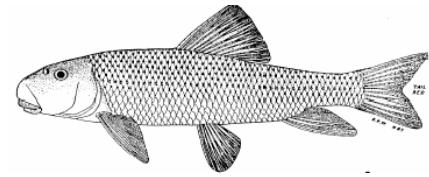


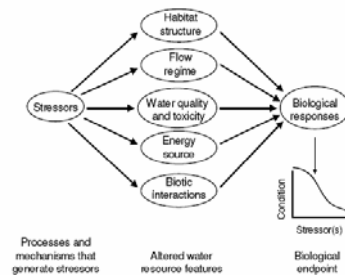
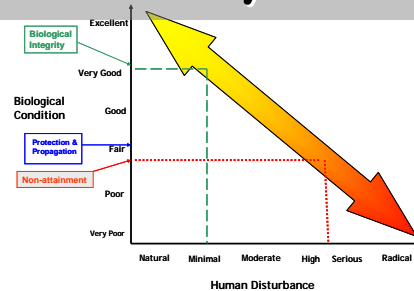
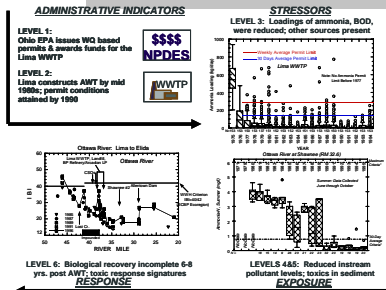
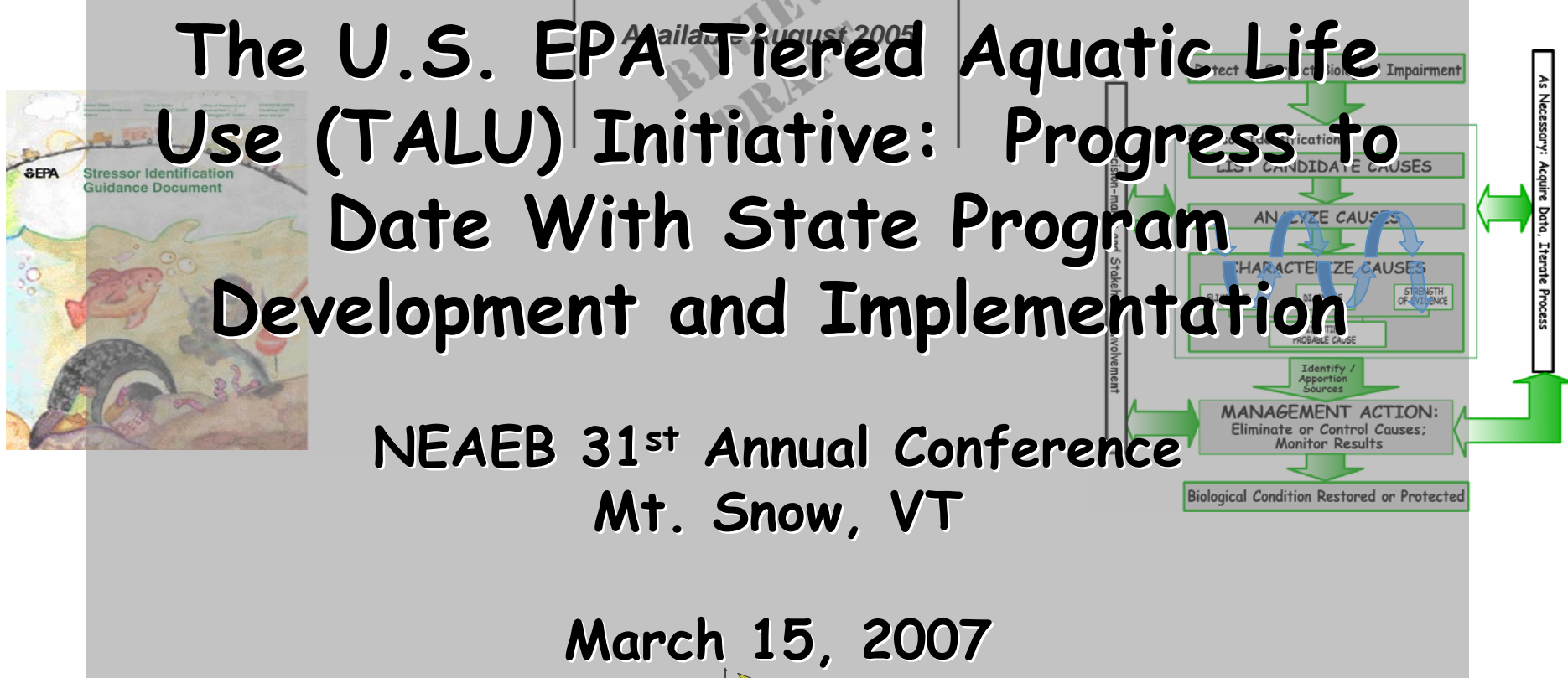
Use of Biological Information to Tier Designated Aquatic Life Uses in State and Tribal Water Quality Standards



The U.S. EPA Tiered Aquatic Life Use (TALU) Initiative: Progress to Date With State Program Development and Implementation

NEAEB 31st Annual Conference
Mt. Snow, VT

March 15, 2007



Aquatic Life Use

ALUs inherently "drive" the determination of status & management responses, thus they are a critical determinant of overall program effectiveness.

How will (do) we assure accuracy in the process of setting and measuring attainment & attainability of ALUs?

Exceptional Resources



structure & function similar to natural community
with some additional taxa and biomass, no or
sensitive invasive taxa may



"Typical" Resources

changes in structure and
of community, some loss of
sensitive taxa
sensitive

Biological C

T

atic

ive
asive



Modified Resources

virtual absence of sens
predominance by one o
taxa, extremely low taxa
abnormalities and anon
elevated

LOW

Stressor Gradient -
[Effect of Human Activity]

Limited Resources



Why Tiered Uses?

Rationale for Tiered Uses – circa 1977

- ***Natural history*** - published texts conveyed a knowledge of distinguishable ecological attributes.
- These correspond to **major drivers of the ecosystem** (e.g., landscape features, etc.).
- “One-size-fits-all” uses do not represent ***reality***.
- “One-size-fits-all” ***does not “sell”***.
- TALU promises more customized and cost-effective ***water quality management outcomes*** (TMDLs, permits, policies, etc.).

TALU Facts

What TALUs Are:

- A reflection of the whole ecosystem – based on ***representative ecological attributes***.
- Assigned to water bodies based on the protection and restoration of ***ecological potential***.

What They Are Not:

- Responsive to “***user preferences***” (i.e., effluent conveyance, land use issues).
- A vehicle for ***lessening*** pollution controls.
- An “easy exit” from an ***impaired waters*** listing.

TALU Development

Some Key Concepts:

- ***Reference Condition*** – determine ecological attributes, their potential, and allied factors.
- ***Attainability*** – a systematic process and tool set to grapple with the inherent conflict between restoration ideals and socioeconomic realities of multiple water resource uses.
- ***EPA Water Quality Regulations*** provide a ***general*** process – *key details are lacking*.
- ***Tools to Assess and Implement*** were lacking prior to the development of biocriteria and TALU.

National Academy of Sciences Committee to Assess Science in TMDLs¹

Two Major WQ Program Areas Identified as Needing Improvement: Water Quality Standards

- Refined designated uses
- UAA process
- Biological criteria

We cannot effectively deal with the complex mosaic of watershed level impacts unless a framework is established via TALU and biocriteria

Monitoring & Assessment

- “Adequacy” in terms of concepts and elements
- Appropriate roles of ambient indicators

¹NRC (2001). *Assessing the TMDL Approach to Water Quality Management*

Aquatic Life Uses

Codified in WQS:

- Uses defined as narratives.
- Chemical & biological criteria assigned to each in accordance with the attributes described in the use narrative.

Uses Are Assigned Based on (in order of importance):

- Attainment of the biocriteria.
- Habitat assessment demonstrates potential for a particular TALU.



United States
Environmental Protection
Agency

Use of Biological Information to Tier Designated Aquatic Life Uses in State and Tribal Water Quality Standards

**The Ohio and Maine programs
are highlighted as state case
examples of long term TALU
implementation – the “roots”
of each were visible in the
1970s**

Introduction

1. What are Tiered Aquatic Life Uses (TALUs)?

The Biological Condition Gradient (BCG)

2. What is the scientific basis of the BCG?
3. How do you develop and calibrate a BCG?
4. The x-axis: A Generalized Stressor Gradient (GSG)

Incorporating TALUs into State and Tribal WQS: Case Examples

5. Key concepts and milestones in the development of TALUs
6. How have states and tribes used TALUs in WQS and management?

