

DEGRADE: Degradation shall be determined by comparison of the waste field and reference site(s) for characteristics species diversity, population density, contamination, growth anomalies, debility, or supplanting of normal species by undesirable plant and animal species. Degradation occurs if there are significant differences in any of three major biotic groups, namely, demersal fish, benthic invertebrates, or attached algae. Other groups may be evaluated where benthic species are not affected, or are not the only ones affected. Note: This provision is an example: other California waters have similar provisions.

SOURCE: Water Quality Standards for the State of California (ocean waters) are contained in: Amendment of the Water quality Control Plan for Ocean Waters of California, State Water Resources Control Board Resolution No. 90-27. (Adopted and effective March 22, 1990).

CONNECTICUT

NARRATIVE BIOCRITERIA

Surface waters and sediments shall be free from chemical constituents in concentrations or combinations which will or can reasonably be expected to result in acute or chronic toxicity to aquatic organisms or impair the biological integrity of aquatic or marine ecosystems outside of any allocated zone of influence or which will or can reasonably be expected to bioconcentrate or bioaccumulate in tissues of fish, shellfish and other aquatic organisms to levels which will impair the health of aquatic organisms or wildlife or result in unacceptable tastes, odors or health risks to human consumers of aquatic life. In determining consistency with this Standard, the Commissioner shall at a minimum consider the specific number criteria listed in Appendix D and any other information she or he deems relevant.

Benthic invertebrate criteria may be utilized where appropriate for assessment of biological integrity of surface waters. The criteria apply to the fauna of erosional or riffle habitats in flowing waters which are not subject to tidal influences.

SOURCE: Connecticut Water Quality Standards January 1992. II 13; II 14

DELAWARE

NARRATIVE BIOCRITERIA

Section 4.1(a)(iii):
All surface waters of the State...shall meet the following minimum criteria:
(a) Waters shall be free from substances that are attributable to wates of industrial, municipal, agricultural or other human-induced origin. Examples include but are not limited to the following:
(iii) Any pollutants,... that may interfere with attainment and maintenance of designated uses of the water, may impart indesirable odors, tastes, or colors to the water or to aquatic life found therein, may endanger public health, or may result in dominance of nuisance species.

Section9.2(a)&(b)
(a) Waters of the State shall not exhibit acute toxicity to fish, aquatic life, and wildlife except in special cases applying to regulatory mixing zones as provided in Section 6.

(b) Waters of the State shall not exhibit chronic toxicity to fish, aquatic life, and wildlife except in regulatory mixing zones as provided in Section 6, at flows less than critical flows as provided in Section 8, or in low flow waters as provided in Section 12.

NUMERIC BIOCRITERIA
Information currently not available.

SOURCE: State of Delaware surface Water Quality Standards (as Amended, February 26, 1993),Section 4.1(a)(iii),9.2(a)&(b).

DISTRICT OF COLUMBIA

NARRATIVE BIOCRITERIA
The surface waters of the District shall be free from substances attributable to point or nonpoint sources discharged in amounts that impair the biological community which naturally occurs in the waters or depends on the waters for their survival and propagation.

SOURCE: DC District of Columbia Water Quality Standards March 4, 1994. 1104.1(f)

FLORIDA

NARRATIVE BIOCRITERIA
Nuisance Species: [Class I, II, III (fresh & marine), IV, V] Substances in concentrations which result in the dominance of nuisance species. None shall be present.

Nutrients:[Class I, II, III (fresh & marine), IV, V] In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of flora or fauna.

NUMERIC BIOCRITERIA
Biological Integrity: [Units: Percent reduction of Shannon-Weaver Diversity Index]
Class I: The Index for benthic macroinvertebrates shall not be reduced to less than 75% of background levels or increased using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three Hester-Dendy type artificial substrate samples of 0.10 to 0.15 m^2 area each incubated for a period of four weeks.

Class II: The Index for benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three natural substrate samples taken with Ponar type samplers with minimum sampling area of 225 em^2.

Class III Fresh: The Index for benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three Hester-Dendy type artificial substrate samples of 0.10 to 0.15 m^2 area each incubated for a period of four weeks.

Class III Marine: The Index for benthic macroinvertebrates shall not be reduced to less than 75% of established background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three natural substrate samples taken with Ponar type samplers with minimum sampling area of 225 em^2.

DEFINITIONS

"Background" shall mean the condition of waters in the absence of the activity or discharge under consideration, based on the best scientific information available to the Department

"Natural Background" shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration date.

"Nuisance Species" shall mean species of flora or fauna whose noxious characteristics or presence in sufficient number, biomass, or areal extent may be reasonably expected to prevent, or unreasonably interfere with, a designated use of those waters.

"Propagation" shall mean reproduction sufficient to maintain the species' role in its respective ecological community.

"Shannon-Weaver Diversity Index" shall mean negative summation (from I = 1 to s) or $(n_i/N) \log_2 (n_i/N)$ where s is the number of species in a sample, N is the total number of individuals in a sample, and n_i is the total number of individuals in species I.

SOURCE: Florida Surface Water Quality Standards (1/23/95). 62-302.200 (3),(14),(15),(22),(24); 62-302.530(11),(48)(b),(47).

GEORGIA

NARRATIVE BIOCRITERIA

The purpose and intent of the State in establishing Water Quality Standards are to provide enhancement of water quality and prevention of pollution; to protect the public health or welfare in accordance with the public interest for drinking water supplies, conservation of fish, wildlife and other beneficial aquatic life, and agricultural, industrial, recreational, and other reasonable and necessary uses and to maintain and improve the biological integrity of the waters of the State.

DEFINITIONS

"Biological integrity" is functionally defined as the condition of the aquatic community inhabiting least impaired waterbodies of a specified habitat measured by community structure and function.

SOURCE: Georgia Rules and Regulations for Water Quality Control Chapters 391-3-6-.03.2(a);391-3-6-.03.3(a).May 29,1994.

HAWAII

NARRATIVE BIOCRITERIA

Basic water quality criteria applicable to all waters.

(a) All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants including:

High or low temperatures; biocides; pathogenic organisms; toxic, radioactive, corrosive, or other deleterious substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water

SOURCE: Hawaii Administrative Rules 11-54-04(4). October 29, 1992.

LOUISIANA

NARRATIVE BIOCRITERIA

Biological and Aquatic Community Integrity. The biological and community structure and function in state waters shall be maintained, protected, and restored except where not attainable and feasible as defined in

LAC 33:IX.1109.B.3. This is the ideal condition of the aquatic community inhabiting the unimpaired water bodies of a specified habitat and region as measured by community structure and function. The biological integrity will be guided by the fish and wildlife propagation use designated for that particular water body. Fish and wildlife propagation uses are defined in LAC 33.IX.1111.C. The condition of these aquatic communities shall be determined from the measures of physical, chemical, and biological characteristics of each surface water body type, according to its designated use (LAC 33.IX.1123). Reference site conditions will represent naturally attainable conditions. These sites should be the least impacted and most representative of water body types. Such reference sites or segments of water bodies shall be those observed to support the greatest variety and abundance of aquatic life in the region as is expected to be or has been recorded during past surveys in natural settings essentially undisturbed by human impacts, developments, or discharges. The condition shall be determined by consistent sampling and reliable measures of selected, indicative communities of animals and/or invertebrates as established by the office and may be used in conjunction with accepted chemical, physical, and microbial water quality measurements and records as deemed for this purpose.

SOURCE: Louisiana Water Quality Regulations. Chap. 11, Sec. 1113.12. August 20, 1994.

MAINE

NARRATIVE BIOCRITERIA

The Legislature declares that it is the State's objective to restore and maintain the chemical, physical, and biological integrity of the State's waters and to preserve certain pristine state waters. The Legislature further declares that in order to achieve this objective, the State's goals are: That water quality be sufficient to provide for the protection and propagation of fish, shellfish, and wildlife and provide for recreation in and on the water.

Class AA waters shall be the highest classification

A. Class AA waters shall be of such quality that they are suitable...as habitat for fish and other aquatic life. The habitat shall be characterized as free flowing and natural.
B. The aquatic life, dissolved oxygen and bacteria content of Class AA waters shall be as naturally occurs.

Class A waters shall be the 2nd highest classification.

A. Class A waters shall be of such quality that they are suitable...as habitat for fish and other aquatic life. The habitat shall be characterized as natural.
B. The aquatic life and bacteria content of Class A waters shall be as naturally occurs.

Class B waters shall be the 3rd highest classification.

A. Class B waters shall be of such quality that they are suitable...as habitat for fish and other aquatic life. The habitat shall be characterized as unimpaired.
C. Discharges to Class B waters shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community.

Class C waters shall be the 4th highest classification.

A. Class C waters shall be of such quality that they are suitable...as a habitat for fish and other aquatic life.
C. Discharges to Class C waters may cause some changes to aquatic life, provided that the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

DEFINITIONS

"Aquatic life" means any plants or animals which live at least part of their life cycle in fresh water.

"Community function" means mechanisms of uptake, storage, and transfer of life-sustaining materials available to a biological community which determines the efficiency of use and the amount of export of the materials from the community.

"Community structure" means the organization of a biological community based on numbers of individuals within different taxonomic groups and the proportion each taxonomic group represents of the total community.

"Indigenous" means supported in a reach of water or known to have been supported according to historical records compiled by State and Federal agencies or published scientific literature.

"Natural" means living in, or as if in, a state of nature not measurably affected by human activity.

"Resident biological community means aquatic life expected to exist in a habitat which is free from the influence of the discharge of any pollutant. This shall be established by accepted monitoring techniques.

"Without detrimental changes in the resident biological community" means no significant loss of species or excessive dominance by any species or group of species attributable to human activity.

SOURCE: ME Maine Water Classification Program July 1994. 38 S 464.1(C); 38 S 465.1,2,3,4; 38 S 466.1,3,4,8,9,10,12

MASSACHUSETTS

NARRATIVE BIOCRITERIA

Control of Eutrophication: From and after the date 314 CMR 4.00 become effective there shall be no new or increased point source discharge of nutrients, primarily phosphorus and nitrogen, directly to lakes and ponds. There shall be no new or increased point source discharge to tributaries of lakes or ponds that would encourage cultural eutrophication or the growth of weed or algae in these lakes or ponds. Any existing point source discharge containing nutrients in concentrations which encourage eutrophication or growth of weeds or algae shall be provided with the highest and best practical treatment to remove such nutrients. Activities which result in the nonpoint source discharge of nutrients to lakes and ponds shall be provided with all reasonable best management practices for nonpoint source control.

Class B Waters: These waters are designated as a habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation.

1. Dissolved Oxygen
   b. Natural, seasonal and daily variations above these levels shall be maintained; levels shall not be lowered below 75% of saturation in cold water fisheries nor 60% of saturation in warm water fisheries due to a discharge.
2. Temperature
   a. Shall not exceed 68°F (20°C) in cold water fisheries nor 83°F (28.3°C) in warm water fisheries, and the rise in temperature due to a discharge shall not exceed 3°F (1.7°C) in rivers and streams designated as cold water fisheries nor 5°F (2.8°C) in rivers and streams designated as warm water fisheries (based on the minimum expected flow for the month); in lakes and ponds the rise shall not exceed 3°F (1.7°C) in the epilimnion (based on the monthly average of maximum daily temperature); and
   b. Natural seasonal and daily variations shall be maintained. There shall be no changes from background conditions that would impair any use assigned to this Class, including site-specific limits necessary to protect species diversity, successful migration, reproductive functions or growth of aquatic organisms.

Additional minimum criteria applicable to all surface waters:

(a) Aesthetics - All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

(b) Bottom pollutant or Alterations - All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.

(e) Toxic Pollutants - All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife.

Site Specific Limits: Where recommended limits for a specific pollutant are not available or where they are invalid due to site-specific physical, chemical or biological considerations, the Division shall use a site-specific limit as the allowable receiving water concentration for the affected waters. In all cases, at a minimum, site-specific limits shall not exceed safe exposure levels determined by toxicity testing using methods approved by the Director.

Accumulation of Pollutants: Where appropriate the Division shall use an additional margin of safety when establishing water quality based on effluent limits to assure that pollutants do not persist in the environment or accumulate in organisms to levels that:

a. are toxic to humans or aquatic life; or
b. Result in unacceptable concentrations in edible portions or marketable fish or shellfish or for the recreational use of fish, shellfish, other aquatic life or wildlife for human consumption.

DEFINITIONS

Aquatic Life - A native, naturally diverse, community of aquatic flora and fauna

Background Conditions - That water quality which exists or would exist in the absence of discharges of pollutants requiring permits and other controllable cultural factors that are subject to regulation under M.G.L. c. 21, §§ 26 through 53.

SOURCE: Massachusetts Surface Quality Standards 12/1/93. 314CMR 4.02; 4.04:(5); 4.05(b),(b)1, (b)2;4.05:(5)(a)(b)(e); 4.05:(e)(1)(3).

MARYLAND

NARRATIVE BIOCRITERIA

Water Quality and Watershed Management Plans. A regulated activity may not cause or contribute to a: Degradation of ground waters or surface waters, including individual and cumulative effects on:

Plankton, fish, shellfish, and wildlife,
Aquatic ecosystem diversity, productivity, and stability

General Water Quality Criteria. The waters of the State may not be polluted by:

High temperature or corrosive substances attributable to sewage, industrial waste, or other waste in concentrations or combinations which:

(a) Interfere directly or indirectly with designated uses, or
(b) Are harmful to human, animal, plant, or aquatic life.

SOURCE: Title 26. Department of the Environment, Subtitle 08 Water Pollution, Subpart 26.08.02. June 7, 1993.

MINNESOTA

NARRATIVE BIOCRITERIA

The biological quality of any given surface water body shall be assessed by comparison to the biological integrity of a reference condition or conditions which best represents the most natural condition for that surface water body type within a geographic region. The biological quality shall be determined by reliable measures of indicative communities of fauna and flora.

SOURCE: Chapter 7050 Minnesota Standards For Protection of Quality and Purity 7050.0150;April 18, 1994.

MISSOURI

NARRATIVE BIOCRITERIA

The biological integrity of waters, as measured by lists or numeric diversity indices of benthic invertebrates, fish, algae, or other appropriate indicators shall not be significantly different from reference waters. Waters shall be compared with reference waters of similar size within an ecoregion.

DEFINITIONS
Biocriteria: Numeric values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters that have been designated for aquatic life protection.

Reference stream reaches: Stream reaches determined by the department to be the best available representatives of ecoregion waters in a natural condition, with respect to habitat, water quality, biological integrity and diversity, watershed land use and riparian conditions.

SOURCE: Missouri Rules of Department of Natural Resources Div. 20-Clean Water Commission,Chap. 7-Water Quality, Title 10CSR 20-7.031(D),(R). (3/30/94).

NEBRASKA

NARRATIVE BIOCRITERIA
Any human activity which would significantly impact or displace an identified "key species" shall not be allowed.