References,
Glossary & Acronyms

Appendixes A – E

- Maine TALU Implementation Case History (A)
- Ohio TALU Implementation Case History (B)
- Summary of draft documents addressing technical elements of bioassessment programs (C), reference condition (D), and statistical guidance for developing indicators (E)

Biological Condition Gradient

Natural structure and function of community

ORW
Uses

Structure & function similar to natural community with some additional taxa and biomass, no or

**The Biological Condition Gradient:
A conceptual model for interpreting
detrimental change in aquatic ecosystems**

**Susan P. Davies and Susan K. Jackson
(Ecological Applications 16[4]: 2006)**

Extreme changes in structure and function, wholesale changes in taxa, virtual absence of sensitive taxa, predominance by one or a few tolerant taxa, extremely low taxa richness, abnormalities and anomalies extremely elevated

dominance by tolerant or invasive taxa, nuisance growths, abnormalities and anomalies may be common.

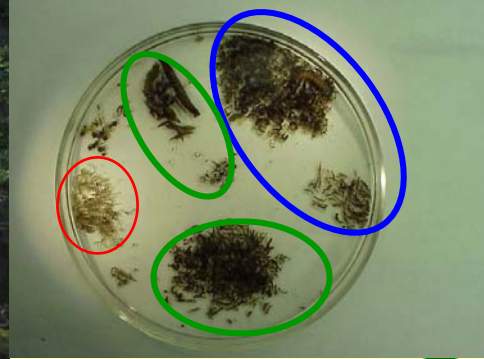
Unacceptable
Limited
Uses

Unacceptable

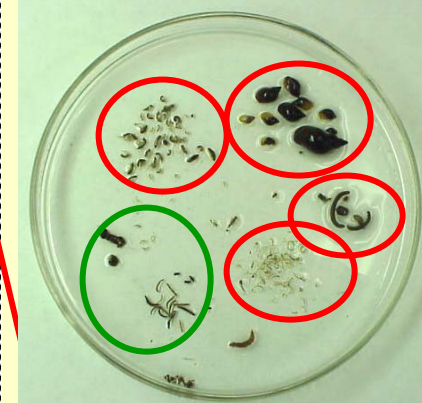
LOW ————— **Stressor Gradient** —————> HIGH
[Effect of Human Activity]

Biological Condition

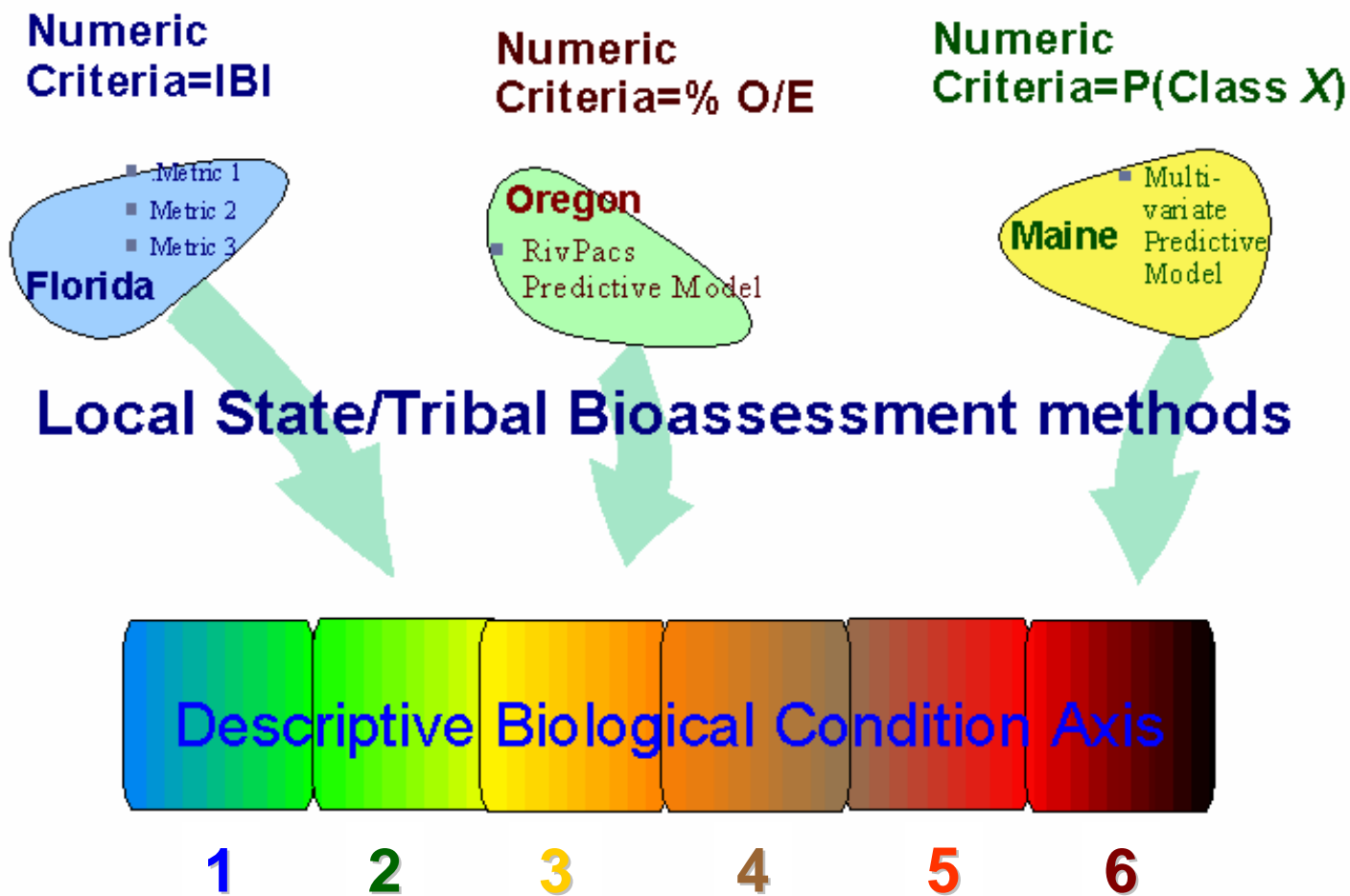
[Indices Specific to Ecotype]



	Tier 1	Tier 3	Tier 6
Attribute 1 Historically documented, sensitive, long-lived or regionally endemic taxa	As predicted for natural occurrence except for global extinctions	Some may be absent due to global extinction or local extirpation	Absent
Attribute II <i>Sensitive-rare</i> taxa	As predicted for natural occurrence, with at most minor changes from natural densities	Some loss, with replacement by functionally equivalent <i>Sensitive-ubiquitous</i> taxa	Absent



The Biological Condition Gradient: Comparable Assessments by Different Methods (a key issue)



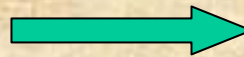
*Slide used courtesy of S. P. Davies, Maine DEP;
U.S. EPA Aquatic Life Uses Working Group*

Maine Tiered Uses Based on Measurable Ecological Values

Narrative Standard

Ecological Expression

CLASS A
natural



**Taxonomic and Numeric
Equality; Presence of
sensitive/specialist taxa**

CLASS B
*unimpaired, maintain
all indigenous taxa*



**Retention of taxa and numbers;
Absence of hyperdominance;
Presence of sensitive/specialist taxa**

CLASS C
*maintain fish taxa
maintain structure
maintain function*



**Resistance; Redundancy;
Resilience; Balanced Distribution**

maintain function



**Energy transfer;
Resource assimilation;
Reproduction**

I
n
t
e
r
i
m

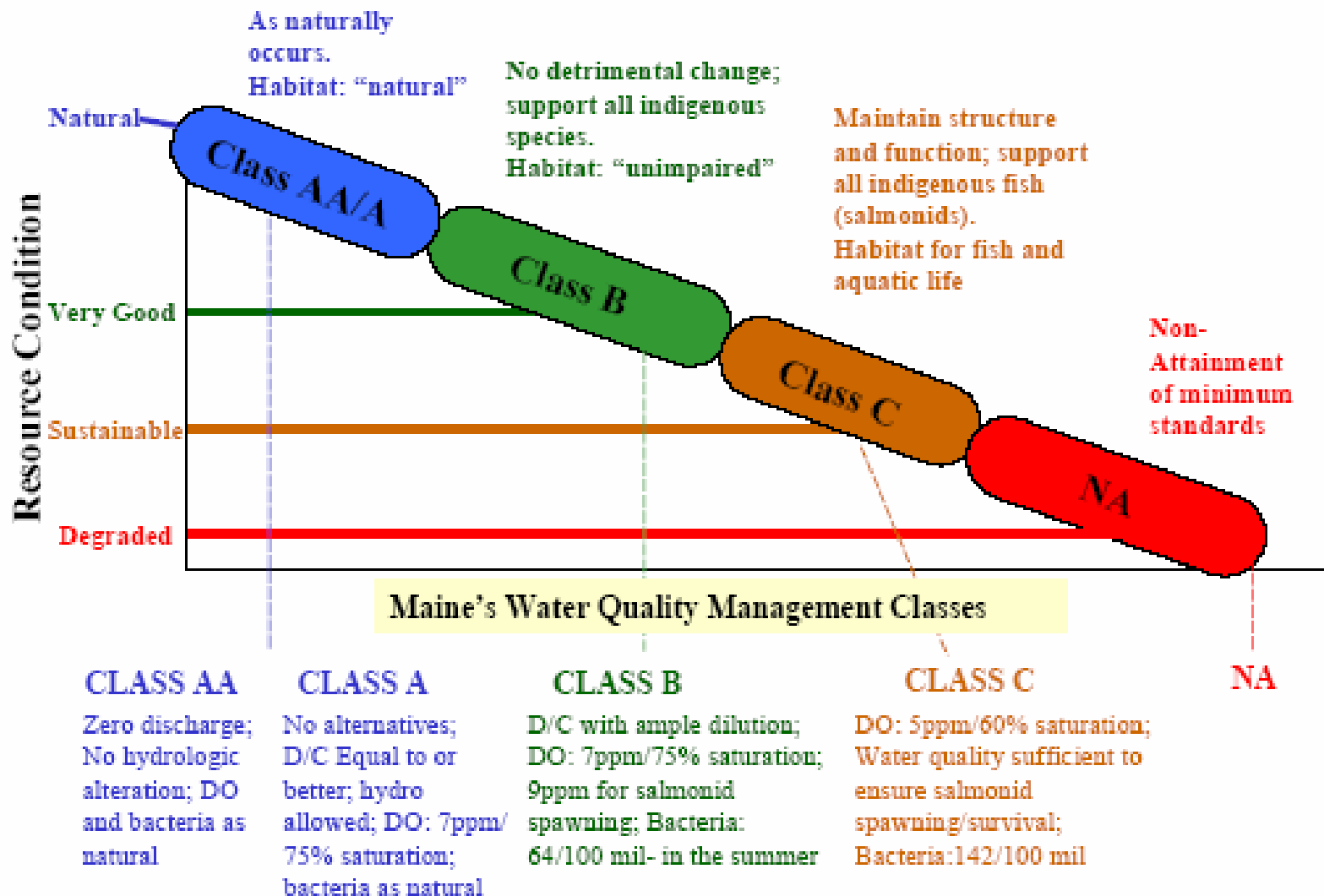
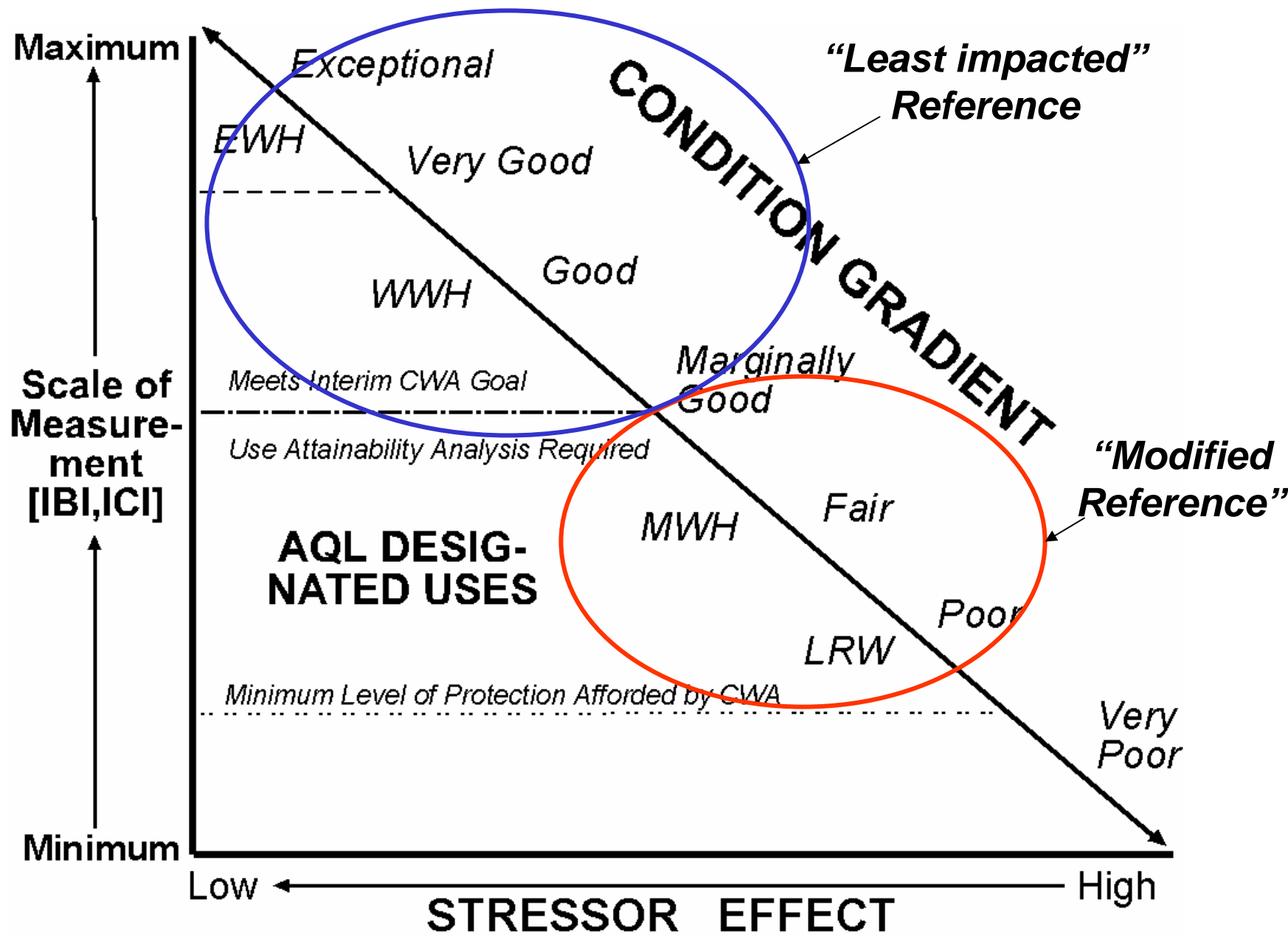


FIGURE A-3. Relation between Maine TALUs and other water quality standards and criteria.

Maine TALU Attainment

Legislative Class	Monitoring Result	Attains Class?	Next Step
A	A	Yes	--
C	B	Yes	--
A	B	No	TMDL
B	NA	No	TMDL

DESIGNATED USE OPTIONS ALONG THE BIOAXIS AND BIOLOGICAL CONDITION GRADIENT



Ohio Biological Criteria: Adopted May 1990 (OAC 3745-1-07; Table 7-14)

Huron Erie Lake Plain (HELP)

Use	Size	IBI	Mlwb	ICI
WWH	H	28	NA	34
	W	32	7.3	34
	B	34	8.6	34
MWH-C	H	20	NA	22
	W	22	5.6	22
	B	20	5.7	22
MWH-I	B	30	5.7	NA

Eastern Corn Belt Plains (ECBP)

Use	Size	IBI	Mlwb	ICI
WWH	H	40	NA	36
	W	40	8.3	36
	B	42	8.5	36
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Interior Plateau (IP)

Use	Size	IBI	Mlwb	ICI
WWH	H	40	NA	30
	W	40	8.1	30
	B	38	8.7	30
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Statewide Exceptional Criteria

Use	Size	IBI	Mlwb	ICI
EWH	H	50	NA	46
	W	50	9.4	46
	B	48	9.6	46

Erie Ontario Lake Plain (EOLP)

Use	Size	IBI	Mlwb	ICI
WWH	H	40	NA	34
	W	38	7.9	34
	B	40	8.7	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-I	B	30	6.6	NA

Western Allegheny Plateau (WAP)

Use	Size	IBI	Mlwb	ICI
WWH	H	44	NA	34
	W	44	8.4	34
	B	40	8.6	34
MWH-C	H	24	NA	22
	W	24	6.2	22
	B	24	5.8	22
MWH-A	H	24	NA	30
	W	24	5.5	30
	B	24	5.5	30
MWH-I	B	30	6.6	NA