DEFINITIONS
Key species are identified endangered, threatened, sensitive, or recreationally-important aquatic species. Key species are designated by stream segment.

SOURCE: Title 117-Nebraska Surface Water Quality Standards. Chap. 4, 003.01F, 003.01F1. November 17, 1993.

NEVADA

NARRATIVE BIOCRITERIA
Waters must be free from high temperatures, biocides, organisms pathogenic to human beings, toxic, corrosive or other deleterious substances attributable to domestic or industrial waste or other controllable sources at levels or combinations sufficient to be toxic to human, animal, plant or aquatic life or in amounts sufficient to interfere with any beneficial use of the water. Compliance with the provisions of this subsection may be determined in accordance with methods of testing prescribed by the department. If used as an indicator, survival of test organisms must not be significantly less in test water than in control water.

SOURCE: Nevada Administrative Code 445.119.4. September 26, 1994.

NEW JERSEY

NARRATIVE BIOCRITERIA
Water is vital to life and comprises an invaluable natural resource which is not to be abused by any segment of the State's population or economy. It is the policy of the State to restore, maintain, and enhance the chemical, physical, and biological integrity of its waters, to protect the public health, to safeguard the aquatic biota, protect scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, agricultural, and other reasonable uses of the State's waters.

Toxic substances in waters of the State shall not be at levels that are toxic to humans or the aquatic biota, or that bioaccumulate in the aquatic biota so as to render them unfit for human consumption.

SOURCE: New Jersey Water Quality Standards April 1994. 7:9B-1.5(a)2 & 3.

NEW YORK

NARRATIVE BIOCRITERIA
Fresh Surface Waters (Class AA-Special, Class A-Special, Class AA, Class A, Class B, Class C, Class D): The waters shall be suitable for fish propagation and survival.

Saline Surface Waters (Class SA, Class SB, Class SC, Class I, Class SD): These waters shall be suitable for fish propagation and survival.

SOURCE: Water Quality Regulations for Surface Waters and Groundwaters September 1, 1991. 6NYCRR Parts 701.3,701.4,701.5,701.6,701.7,701.8, 701.9,701.10,701.11,701.12,701.13,701.14.

NORTH CAROLINA

NARRATIVE BIOCRITERIA

All fresh surface waters (Class C)

(1) Best Usage of Waters. Aquatic life propagation and maintenance of biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture and any other usage except for primary recreation or as a source of water supply for drinking, culinary or food processing purposes;

(2) Conditions Related to Best Usage. The waters will be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation, and agriculture; sources of water pollution which preclude any of these uses on either a short-term or long-term basis will be considered to be violating a water quality standard.

All tidal salt waters (Class SC)

(1) Best Usage of Waters. Aquatic life propagation and maintenance of biological integrity (including fishing, fish, and functioning PNAs), wildlife, secondary recreation, and any other usage except primary recreation or shellfishing for market purposes;

(2) Conditions Related to Best Usage. The waters will be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, and secondary recreation; any source of water pollution which precludes any of these uses, including their functioning as PNAs, on either a short-term or a long-term bass will be considered to be violating a water quality standard.

BIOLOGICAL PROCEDURES

Methods published by the North Carolina Department of Environment, Health, and Natural resources, as outlined in "Standard Operating Procedures: Biological Monitoring" (1990; division of Environmental Management, Water Quality Section) or subsequent versions, or such other methods as approved by the Director.

DEFINITIONS

Biological integrity means the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions.

SOURCE: 15A NCAC 2B .0100-Procedures for Assignment of Water Quality Standards, Sec. .0103(b), 1994. 15A NCAC 2B .0200-Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina .0202(10), .0211(b)(1)&(2),.0212(b)(1)&(2). 1994.

OHIO

NARRATIVE BIOCRITERIA

Biological criteria presented in table 7-17 to this rule provide a direct measure of the attainment of the warm water habitat, exceptional warm water habitat and modified warm water habitat aquatic life uses. Biological criteria and the exceptions to chemical-specific or whole-effluent criteria allowed by this paragraph do not apply to any other use designations.

(a) Demonstrated attainment of the applicable biological criteria in a water body will take precedence over the application of chemical-specific or whole-effluent criteria associated with these uses when the director, upon considering appropriately detailed chemical, physical and biological data, finds that one or more chemical-specific or whole-effluent criteria are inappropriate. In such cases the options which exist include:

(i) The director may develop, or a discharger may provide for the director's approval, a justification for a site-specific water quality criterion according to methods described in "Water Quality Standards handbook, 1983, U.S. EPA Office of Water";

(ii) The director may proceed with establishing water quality based effluent limits consistent with attainment of the designated use.

(b) Demonstrated nonattainment of the applicable biological criteria in a water body with concomitant evidence that the associated chemical-specific criteria and whole-effluent criteria are met will cause the director to seek and establish, if possible, the cause of the nonattainment of the designated use. The director shall evaluate the existing designated use and, where not attainable, propose to change the designated use. If the designated use is deemed attainable, the director shall,

whenever possible and reasonable, implement regulatory controls or make other recommendations regarding water resource management to restore the designated use.

Definitions-

"Warmwater"- these are waters capable of supporting and maintaining a balanced, integrated, adaptive community of warmwater aquatic organisms having a species composition, diversity, and functional organization comparable to the twenty-fifth percentile of the identified reference sites within each of the following ecoregions: the interior plateau ecoregion, the Erie/Ontario lake plains ecoregion, the western Allegheny plateau ecoregion and eastern corn belt plains ecoregion. For the Huron/Erie lake plains ecoregion, the comparable species composition, diversity and functional organization are based upon the ninetieth percentile of all sites within the ecoregion. For all ecoregions, the attributes of species composition, diversity and functional organization will be measured using the index of biotic integrity, the modified index of well-being and the invertebrate community index as defined in "Biological Criteria for the Protection of Aquatic Life: volume II, Users Manual for Biological field Assessment of Ohio Surface Waters," ... Attainment of this use designation is based on the criteria in table 7-17 to this rule. A temporary variance to the criteria associated with this use designation may be granted as described in paragraph (G) of rule 3745-1-01 of the Administrative Code.

"Exceptional Warmwater" - these are waters capable of supporting and maintaining an exceptional or unusual community of warmwater aquatic organisms having a species composition, diversity, and functional organization comparable to the seventy-fifth percentile of the identified reference sites on a statewide basis. The attributes of species composition, diversity and functional organization will be measured using the index of biotic integrity, the modified index of well-being and the invertebrate community index as defined in "Biological Criteria for the Protection of Aquatic Life: volume II, Users Manual for Biological field Assessment of Ohio Surface Waters,"... In addition to those stream segments designated in rules 3745-1-08 to 3745-1-32 of the Administrative Code, all lakes and reservoirs, except upground storage reservoirs, are designated exceptional warmwater habitats. Attainment of this use designation (except for lakes and reservoirs) is based on the criteria in table 7-17 to this rule. A temporary variance to the criteria associated with this use designation may be granted as described. in paragraph (G) of rule 3745-1-01 of the Administrative Code.