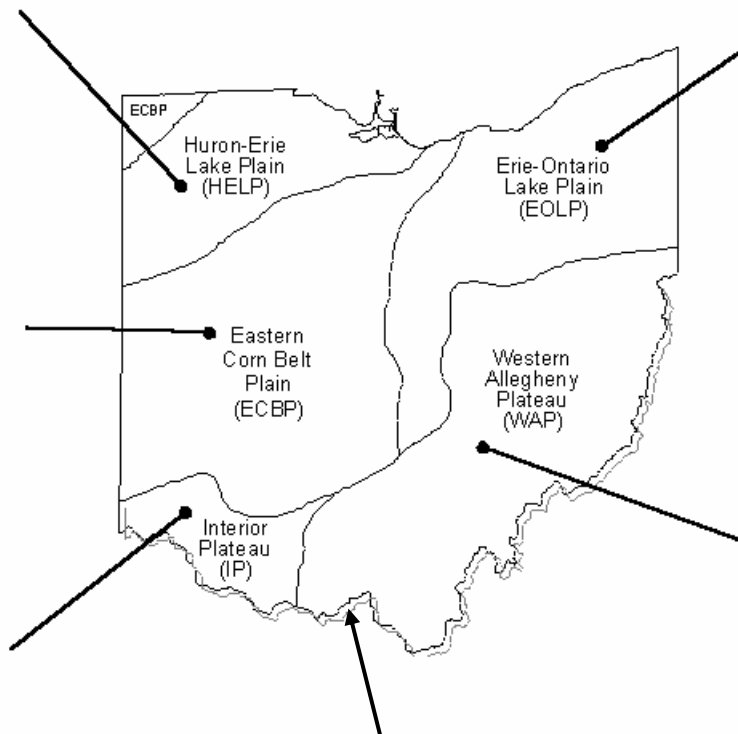
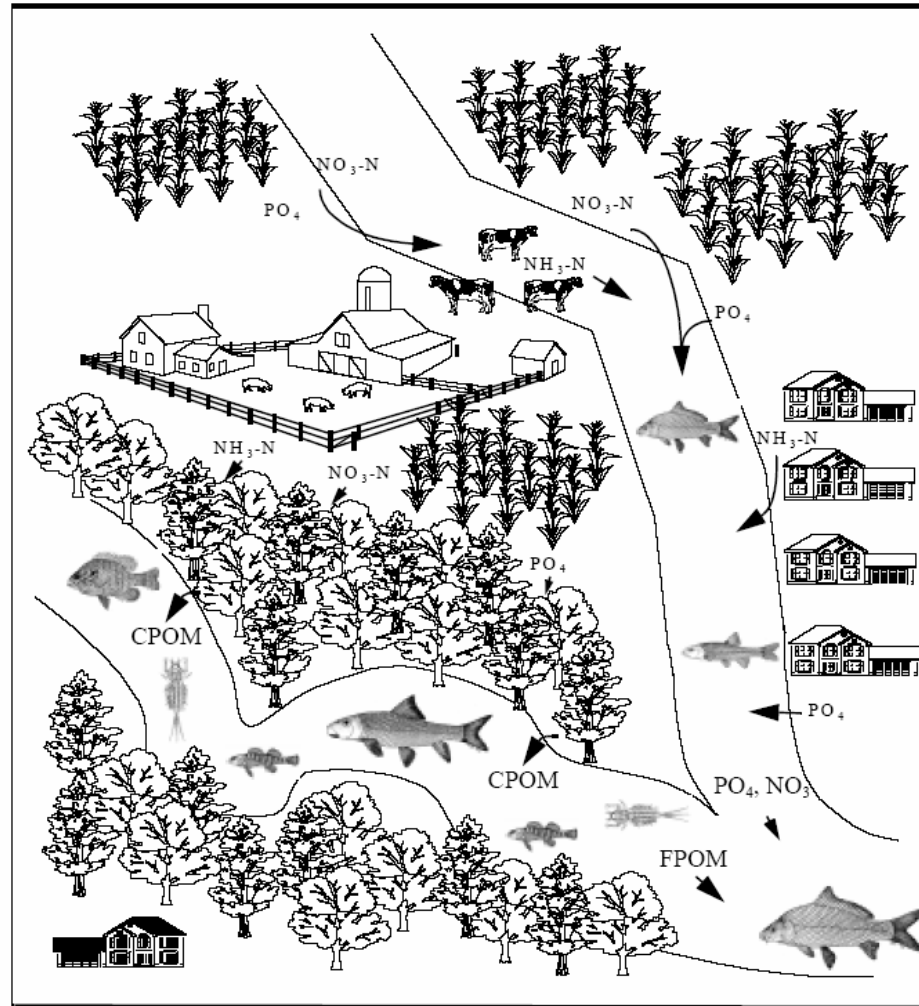


TABLE B-4. Key features associated with tiered aquatic life uses in the Ohio WQS (OAC 3745-1-07).

Aquatic Life Use	Key Attributes	Why a Waterbody Would Be Designated	Practical Impacts (compared to a baseline of WWH)
Warmwater Habitat (WWH)	Balanced assemblages of fish/invertebrates comparable to least impacted <i>regional</i> reference condition	Either supports biota consistent with numeric biocriteria for that ecoregion or exhibits the habitat potential to support recovery of the aquatic fauna	Baseline regulatory requirements consistent with the CWA “fishable” and “protection & propagation” goals; criteria consistent with EPA guidance with State/regional modifications as appropriate
Baseline CWA Expectation			
Exceptional Warmwater Habitat (EWH)	Unique and/or diverse assemblages; comparable to upper quartile of <i>statewide</i> reference condition	Attainment of the EWH biocriteria demonstrated by both organism groups	More stringent criteria for D.O., temperature, ammonia, and nutrient targets; more stringent restrictions on dissolved metals translators; restrictions on nationwide dredge & fill permits; may result in more stringent wastewater treatment requirements
Highest CWA Expectation			
Coldwater Habitat (CWH)	Sustained presence of Salmonid or non-salmonid coldwater aquatic organisms; bonafide trout fishery	Bioassessment reveals coldwater species as defined by Ohio EPA (1987); put-and-take trout fishery managed by Ohio DNR	Same as above except that common metals criteria are more stringent; may result in more stringent wastewater treatment requirements
Modified Warmwater Habitat (MWH)	Warmwater assemblage dominated by species tolerant of low D.O., excessive nutrients, siltation, and/or habitat modifications	Impairment of the WWH biocriteria; existence and/or maintenance of hydrological modifications that cannot be reversed or abated to attain the WWH biocriteria; a use attainability analysis is required	Less stringent criteria for D.O., ammonia, and nutrient targets; less restrictive applications of dissolved metals translators; Nationwide permits apply without restrictions or exception; may result in less stringent wastewater treatment requirements
Below CWA Expectation – UAA Required			
Limited Resource Waters (LRW)	Highly degraded assemblages dominated exclusively by tolerant species; <i>should not</i> reflect acutely toxic conditions	Extensive physical and hydrological modifications that cannot be reversed and which preclude attainment of higher uses; a use attainability analysis is required	Chemical criteria are based on the prevention of acutely lethal conditions; may result in less restrictive wastewater treatment requirements

Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams

Ohio EPA Technical Bulletin MAS/1999-1-1



Robert A. Taft, Governor
Christopher Jones, Director
Ohio Environmental Protection Agency
P.O. Box 1049, Lazarus Government Center
122 S. Front Street, Columbus, Ohio 43216-1049

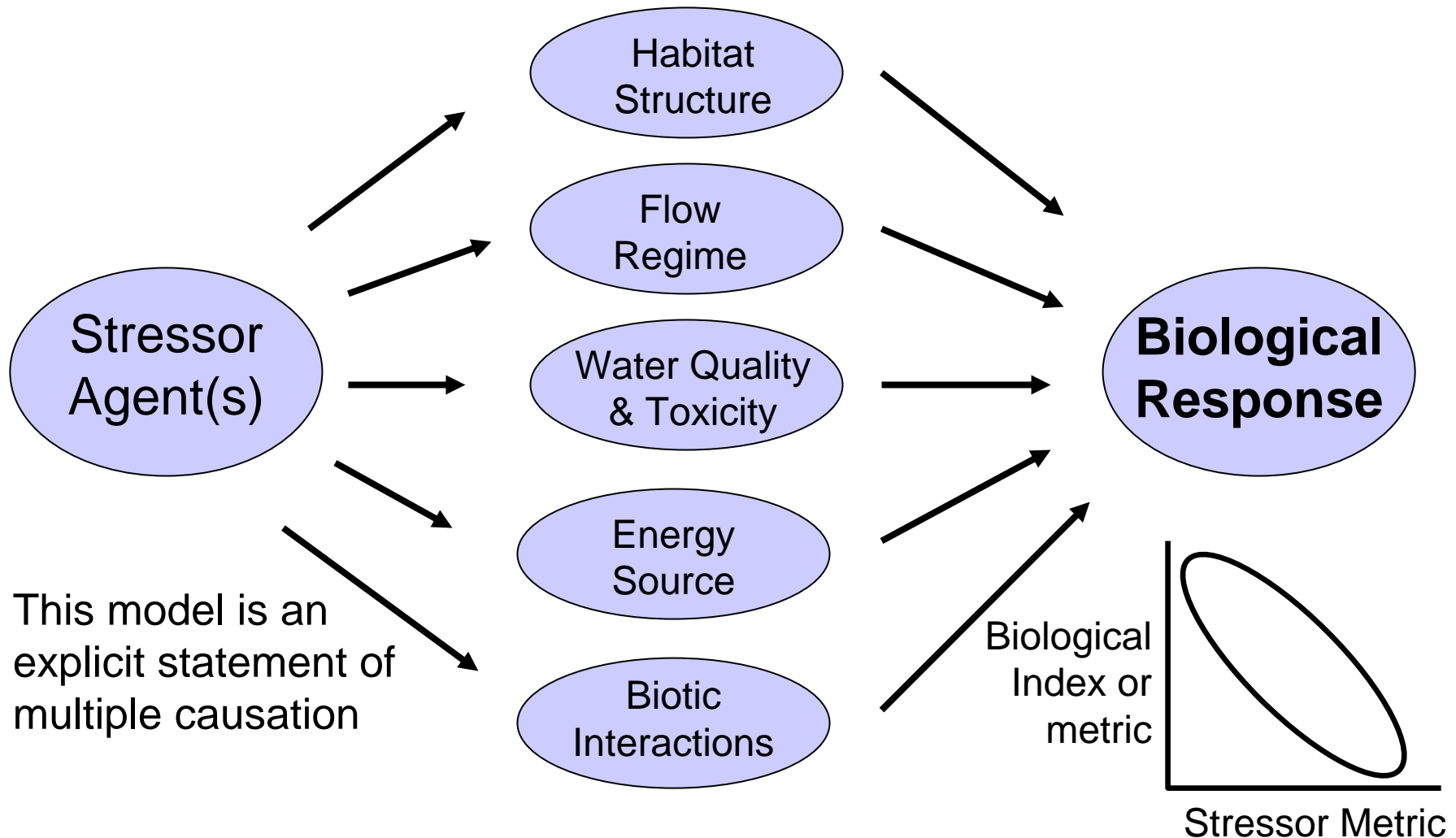
- Table 1. Median and seventy-fifth percentile nitrate+nitrite nitrogen concentrations by stream size and ecoregion for reference sites, oligo-mesotrophic and meso-eutrophic boundaries given by Dodd et al. (1998), and proposed statewide criteria for WWH, EWH and MWH streams. Values corresponding to the IBI range typical of the MWH use represent best attainable concentrations for MWH streams

	Ecoregional Criteria					Oligo-mesotrophic Meso-eutrophic boundaries [†]	State-wide Criteria		
	HELP	IP	EOLP	WAP	ECBP		WWH	EWH	MWH*
<i>Headwaters (drainage area < 20 mi²)</i>									
median	0.38	0.49	0.42	0.15	0.98	0.7			
75th %	2.26	1.18	1.00	0.34	2.24	1.5	1.0	0.5	1.0
20 - 29	1.22	3.15	0.56	0.21	0.86				
<i>Wadable (drainage area • 20 mi² < 200 mi²)</i>									
median	0.16	0.24	0.43	0.22	0.84	0.7			
75th %	0.60	0.54	1.05	0.47	2.80	1.5	1.0	0.5	1.6
20 - 29	0.68	1.42	1.60	0.50	1.34				
<i>Small Rivers (drainage area • 200 mi² < 1000 mi²)</i>									
median	1.88	0.43	1.00	0.64	1.65	0.7			
75th %	3.24	0.96	1.42	1.02	3.06	1.5	1.5	1.0	2.2
20 - 29	2.01	-	1.97	1.55	1.88				
<i>Large Rivers (drainage area > 1000 mi²)</i>									
median	1.47	2.63	-	1.50	3.08	0.7			
75th %	2.76	2.93	-	2.20	4.14	1.5	2.0	1.5	2.4
20 - 29	1.73	-	-	2.60	3.98				

[†]Oligotrophic-mesotrophic and mesotrophic-eutrophic boundaries are given by Dodd et al. (1998) and were derived from data sets covering a wide range of stream sizes.

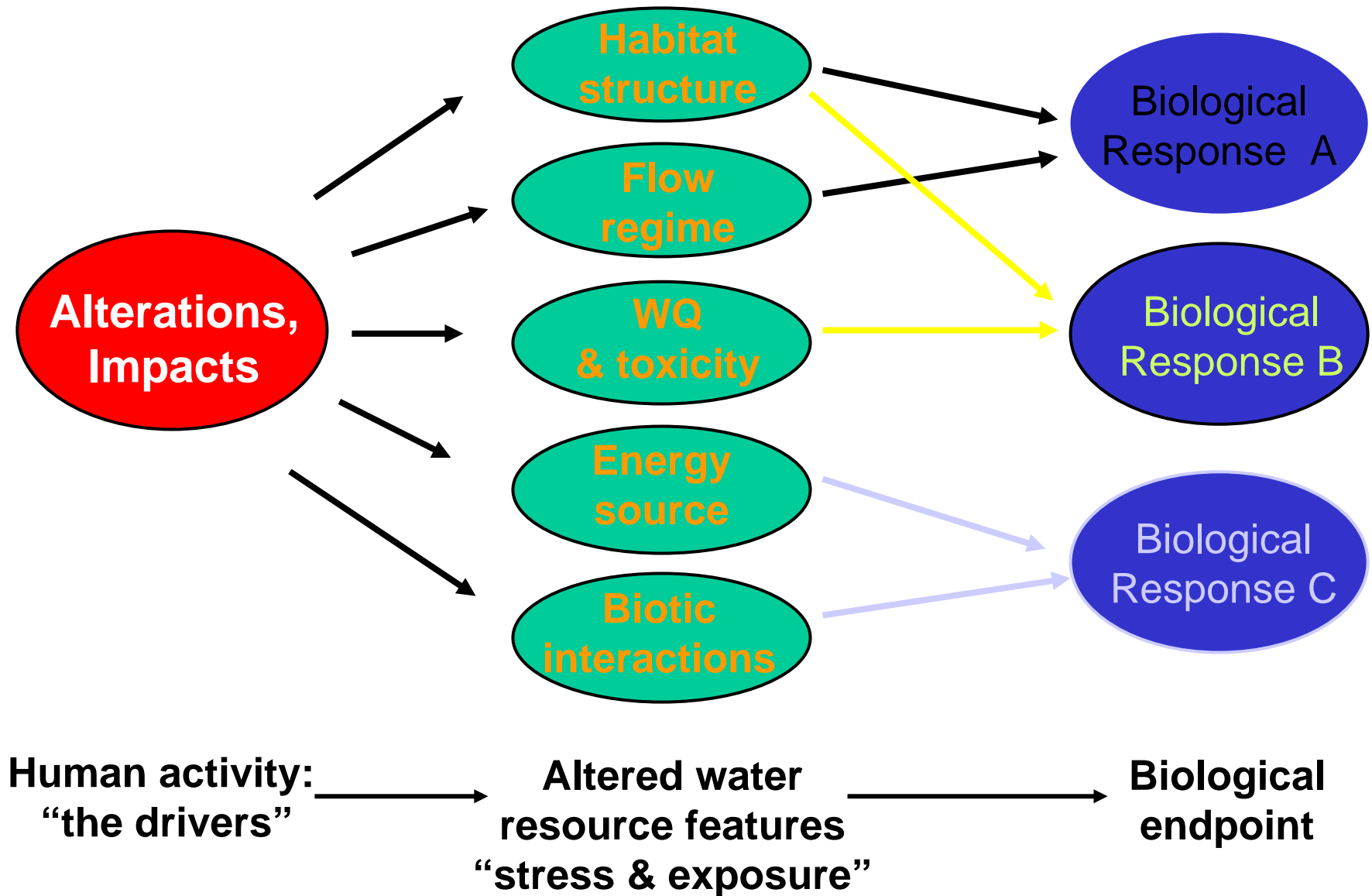
* MWH criteria are the statewide median concentrations from the ALL database for an IBI range of 20 - 29.