"Modified Warmwater" - these are waters that have been the subject of a use attainability analysis and have been found to be incapable of supporting and maintaining a balanced, integrated, adaptive community of warmwater organisms due to irretrievable modifications of the physical habitat. Such modifications are of a long-lasting duration (i.e., twenty years or longer) and may include the following examples: extensive stream channel modification activities permitted under sections 401 and 404 of the act or Chapter 6131 of the Revised Code, extensive sedimentation resulting from abandoned mine land runoff, and extensive permanent impoundment of free-flowing water bodies. The attributes of species composition The attributes of species composition, diversity and functional organization will be measured using the index of biotic integrity, the modified index of well-being and the invertebrate community index as defined in "Biological Criteria for the Protection of Aquatic Life: volume II, Users Manual for Biological field Assessment of Ohio Surface Waters,"... Attainment of this use designation is based on the criteria in table 7-17 to this rule. Each water body designated modified warmwater habitat will be listed in the appropriate use designation rule (rules 3745-1-08 to 3745-1-32 of the Administrative Code) and will be identified by ecoregion and type of physical habitat modification as listed in table 7-17 to this rule. The modified warmwater habitat designation can be applied only to those waters that do not attain the warmwater habitat designation that do not attain the warmwater habitat biological criteria in table 7-17 to this rule because of irretrievable modifications of the physical habitat. All stream segments designated modified warmwater habitat will be reviewed an a triennial basis (or sooner) to determine whether the use designation should be changed. A temporary variance to the criteria associated with this use designation may be granted as described. in paragraph (G) of rule 3745-1-01 of the Administrative Code.

NUMERIC BIOCRITERIA
See Table 7-17 below

SOURCE: Ohio Water Standards Administrative Code May 1, 1990. Rule 3745-1-07(5),(a),(1),(11),(b); 3745-1-07(B)(1)(a),(c),(d); Table 7-17.

Ohio Numeric Biocriteria: Table 7-17

Biological criteria for Warm water, Exceptional Warm water, and Modified Warm water Habitats. Description and derivation of indices and ecoregions are contained in "Biological Criteria for the Protection of Aquatic Life: Volume II. Users Manual for Biological Field Assessment of Ohio Surface Waters" cited in paragraph (B) of Rule 3745-1-03 of the Administrative Code. These criteria do not apply to the Ohio River, lakes or Lake Erie river mouths.

Index Sampling Site Ecoregion[1]	Modified Warm water Habitat Channel Modification	Mine Affected	Impounded	Warm water Habitat	Exceptional Warm water Habitat
I. Index of Biotic Integrity (Fish)					
A. Wading Sites[2]					
HELP	22	--	--	32	50
IP	24	--	--	40	50
EOLP	24	--	--	38	50
WAP	24	24	--	44	50
ECBP	24	--	--	40	50
B. Boat Sites[2]					
HELP	20	--	22	34	48
IP	24	--	30	38	48
EOLP	24	--	30	40	48
WAP	24	24	30	40	48
ECBP	24	--	30	42	48
C. Headwater Sites[3]					
HELP	20	--	--	28	50
IP	24	--	--	40	50
EOLP	24	--	--	40	50
WAP	24	24	--	44	50
ECBP	24	--	--	40	50
II. Modified Index of Well-Being (Fish)[4]					
A. Wading Sites[2]					
HELP	5.6	--	--	7.3	9.4
IP	6.2	--	--	8.1	9.4
EOLP	6.2	--	--	7.9	9.4
WAP	6.2	5.5	--	8.4	9.4
ECBP	6.2	--	--	8.3	9.4
B. Boat Sites[2]					
HELP	5.7	--	5.7	8.6	9.6
IP	5.8	--	6.6	8.7	9.6
EOLP	5.8	--	6.6	8.7	9.6
WAP	5.8	5.4	6.6	8.6	9.6
ECBP	5.8	--	6.6	8.5	9.6
III. Invertebrate Community Index (Macroinvertebrates)					
A. Artificial Substrate Samplers[2]	22	--	--	34	46
HELP	22	--	--	30	46
IP	22	--	--	34	46
EOLP	22	30	--	36	46
WAP	22	--	--	36	46
ECBP					

[1] HELP = Huron/Erie Lake Plain Ecoregion. IP = Interior Plateau Ecoregion. EOLP = Erie/Ontario Lake Plain Ecoregion. WAP = Western Allegheny Plateau Ecoregion. ECPB = Eastern Corn Belt Plains Ecoregion

[2] Sampling methods descriptions are found in the "Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices," cited in paragraph (B) of Rule 3745-1-03 of the Administrative Code.

[3] Modification of the IBI that applies to sites with drainage areas less than 20 square miles.

[4] Does not apply to sites with drainage areas less than 20 square miles.

(Effective February 14, 1978; April 4, 1985; August 19, 1985; April 30, 1987; May 1, 1990)

OKLAHOMA

NARRATIVE BIOCRITERIA

(A) Aquatic life in all waterbodies designated Fish and Wildlife Propagation (excluding waters designated "Trout, put-and-take") shall not exhibit degraded conditions as indicated by one or both of the following:
   (i) comparative regional reference data from a station of reasonably similar watershed size or flow, habitat type and Fish and Wildlife beneficial use subcategory designation or
   (ii) by comparison with historical data from the waterbody being evaluated.

(B) Compliance with the requirements of 785:45-5-12(e) (5) shall be based upon measures including, but not limited to, species tolerance, trophic structure, dominant species, indices of biotic integrity (IBI's), indices of well being (IWB's), or other measures.

SOURCE: Oklahoma's Water Quality Standards, 785:45-5-12(e)(5),5-26-92.

OREGON

NARRATIVE BIOCRITERIA

Waters of the State shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.

DEFINITIONS

"Aquatic species" means any plants or animals which live at least part of their life cycle in waters of the State.

"Biological criteria" means numerical values or narrative expressions that describe the biological integrity of aquatic communities inhabiting waters of a given designated aquatic life use.

"Designated beneficial use" means the purpose or benefit to be derived from a water body as designated by the Water Resources Department of the Commission.

"Indigenous" means supported in a reach of water or known to have been supported according to historical records compiled by State and Federal agencies or published scientific literature.

"Resident biological community" means aquatic life expected to exist in a particular habitat when water quality standards for a specific ecoregion, basin, or water body are met. This shall be established by accepted biomonitoring techniques.

"Without detrimental changes in the resident biological community" means no loss of ecological integrity when compared to natural conditions at an appropriate reference site or region.

"Ecological integrity" means the summation of chemical, physical, and biological integrity capable of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region.

"Appropriate reference site or region" means a site on the same water body, or within the same ecoregion that has similar habitat conditions, and represents the water quality and biological community attainable within the area of concern.

SOURCE: Oregon Administrative Rules, State-Wide Water Quality Management Plan; Beneficial Uses, Policies, Standards, and Treatment Criteria for Oregon 340-41-027,340-41-006 (32),(33),(34),(35), (36),(37),(38),(39).January 1993.

PENNSYLVANIA

NARRATIVE BIOCRITERIA

Water may not contain substances attributable to point or nonpoint source waste discharges in concentration or amounts sufficient to be inimicable or harmful to the water uses to be protected or to human, animal, plant, or aquatic life.

SOURCE: Pennsylvania Water Quality Standards May 1990. Chapter 93.6(a).

SOUTH CAROLINA

NARRATIVE BIOCRITERIA

Purpose and Scope: It is the goal of the department to maintain and improve all surface waters to a level to provide for the survival and propagation of a balanced indigenous aquatic community of flora and fauna and to provide for recreation in and on the water. It is also a goal to provide, where appropriate and desirable, for drinking water after conventional treatment, shellfish harvesting, and industrial and agricultural uses.

Applicability of Standards: Mixing zones shall not be acutely toxic to aquatic organisms, shall allow safe passage of aquatic organisms when passage is otherwise obstructed, and shall allow for the protection and propagation of a balanced, indigenous population of aquatic organisms in and on the water body. The mixing zone size shall be based upon critical flow conditions. The mixing zone shall not be an area of waste treatment nor shall it interfere with or impair existing recreational uses, existing drinking water supply uses, existing industrial or agricultural uses, or existing or classified shellfish harvesting uses.

Antidegradation Rules: A new activity or an expansion of an existing activity will not be allowed in Class ORW or Shellfish Harvesting waters if it would exclude, through establishment of a closed safety zone, an existing shellfish harvesting or culture use. A new activity or expansion of an existing activity which will result in a closed safety zone may be allowed in Class SA or SB waters when determined to be appropriate by the Department.

General Rules and Standards Applicable to All Waters: It is declared to be the public policy of the State to maintain reasonable standards of purity of the air and water resources of the State, consistent with the public health, safety, and welfare of its citizens, maximum employment, the industrial development of the State, the propagation and protection of terrestrial and marine flora and fauna, and the protection of physical property and other resources. It is further declared that to secure these purposes and the enforcement of the provisions of this Act, the Department of Health and Environmental Control shall have authority to abate, control, and prevent pollution.

Discharge of fill into State waters is not allowed unless the activity is consistent with Department regulations and will result in enhancement of classified uses with no significant degradation to the aquatic ecosystem or water quality.

Derivation of effluent limits: When the derived effluent limit is below the limits of analytical detectability for a substance, either the derived effluent limit will include an accompanying statement in the permit that the detection limit using approved analytical methods will be considered as being in compliance with the limit or an effluent limit based on limits of dectectability may be established. In both cases, appropriate biological monitoring requirements will be incorporated into the permit to determine compliance with appropriate water quality standards. Additionally, if naturally occurring instream concentrations for a substance is higher than the derived limit, the Department may establish permit limits at a level higher than the derived limit, but no higher than the natural background concentration. In such cases, the Department may require effluent bioassays and instream monitoring.

Evaluation of Ambient Water Quality:
(1) If the national criterion described in Section (a) above is lower than the analytical detection limit, the criterion is not considered violated if the ambient concentration is below the detection limit and the instream indigenous biological community is not adversely impacted.

(2) If the ambient concentration is higher than the national criterion described in Section (a) above, the criterion is not considered violated if biological monitoring has demonstrated that the instream indigenous biological community is not adversely impacted.

The Department may require biological monitoring in NPDES permits to further ascertain any bioaccumulative effects of pollutants. Biological assessment methods may be employed in appropriate situations to determine abnormal nutrient enrichment, median tolerance limits (TLm), concentration of toxic substances, acceptable instream concentrations, or acceptable effluent concentrations for maintenance of a balanced indigenous aquatic community.

Specific Standards for Surface Waters: All water use classifications protect for a balanced indigenous aquatic community of flora and fauna. In addition, Trout Natural and Trout Put, Grow, and Take classifications protect for reproducing trout populations and stocked trout populations, respectively.

SOURCE: South Carolina Water Classifications and Standards Sec. A; Sec. C(7)(a); Sec. D(1)(a); Sec. E (first paragraph), E(4), E(7)(b)(2), E(7)(c)(1), E(7)(c)(2), E(8)(d), E(10)(b); Sec. F; Sec. G. May 28, 1993.

SOUTH DAKOTA

NARRATIVE BIOCRITERIA

Biological integrity of surface waters of the state. All waters of the state must be free from substances whether attributable to human-induced point source discharges or nonpoint source activities, in concentrations or combinations which will adversely impact the structure and function of indigenous or intentionally introduced aquatic communities.

SOURCE: South Dakota Surface Water Quality Standards. 74:03:02:59. August 8, 1994.

TENNESSEE

NARRATIVE BIOCRITERIA

Biological Integrity - The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or adversely affected. The condition of biological communities will be measured by use of metrics suggested in guidance such as *Rapid Bioassessment Protocols for Use in Streams and Rivers* (EPA/444/4-89-001) or other scientifically defensible methods. Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same ecoregion.

DEFINITIONS

Ecoregion - A relatively homogenous area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.

Reference Site - least impacted waters within an ecoregion that have been monitored to establish a baseline to which alterations of other waters can be compared.

SOURCE: Tennessee General Water Quality Criteria, November 1994 Chapter 1200-4-3.03(j);1200-4-3-.04(6); 1200-4-3-.04(7).

VERMONT

NARRATIVE BIOCRITERIA

It is the policy of the State of Vermont to assure the maintenance of water quality necessary to sustain existing aquatic communities.

In making a determination of the uses to be protected and maintained, the Secretary shall consider the beneficial values or uses for that water body and:

a. Fish and aquatic life present in the water body;
b. Wildlife that utilize the water body;
c. Habitat, including wetlands, within a water body supporting existing populations of fish, aquatic life, wildlife, or plant life that is maintained by the water body.

Aquatic habitat--No change from background conditions that would have an undue adverse effect on the composition of the aquatic biota, the physical or chemical nature of the substrate or the species composition or propagation of fishes.

SOURCE: Vermont Water Quality Standards. Sec. 1-02 A.4; Sec 1-02 B.1.a, b and c; Sec. 3-01 B.5 August 1, 1994.

VIRGINIA

NARRATIVE BIOCRITERIA

All state waters shall be maintained at such quality as will protect all existing beneficial uses attained on or after November 28, 1975 and will support the propagation and growth of all aquatic life, including game fish, which might reasonably be expected to inhabit them.

SOURCE: Virginia Surface Water Standards 5/20/92. VR680-21-01.2(A).

WEST VIRGINIA

NARRATIVE BIOCRITERIA

No significant adverse impact to the chemical, physical, hydrologic, or biological components of aquatic ecosystems shall be allowed.

SOURCE: Title 46, Legislative Rules, Environmental quality Board, Series 1, Requirements Governing Water Quality Standards, 46-1-3.2(l).

AMERICAN TERRITORIES

American Samoa

NARRATIVE BIOCRITERIA

Waters shall be substantially free from substances and conditions or combinations thereof attributable to sewage, industrial wastes, or other activities of man which may be toxic to humans, other animals, plants, and aquatic life or produce undesirable aquatic life.

Toxic Substances: Compliance with paragraph (a)(4) of this section will be determined by use of indicator organisms, analysis of species diversity, populations density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the EQC.

SOURCE: American Samoa Administrative Code; Sec. 24.0201-24.0211,24.0207(a) CNMI. September 25, 1990.

Guam

NARRATIVE BIOCRITERIA

General Criteria Applicable to All Waters: Effects of high temperature, biocide, pathogenic organisms, toxic, corrosive, or other deleterious substances at levels or combinations sufficient to be toxic or harmful to human, animal, plant or aquatic life or in amounts sufficient to interfere with any beneficial use of the water, shall be evaluated as a minimum, by use of a 96-hour bioassay as described in the most recent edition of the EPA Manual of ASTM.

SOURCE: Guam Water Quality Standards Sec. II A. Palau Palau National Code; Environmental quality Protection Act; Marine and Fresh Water Quality Standard Regulations PNC Part 3.1(e). March 23, 1992.

Mariana Islands

NARRATIVE BIOCRITERIA

Basic Water Quality Criteria Applicable to All Waters: All waters shall be free of substances attributable to domestic, industrial, or other controllable sources of pollutants and shall be capable of supporting desirable aquatic life and be suitable for recreation in and on the water

High temperatures; biocides; pathogenic organisms; toxic, radioactive, *corrosive, or other deleterious* substances at levels or in combinations sufficient to be toxic or harmful to human health or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water.