The Linkage From Stressor Effects to Ecosystem Response

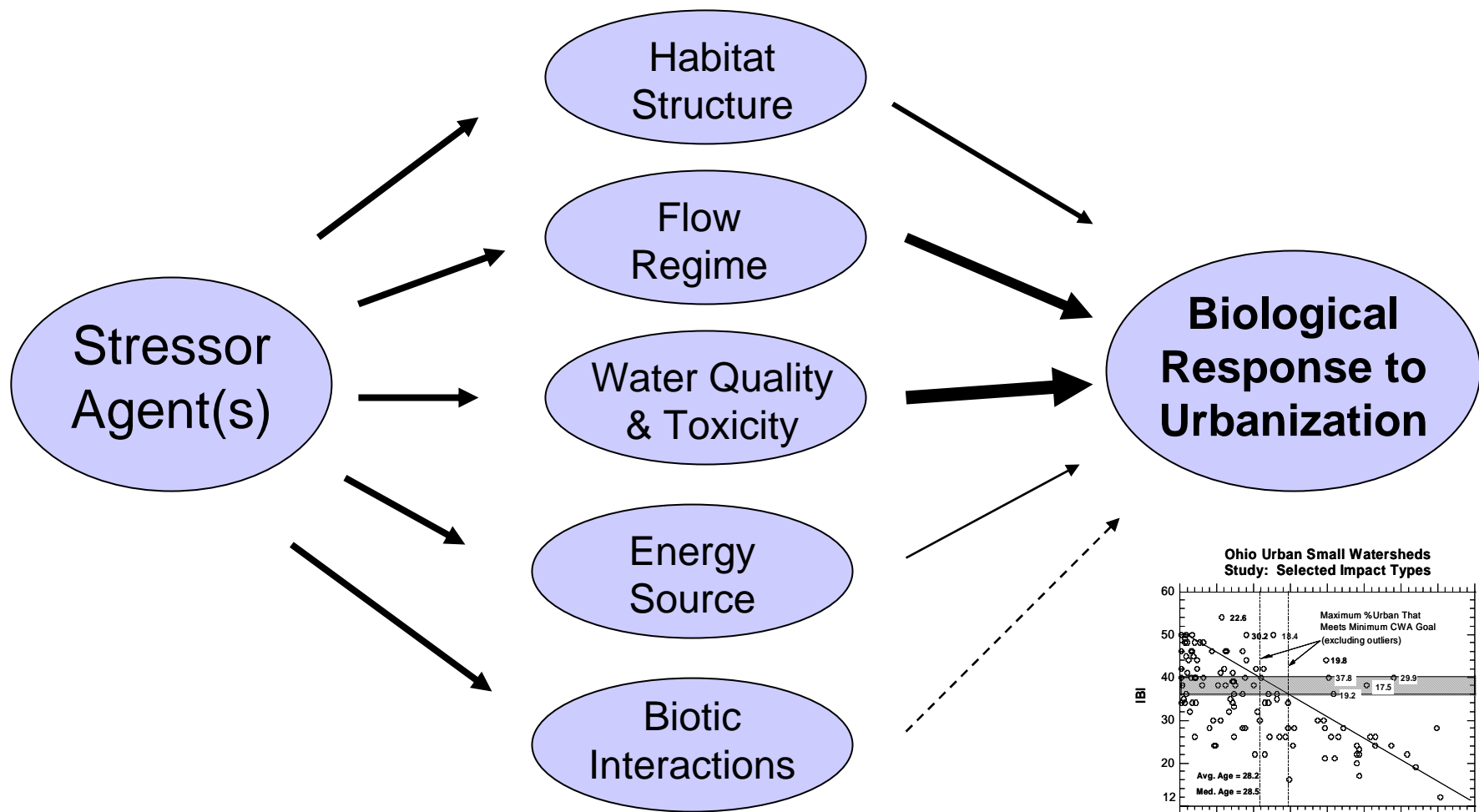


STRESSORS → **EXPOSURE** → **RESPONSE**

Linking Biological Responses to Stressors



The Linkage From Stressor Effects to Ecosystem Response



STRESSORS → **EXPOSURE** → **RESPONSE**

CRITICAL TECHNICAL ELEMENTS FOR A BIOASSESSMENT PROGRAM

Michael T. Barbour, Tetra
Tech

Chris O. Yoder, MBI

Technical Guidelines for Supporting Bioassessment/Biocriteria programs

6 EPA efforts that will help States/Tribes:

- Develop categories (tiers) of aquatic life use
- Link biological and water quality criteria
- Define and use reference conditions
- Apply statistical and modeling tools
- *Assess technical elements of bioassessment programs - "critical elements process"*
- Determine performance and comparability of bioassessments

States Evaluated Since 2004:

Region I: CT, ME

Region IV: AL

Region V: IL, IN, MI, MN, WI, OH

Region VI: NM

Region VIII: CO, MT

Region IX: AZ

plus Several Tribes

Reviews are conducted at the request
of the State and/or EPA Region

Who are the Primary Users?

- State and Tribal program managers and staff who are responsible for monitoring and assessment and WQS programs. U.S. EPA WQS and Monitoring & Assessment coordinators who conduct review and oversight of State and Tribal programs.

Key Concepts

Accuracy: Biological assessments should produce sufficiently accurate delineations to minimize Type I and II assessment errors.

Comparability: technically different approaches should produce comparable assessments in terms of condition ratings, impairments, & diagnostic properties.

Comprehensiveness: biological response is evaluated in conjunction with other stressor/exposure information to understand the key limiting factors.

Cost-Effectiveness: having reliable biological data to support management decisions outweighs the intrinsic costs of development and implementation (NRC 2001).

Bioassessment to Support All Relevant WQ Management Programs

Programmatic Elements for WQ Management	
Basic Reporting	<ul style="list-style-type: none">• Status• Trends
WQS Program	<ul style="list-style-type: none">• Tiered Uses• UAA• Refined WQC• Anti-deg.• Site-specific crit. mod.
Watersheds/NPS	<ul style="list-style-type: none">• NPS/BMP Effect.• Habitat• Stressor I.D.
TMDL/303d	<ul style="list-style-type: none">• List/Delist• TMDL Dev.• Severity/Extent
NPDES/Other Permitting	<ul style="list-style-type: none">• WQ BELs• Priority Setting• CSOs/SSOs• Stormwater Ph. I&II• WET Limits/Cond.• Enforcement• Dredge & Fill

What Do the Levels Mean?

Level 1 produces pass/fail assessments - is not amenable to supporting other tasks *i.e.*, severity/magnitude, causal associations.

Level 2 includes pass/fail to multiple condition assessments (3-4 categories); capable of general causal determinations.