Toxic Pollutants: In order that the designated uses of State waters be protected, all waters shall be free from toxic pollutants in concentrations that are lethal to, or that produce detrimental physiological responses in human, plant, or animal life. Detrimental responses include, but are not limited to, decreased growth rate and decreased reproductive success of resident or indicator species and/or significant alterations in population or community ecology or receiving water biota.

In order to determine compliance with this section, the Chief may require additional studies of indicator organisms which include, but are not limited to, analyses of species diversity, species abundance, reproductive success, population density and growth anomalies. Additionally, effects on human health due to bioconcentration shall be considered.

SOURCE: Mariana Islands Commonwealth of the Northern Mariana Islands Water Quality Standards, Part 6,6(d),7.10. November 25, 1991.

Palau

NARRATIVE BIOCRITERIA

3.1 Basic Criteria Applicable to all Waters:

All waters shall be capable of supporting desirable aquatic life and be suitable for recreation in and on the water. In furtherance of this goal, all waters shall be:

(e) Maintained free of toxic substances in concentrations that are toxic to or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analysis of species diversity, population density, growth anomalies, bioassay of appropriate duration or other appropriate methods as specified by the Board. The survival of aquatic life in waters subjected to waste discharge or other controllable water quality factors shall not be less than that for the same water body in areas unaffected by the waste discharge or when necessary for other control water that is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater latest edition. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a ninety-six (96) hour bioassay.

SOURCE: Palau National Code; Environmental Quality Protection Act' Marine and Freshwater Quality Standards Regulations PNC Part 3.1(e). December 8, 1990.

Puerto Rico

NARRATIVE BIOCRITERIA

Class SA: Coastal waters whose existing characteristics should not be altered in order to preserve the existing natural phenomena.

Class SB: Coastal waters intended for uses...in propagation and preservation of desirable species.

Class SC: Coastal waters...for use in propagation and maintenance of desirable species.

Class SD: Surface waters intended for...propagation and preservation of desirable species.

Class SE: Surface waters of exceptional ecological value, whose existing characteristics should not be altered in order to preserve the existing natural phenomena.

DEFINITIONS

Communities--Populations dominated by one species or a specific group of organisms. The community derives its name from that of the dominant organism (s), such as coral reefs, and including mangroves and limestone beds.

Desirable Species--Species indigenous to the areas or introduced to the area because of ecological or commercial value.

SOURCE: Water Quality Standards Regulation of Puerto Rico. March 2, 1983. Article 1; Articles 2.2.1(A), 2.2.2(A), 2.2.3(A), 2.2.4(A), 2.2.5(A)

Virgin Islands

NARRATIVE BIOCRITERIA

All surface waters shall be capable of supporting diversified aquatic life.

Class B and Class C--Best usage of waters: For propagation of desirable species of marine life.

SOURCE: Title 12 Virgin Islands Code of Rules and Regulations Chap. 7, Subchapter 186 Water Quality Standards for Coastal Waters of the Virgin Islands Sec. 186-1, 186.3, 186.4. May 8, 1985.

Questions on the documentation of state and territory biocriteria language may be addressed by contacting Candace Stoughton, USEPA, Office of Water, at 202-260-1737 (phone) or email at STOUGHTON.CANDACE@EPAMAIL.EPA.GOV.

Section 5. Literature Cited and Information Sources

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For additional information, please see the accompanying bibliography "Biological Assessment Methods, Biocriteria, and Biological Indicators: Bibliography of Selected Technical, Policy, and Regulatory Literature" (U.S. EPA 1996).

Section 6. List of Contacts

State Contacts

ALABAMA
Robert W. Cooner
Alabama Department of Environmental Management
Field Operations Division
P.O. Box 301463
Montgomery, AL 36130-1463
(334)260-2700/272-8131 (fax)

ALASKA
Jeffrey Hock
Alaska Department of Environmental Conservation
Water Quality Technical Services Section
10107 Bentwood Place
Juneau, AK 99801-8552
(907)790-2169

ARIZONA
Patti Spindler
Arizona Department of Environmental Quality
Water Quality Standards Unit
3033 North Central Avenue, 3rd Floor
Phoenix, AZ 85012
(602)207-4543/4528 (fax)

ARKANSAS
John Giese
Arkansas Department of Pollution Control and Ecology
8001 National Drive
Little Rock, AR 72219-8913
(501)570-2121

CALIFORNIA
Jim Harrington
California Fish and Game Department
Water Pollution Control Laboratory
2005 Nimbus Road
Rancho Cordova, CA 95670
(916)358-2858/985-4301 (fax)

COLORADO
Robert McConnell
Colorado Department of Public Health and Environment
Water Quality Control Division
4300 Cherry Creek Drive, South
Denver, CO 80222-1530
(303)692-3578/782-0390

CONNECTICUT
Ernest Pizzuto or Guy Hoffman
Connecticut Department of Environmental Protection
Bureau of Water Management, PERD
79 Elm Street
Hartford, CT 06106-5127
(860)424-3715 or 3733/566-8650 (fax)

DELAWARE
John Maxted
Delaware Department of Natural Resources and Environmental Control
P.O. Box 1401
84 Kings Highway
Dover, DE 19903
(302)739-4590/6140 (fax)

DISTRICT OF COLUMBIA
Hamid Karimi
Chief, Water Quality Monitoring Branch
DC Environmental Regulation Administration
Department of Consumer & Regulatory Affairs
2100 Martin Luther King, Jr. Avenue,SE
Washington, DC 20020-5732
(202)645-6601

FLORIDA
Ellen McCarron
Florida Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904)488-0782/6579 (fax)

GEORGIA
Mark Winn, III
Georgia Department of Natural Resources
Environmental Protection Division
Water Quality Management Program
205 Butler Street, SE, Floyd Towers, East
Atlanta, GA 30334
(404)656-4905

Steve Schleiger
Georgia Department of Natural Resources
Wildlife Resources Division
Fisheries Management Section
Highway 341 South, Route 3, Box 75
Fort Valley, GA 31030
(912)825-7841

HAWAII
Gordon Smith
Hawaii Department of Health and Environmental Planning
P.O. Box 3378
Honolulu, HI 96801
(808)586-4351/4370 (fax)
Email:gordo@hawaii.edu

IDAHO
Bill Clark
Idaho Department of Health and Welfare
Division of Environmental Quality
1410 North Hilton
Boise, ID 83706-1253
(208)373-0260/0576 (fax)

ILLINOIS
Mike Branham
Illinois Environmental Protection Agency
Division of Water Pollution Control
P.O. Box 19276
Springfield, IL 62794-9276
(217)782-3362/785-1225 (fax)

INDIANA
Lee Bridges
Indiana Department of Environmental Management
105 S. Meridian
P.O. Box 6015
Indianapolis, IN 46206-6015
(317)243-5030/5056 (fax)

IOWA
John Olson
Iowa Department of Natural Resources
Water Resources Section
Wallace State Office Building
Des Moines, IA 50319
(515)281-8905/8895 (fax)

KANSAS
Mike Butler
Kansas Department of Health & Environment
Bureau of Water Protection
Forbes Field, Building 740
Topeka, KS 66620
(913)296-5580/291-3266 (fax)

KENTUCKY
Tom VanArsdale
Kentucky Department for Environmental Protection
Division of Water
14 Reilly Road
Frankfort, KY 40601
(502)564-3410

LOUISIANA
Dugan Sabins
Louisiana Department of Environmental Quality
Office of Water Resources
P.O. Box 82215
Baton Rouge, LA 70884-2215
(504)765-0511/0635 (fax)

MAINE
Dave Courtemanch
Maine Department of Environmental Protection
Bureau of Water Quality Control
State House, Suite 17
Augusta, ME 04333
(207)287-7789/7826 (fax)

MARYLAND
Niles Primrose
Maryland Department of Natural Resources
Tidewater Ecosystem Assessment
416 Chinquapin Round Road
Annapolis, MD 21401
(410)974-3238

Paul Kazyak
Maryland Department of Natural Resources
Monitoring and Nontidal Assessment
Tawes State Office Building, B-2
Annapolis, MD 21401
(410)974-3361

MASSACHUSETTS
Arthur Johnson
Massachusetts Department of Environmental Protection
Office of Watershed Management
40 Institute Road
North Grafton, MA 01536
(508)792-7470/839-3469 (fax)

MICHIGAN
William Creal
Michigan Department of Natural Resources
Surface Water Quality Division
Stevens T. Mason Building
P.O. Box 30273
Lansing, MI 48909
(517)335-4181

MINNESOTA
Judy Helgen
Minnesota Pollution Control Agency
Division of Water Quality
520 Lafayette Road
St. Paul, MN 55155
(612)296-7240/7213 (fax)

MISSISSIPPI
Mike Beiser
Mississippi Department of Environmental Quality
Biological Services Section
1542 Old Whitfield Road
Pearl, MS 39208
(601)939-8553/8773 (fax)

MISSOURI
John Ford
Missouri Department of Natural Resources
Water Pollution Control Program
P.O. Box 176
Jefferson City, MO 65102-0176
(314)751-7024

MONTANA
Bob Bukantis
Montana Department of Health and Environmental Science
Water Quality Bureau, Cogswell Building
1400 Broadway
Helena, MT 59620
(406)444-4684/1374 (fax)

NEBRASKA
Ken Bazata
Nebraska Department of Environmental Quality
301 Centennial Mall
Lincoln, NE 68509
(402)471-4700

NEVADA
Jim Cooper
Bureau of Water Quality Planning
Division of Environmental Protection
123 West Nye Lane
Carson City, NV 89710
(702)687-4670/885-0868 (fax)

NEW HAMPSHIRE
Bob Estabrook
New Hampshire Department of Environmental Services
Water Supply and Pollution Control Division
P.O. Box 95
Concord, NH 03301-6528
(603)271-3503/2867 (fax)

NEW JERSEY
Kevin Berry
New Jersey Department of Environmental Protection and Energy
Office of Land and Water Planning
401 East State Street, 4th Floor
Trenton, NJ 08625
(609)633-1179

NEW MEXICO
Erik Galloway
New Mexico Environment Department
Surface Water Quality Bureau
P.O. Box 26110
Santa Fe, NM 87502-6110
(505)827-2923/0610 (fax)

NEW YORK
Robert Bode
New York Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233-3503
(518)285-5682/5601 (fax)

NORTH CAROLINA
Dave Penrose
North Carolina Division of Environmental Management
Water Quality Section
4401 Reedy Creek Road, P.O. Box 27687
Raleigh, NC 27607
(919)733-6946/9959 (fax)

NORTH DAKOTA
Mike Ell
North Dakota Department of Health
Division of Water Supply and Pollution Control
P.O. Box 5520
Bismarck, ND 58502-5520
(701)328-5210/5200 (fax)

OHIO
Chris Yoder
Ohio Environmental Protection Agency
Ecological Assessment Unit
1685 Westbelt Drive
Columbus, OH 43228
(614)728-3382

OKLAHOMA
John Dyer
Oklahoma Department of Environmental Quality
Water Quality Division
1000 NE Tenth Street
Oklahoma City, OK 73117-1212
(405)271-5205

OREGON
Rick Hafele
Oregon Department of Environmental Quality
1712 S.W. 11th Street
Portland, OR 97201
(503)229-5983

ORSANCO
Jason Heath
Ohio River Valley Water Sanitation Commission
5735 Kellogg Avenue
Cincinnati, OH 45228-1112
(513)231-7719

PENNSYLVANIA
Robert Frey
Pennsylvania Department of Environmental Protection
Bureau of Water Quality Management
P.O. Box 8465, 10th Floor
Harrisburg, PA 17105-8465
(717)783-3638/772-5156 (fax)

RHODE ISLAND
Carlene Newman
Rhode Island Department of Environmental Management
Division of Water Resources
291 Promenade Street
Providence, RI 02908-5767
(401)277-3961

SOUTH CAROLINA
David Chestnut
South Carolina Department of Health and Environmental Control
Bureau of Water Pollution Control
2600 Bull Street
Columbia, SC 29201
(803)734-5300

SOUTH DAKOTA
Andrew Repsys
South Dakota Department of the Environment and Natural Resources
Division of Water Resource Management
523 East Capitol, Joe Foss Building Room 425
Pierre, SD 57501-3181
(605)773-3696

TENNESSEE
Greg Denton
Tennessee Department of Environment and Conservation
Division of Water Pollution Control
401 Church Street, L&C Annex, 6th Floor
Nashville, TN 37243-1534
(615)532-0699

TEXAS
Charles Bayer
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087
(512)239-4583/4420 (fax)

UTAH
Richard Denton
Utah Department of Environmental Quality
Division of Water Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870
(801)538-6859

VERMONT
Steve Fiske
Vermont Department of Environmental Conservation
Agency of Natural Resources
Water Quality Division
103 S. Main Street
Waterbury, VT 05671-0408
(802)244-4520/241-3308 (fax)

VIRGINIA
Lou Seivard
Virginia Department of Environmental Quality
Water Division
P.O. Box 11143
Richmond, VA 23230-1143
(804)762-4121/4522 (fax)

WASHINGTON
Robert Plotnikoff
Washington State Department of Ecology
P.O. Box 47710
Olympia, WA 98504-7710
(360)407-6687

WEST VIRGINIA
Janice Smithson
West Virginia Division of Environmental Protection
Office of Water Resources
1201 Greenbrier Street
Charleston, WV 25331-1088
(304)558-2108/5905 (fax)

WISCONSIN
Joe Ball
Wisconsin Department of Natural Resources
Bureau of Water Resources Management
101 S. Webster Street, GEFII
Box 7921
Madison, WI 53707
(608)266-7390

WYOMING
Dick Johnson
Wyoming Department of Environmental Quality
Water Quality Division
Herschler Building, 4th Floor
122 West 25th Street
Cheyenne, WY 82002
(307)777-6891

EPA Contacts

Region 1- Boston

Ray Thompson
US EPA - Region I
60 Westview Street
Lexington, MA 02173
617-860-4372/4397(fax)
Regional Monitoring Coordinator

Diane Switzer
U.S. EPA - Region I
60 Westview Street
Lexington, MA 02173
617-860-4343/4397(fax)
Regional 305(b) Coordinator

Peter Nolan
U.S. EPA - Region I
JFK Federal Building
Boston, MA 02203
617-860-4343/4397(fax)
Regional Biologist

Bill Beckwith
U.S. EPA - Region I
JFK Federal Building
Boston, MA 02203
617-565-3539
Regional Standards Coordinator

Region 2 - New York

Randy Braun
U.S. EPA - Region II
2890 Woodbridge Avenue
Raritan Depot, Building 10
Edison, NJ 08837-3679
908-321-6692/6616(fax)
Regional Monitoring Coordinator

Jane Leu
U.S. EPA - Region II
Water Management Division
290 Broadway
New York, NY 10007-1866
212-264-3188/2194(fax)
Regional 305(b) Coordinator