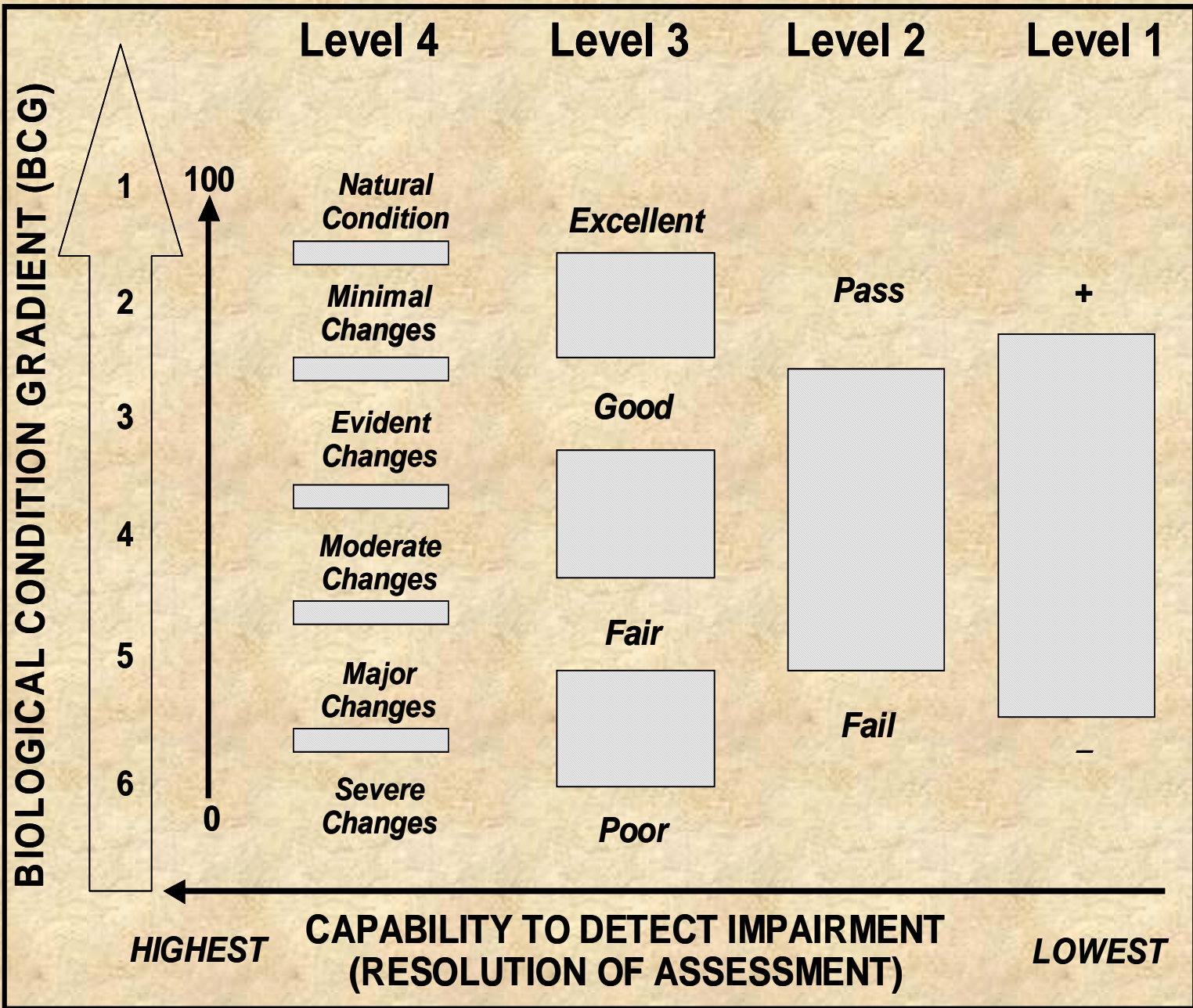
Level 3 is capable of incremental condition assessment along the BCG and for most causal associations; single assemblage limitations.

Level 4 provides full program support & the most robust, accurate, & complete assessments including scientific certainty, accuracy, relevancy of condition, severity & extent, and causal associations.

Level of Rigor in Bioassessment - It Matters

Level	Condition Assessment		Causal Associations		
	Impairment	Multiple Condition	General	Categorical	Parameter Specific
1	*	—	—	—	—
2	**	*	*	—	—
3	**	**	**	**	*
4	***	***	***	***	**

- *** Comprehensively fulfills program support role by providing robust and complete assessment including Best Available scientific certainty in accuracy (i.e., minimizing Type 1 and 2 errors) of condition assessment, and categorical causal associations.
- ** Condition assessments minimizes Type 1 error but does not adequately address Type 2; general causal associations.
- * Condition assessments only address Type 1 error at extremes of condition and do not address Type 2 error; no causal association capacity.



Critical (Key) Technical Elements

		Foundation Elements	Building Blocks	Dependent on Other Elements
Design	1. Temporal coverage		✓	
	2. Spatial coverage		✓	
	3. Natural Classification	✓		
	4. Criteria for reference sites	✓		
	5. Reference conditions			✓
Methods	6. Taxonomic Resolution	✓		
	7. Sample collection	✓		
	8. Sample processing	✓		
	9. Data Management	✓		
Interpretation	10. Ecological attributes	✓		
	11. Biological endpoints			✓
	12. Diagnostic capability			✓
	13. Professional review		✓	

Critical Elements Scoring Categories

		LOW	→	HIGH	
Design	1. Temporal coverage	1.5	2.5	3.5	4.5
	2. Spatial coverage	1.5	2.5	3.5	4.5
	3. Natural Classification	2	3	4	5
	4. Criteria for reference sites	2	3	4	5
	5. Reference conditions	1	2	3	4
Methods	6. Taxonomic Resolution	2	3	4	5
	7. Sample collection	2	3	4	5
	8. Sample processing	2	3	4	5
	9. Data Management	2	3	4	5
Interpretation	10. Ecological attributes	1.5	2.5	3.5	4.5
	11. Biological endpoints	1	2	3	4
	12. Diagnostic capability	1	2	3	4
	13. Professional review	<u>1.5</u>	<u>2.5</u>	<u>3.5</u>	<u>4.5</u>
Total Score		21	34	47	60

Table 1. A checklist for evaluating the degree of development for each technical element of a bioassessment program and associated comments on the elements for the Connecticut DEP program. The point scale for each element ranges from lowest to highest resolution. (Lowest) 1.5 2.0 2.5 3.0 3.5 4.0 4.5 (Highest)

Element	(Lowest)	1.5	2.0	2.5	3.0	3.5	4.0	4.5	(Highest)	Comments
1. Temporal Coverage Points <u>4.0</u>	Collection times are variable throughout the year, and sampling is performed without regard to seasonal influences.		An index period is conceptually recognized, but sampling may take place outside of this period for convenience or to match existing programs; sampling outside of the index is not adjusted for seasonal influences.		A well-documented seasonal index period(s) is calibrated with data for reference conditions, but sampling may take place outside of this period for convenience or to match existing programs; sampling outside of the index is adjusted for seasonal influences. Index periods are selected based on known		Same as Level 3, but administrative needs and index periods fully reconciled. Scientific basis of temporal sampling influences management decision framework.			Adherence to standardized index period is generally maintained; sampling outside of index period is infrequently conducted to satisfy information

Checklist is completed with state staff - consensus based process

Element	(Lowest)	1.5	2.0	2.5	3.0	3.5	4.0	4.5	(Highest)	Comments
2. Spatial Coverage Points <u>4.0</u>	An individual site is used for assessment of watershed condition; simple upstream/downstream and fixed station designs prevail; assessments at local scale.		Multiple sites are used for watershed assessment; spatial coverage only for questions of general status or locally specific problem areas; synoptic (non-random) design at coarse scale (e.g., 8-digit HUC common); spatial extrapolation is based on "rules of thumb"; may be supplemented by simple upstream/downstream assessments.		Spatial network suitable for status assessments; statewide spatial design using rotating basins with single purpose design at coarse scale (e.g., 8 digit HUC); may be supplemented by occasional intensive surveys.		Comprehensive spatial network suitable for reliable watershed assessments in support of multiple water quality management programs at more detailed scale (e.g., 11-14 digit HUC); statewide rotating basin approach or similar scheme to complete statewide monitoring in a specified period of time; multiple spatial designs appropriate for multiple issues.			Combination of targeted intensive surveys and a statewide probability network.

TECHNICAL MEMORANDUM

Critical Technical Elements Evaluation of the Connecticut DEP Bioassessment Program

Connecticut DEP
Hartford, CT

October 31 - November 2, 2006

Purpose:

To evaluate the Connecticut DEP bioassessment program and make recommendations for enhancements relative to design, methodology, and execution for credible data as a basis for making informed decisions regarding the ecological condition of perennial rivers and streams.

Attendance:

Lee Dunbar, Connecticut DEP (Lee.Dunbar@po.state.ct.us)	(860) 424-3731
Ernie Pizzuto, CTDEP (Ernest.Pizzuto@po.state.ct.us)	(860) 424-3715
Mike Beauchene, CTDEP (Mike.Beauchene@po.state.ct.us)	(860) 424-4185
Lisa Wahle, CTDEP (Lisa.Wahle@po.state.ct.us)	(860) 424-3386
Tracy Lizotte, CTDEP (Tracy.Lizotte@po.state.ct.us)	(860) 424-3031
Bob Gilmore, CTDEP (Robert.Gilmore@po.state.ct.us)	(860) 424-3866
Rob Hurst, CTDEP (Robert.Hurst@po.state.ct.us)	(860) 424-3718
Chris Belluci, CTDEP (Christopher.Belluci@po.state.ct.us)	(860) 424-3735
Steven Tessitore, CTDEP (Steven.Tessitore@po.state.ct.us)	(860) 424-3871
Robert LaFrance, CTDEP (Robert.LaFrance@po.state.ct.us)	(860) 424-3401
Walter Tokarz, CTDEP (Walter.Tokarz@po.state.ct.us)	(860) 424-3323
Betsy Wingfield, CTDEP (Betsy.Wingfield@po.state.ct.us)	
Guy Hoffman, CTDEP (Guy.Hoffman@po.state.ct.us)	(860) 424-3733
Mary Kozhal, CTDEP (Mary.Kozhal@po.state.ct.us)	(860) 424-3733
Diane Switzer, U.S. EPA, Region I (Switzer.Diane@epa.gov)	(617) 918-1322
Mary Garren, U.S. EPA, Region I (Garren.Mary@epa.gov)	(617) 918-1322
Chris Yoder, Midwest Biodiversity Institute (yoder@rrohio.com)	(614) 403-9592
Susan Davies, Maine DEP/MBI (Susan.P.Davies@maine.gov)	(207) 287-7778

State Tribal Program Evaluations: Key Steps

- On-site evaluation of state and tribal bioassessment program, facilities, and capacities (2-3 days each).
- Interactive interview with state/tribal program managers and staff - includes bioassessment and WQS programs at minimum.
- Systematic compilation and analysis of all technical & programmatic aspects (methods, indicators, WQS (ALUs)).
- Assess capacity to support all water quality management programs.
- Documents present program strengths and fosters a continuous improvement process.