John Malleck
US EPA - Region II
Water Management Division
290 Broadway
New York, NY 10007-1866
212-264-1833/2194(fax)
Regional 305(b) Coordinator

Jim Kurtenbach
US EPA - Region II
2890 Woodbridge Avenue
Building 10, Bay-B (MS 220)
Edison, NJ 08837
908-321-6695/6616(fax)
Regional Biologist

Wayne Jackson
U.S. EPA Region 2
290 Broadway
New York, NY 10007
212-264-3709
Regional Standards Coordinator

Region 3 - Philadelphia

Chuck Kanetsky
U.S. EPA Region 3 (3ESII)
841 Chestnut Street
Philadelphia, PA 19107
215-597-8176/7906 (fax)
Regional Monitoring & 305(b) Coordinator

Margaret Passmore
U.S. EPA Region 3 (3ESII)
841 Chestnut Street
Philadelphia, PA 19107
215-597-6149/7906(fax)
Regional Indicators Coordinator

Ron Preston
U.S. EPA - Region 3
303 Methodist Building
11th & Chapline Streets
Wheeling, WV 26003
304-234-0245/0260)fax)
Regional Biologist

Evelyn MacKnight
U.S. EPA Region 2
841 Chestnut Street
Philadelphia, PA 19107
215-597-4491
Regional Standards Coordinator

Region 4 - Atlanta

Jim Harrison
U.S. EPA Region 4
345 Courtland Street
25th Floor
Atlanta, GA 30365
404-347-3396/1799(fax)
Regional Water Quality Expert

David Melgaard
U.S. EPA Region 4
Water Management Division
345 Courtland Street, NE
Atlanta, Georgia 30365
404-347-2126/3269(fax)
305(b) Coordinator
Regional Monitoring Coordinator

Bill Peltier, Biologist
US EPA - Region IV
960 College Station Road
Athens, GA 30365-2700
706-546-2296/2459(fax)
Regional Biologist

Fritz Wagener
U.S. EPA Region 4
Water Management Division
345 Courtland Street, NE
Atlanta, Georgia 30365
404-347-3555 x 6633
Regional Standards Coordinator

Region 5 - Chicago

Dave Stoltenberg.
US EPA - Region V
77 West Jackson Boulevard
Chicago, IL 60604-3507
312-353-5784/4342(fax)
Regional 305(b) Coordinator

Thomas Simon
U.S. EPA Region 5 (WQ-16J)
77 W. Jackson Blvd.
Chicago, IL 60604-3507
312-353-8341/886-7804
Regional Biologist

David Pfheiffer
U.S. EPA Region 5
77 W. Jackson Blvd.
Chicago, IL 609604-3507
312-353-9024
Regional Standards Coordinator

Region 6- Dallas

Charlie Howell
U.S. EPA Region 6 (6W-QT)
1445 Ross Avenue
Dallas, TX 75202
214-665-8354/7446
Monitoring Coordinator
Regional Biologist

Russell Nelson
U.S. EPA - Region VI
First Interstate Bank Tower at Fountain Place
1445 Ross Avenue, 12th Floor, Suite 1200
Dallas, TX 75202-2733
214-665-6646/6490(fax)
Regional 305(b) Coordinator

Cheryl Overstreet
U.S. EPA Region 6
First Interstate Bank Tower at Fountain Place
1445 Ross Avenue
Dallas, TX 75202-2733
214-655-6643
Regional Standards Coordinator

Region 7 - Kansas City

John Houlihan
U.S. EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101
913-551-7423/7765(fax)
Regional 305(b) Coordinator

Larry Shepard
U.S. EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101
913-551-7441
Regional Standards Coordinator

Lyle Cowles
U.S. EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101
913-551-5042/5218(fax)
Regional Monitoring Coordinator

Mike Tucker/Gary Welcker
US EPA - Region VII
25 Funston Road
EMCM/ENSV
Kansas City, KS 66115
913-551-5080/5079 (fax)
Regional Biologists

Region 8 - Denver

Phil Johnson
U.S. EPA Region 8 (8WM-WQ)
One Denver Place
999 18th Street, Suite 500
Denver, CO 80202
303-293-1581/1386(fax)
Monitoring Coordinator
Regional 305(b) Coordinator

Bill Wuerthele
U.S. EPA Region 8
One Denver Place
999 18th Street
Denver, CO 80202
303-312-6280
Regional Standards Coordinator

Loys Parrish
US EPA - Region VIII
P.O. Box 25366
Federal Center
Denver, CO 80225
303-236-5055/5109(fax)
Regional Biologist

Region 9 - San Francisco

Ed Liu
U.S. EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105
415-744-1934/1078(fax)
Regional Monitoring Coordinator

Janet Hashimoto
U.S. EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105
415-744-1933/1078(fax)
Regional 305(b) Coordinator

Peter Husby
US EPA - Region IX
Water Division
75 Hawthorne Street
San Francisco, CA 94105
510-412-2331/2304(fax)
Regional Biologist

Phil Woods
US EPA - Region IX
Water Division
75 Hawthorne Street
San Francisco, CA 94105
415-744-1997
Regional Standards Coordinator

Region 10 - Seattle

Gretchen Hayslip
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
206-553-1685/0119(fax)
Regional Monitoring Coordinator
Regional Biologist

Donna Walsh
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
206-553-8293/0119(fax)
Regional 305(b) Coordinator

Lisa Macchio
U.S. EPA Region 10
1200 Sixth Avenue (WS-139)
Seattle, WA 98101
206-553-1834
Regional Standards Coordinator

EPA Headquarters Contacts

Barry Burgan
U.S. EPA Headquarters
Office of Water, Monitoring Branch
401 M Street, SW (4503F)
Washington, DC 20460
202-260-7060
National 305(b) Coordinator

Wayne Davis
U.S. EPA Headquarters
Office of Policy, Planning and Evaluation
401 M. Street, SW (2162)
Washington, DC 20460
202-260-4906
Water Indicators Liaison

Chris Faulkner
U. S. EPA
Office of Water, Monitoring Branch
401 M Street, SW (4503F)
Washington, DC 20460
202-260-6228
National Biological Monitoring Program

Elizabeth Fellows
U.S. EPA Headquarters
Office of Water, Monitoring Branch
401 M Street, SW (4503F)
Washington, DC 20460
202-260-7062
Chief, Monitoring Branch
Coordinator - Water Indicators

George Gibson
U.S. EPA Headquarters
Central Lab, Suite 200
201 Defense Highway
Annapolis, MD 21401
410-
National Biocriteria Program

Jim Horne
U.S. EPA Headquarters
(WH-546)
401 M Street, SW
Washington, DC 20460
202-260-
National Goals Project - Water

Susan Jackson
Office of Water
U.S. EPA Headquarters
401 M Street, SW
Room E-940
Washington, DC 20460
202-260-1800
National Biocriteria Program

William Painter
U.S. EPA Headquarters
Office of Policy, Planning and Evaluation
Office of Sustainable Ecosystems and Communities
401 M Street, SW (2124)
Washington, DC 20460

Donna Reed
U.S. EPA Headquarters
Office of Wastewater Management
401 M Street, SW (4203)
Washington, DC 20460
National Permitting Program

Candace Stoughton
US Environmental Protection Agency
(WH-586)
401 M Street, SW
Washington, DC 20460
202-260-
National Biocriteria Program

Peter Truitt
U.S. EPA Headquarters
Office of Policy, Planning and Evaluation
401 M Street, SW (2162)
Washington, DC 20460
202-260-
Coordinator National Goals Project