Midwest Biodiversity Institute & Center for
Applied Bioassessment and Biocriteria
P.O. Box 21561
Columbus, OH 43221-0561



REGION V STATE BIOASSESSMENT
AND AMBIENT MONITORING
PROGRAMS: INITIAL EVALUATION
AND REVIEW

Region V State Bioassessment and Ambient Monitoring Programs: Initial
Evaluation and Review

February 28, 2003
(Revised January 30, 2004)

Final Report

http://www.epa.gov/region5/water/wqb/wqb_r5mon.htm



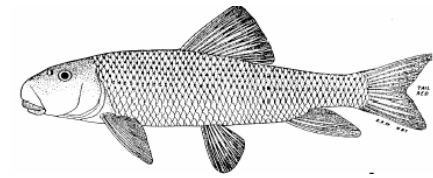
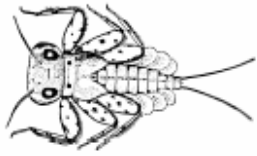
Technical Report MBI/0403-1

Chris O. Yoder
Midwest Biodiversity Institute & Center for Applied Bioassessment and Biocriteria
P.O. Box 21561
Columbus, Ohio 43221-0561

Critical Technical Elements: Region V States (2004)

Critical Element	IL	IN	MI	MN	OH	WI
1. Temporal	4.5	3.5	4.5	4.5	5	5
2. Spatial Design	2.5	4.5	4	4	4	2.5
3. Natural Classification	3	3.5	3.5	3.5	4.5	3.5
4. Reference Condition	3.5	3	3	3	3	3
5. Reference Sites	5	4	4	4	4.5	4.5
6. Indicator Assemblages	5	4.5	3	5	5	4.5
7. Sample Collection	5	4	4	4.5	4.5	4
8. Sample Processing	4.5	4	4	4	5	4.5
9. Data Management	4	4	3.5	5	5	4
10. Ecological Attributes	3.5	3.5	3.5	3.5	4.5	3.5
11. Biological Endpoints	3	3	3	3	4	3
12. Diagnostics	2	3	2	3	4	2.5
13. Professional Review	2.5	3	3.5	3.5	4.5	4
CE Score	48	47.5	45.5	50.5	57.5	48.5
%CE Score	81	80	76	85	97	82
CE Level	L2	L2	L2	L3	L4	L2

L1	<70
L2	>70
L3	>85
L4	>=95

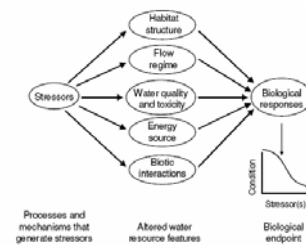
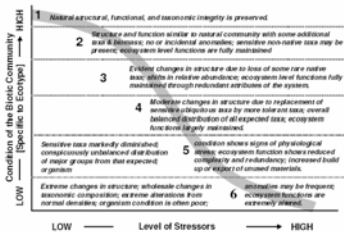


Region V States Bioassessment Working Group

Best Practices in Bioassessment Workshop I

Chicago Marriot Northwest
Chicago, Illinois

November 29 - December 1, 2005



Incorporating Tiered Aquatic Life Uses Into State and Tribal WQS

As a key component of State and Tribal water quality standards, designated uses define the goals for a waterbody, determine the criteria to protect it, guide management outputs, and, ultimately, environmental outcomes. Aquatic life tiers couple descriptive narratives (tiered uses) with supporting numeric criteria. The specificity of designated uses greatly influences the level of precision at which a water quality management program operates. Incorporating more refined, or tiered, aquatic life uses into water quality standards can have a positive effect on water quality management outcomes.

Tiered aquatic life uses are descriptive narratives of designated uses that are supported with numeric biocriteria and chemical/ physical criteria.

States that have made this transition have demonstrated that tiered aquatic life uses promote both the development of more appropriate aquatic life use goals and biological criteria to measure attainment of those goals. The data and experience developed from tiered uses supported by comprehensive monitoring have multiple uses in the water quality based approach to pollution control (Figure 4-1). In this chapter, we outline the key concepts, milestones, and processes for establishing tiered uses. What follows is a conceptual road map that States can follow in the development and adoption of tiered aquatic life uses.

The preceding chapters of this document describe ways of better characterizing and defining the biological and physical condition of waterbodies and their aquatic life uses. These next two chapters discuss the underlying principles and processes involved in developing tiered aquatic life uses and applying them in water quality management based on “lessons learned” from State experiences. Maine and Ohio are two states that have adopted tiered aquatic life uses in their WQS and have implemented them through systematic monitoring and assessment. The experiences of Maine and Ohio provide a sequence of steps, or milestones, that can serve as a template for other States to follow. These milestones are:

1. Establish conceptual foundation
2. Merge scientific and policy foundations
3. Establish monitoring program
4. Develop and validate quantitative thresholds
5. Apply tiered uses in water quality management

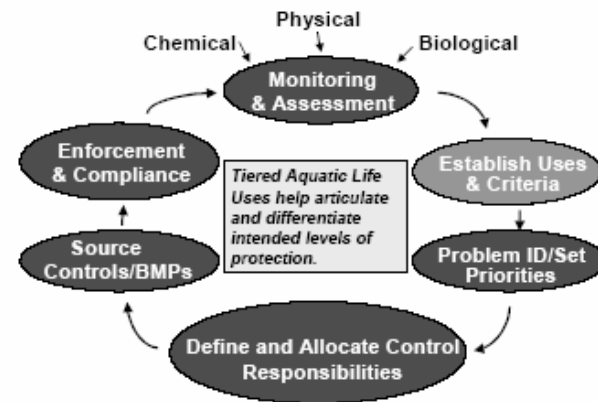
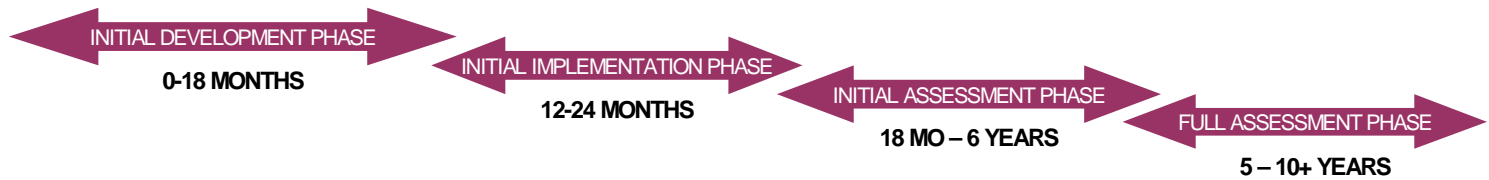


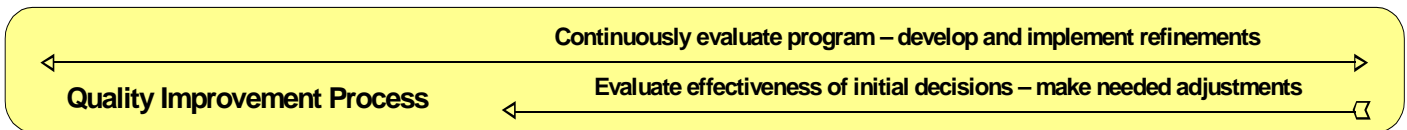
FIGURE 4-1. U.S. EPA Water Quality Based Approach to Pollution Control based on Chapter 7, Water Quality Standards Handbook.

TABLE 4-1. Expertise and tasks for key TALU milestones.

Conceptual Foundations	Technical Foundations	Policy/Legal Foundations
<i>Professional Expertise Required</i>		
<ul style="list-style-type: none"> ✓ Senior professional biologists ✓ Regional ecological experts 	<ul style="list-style-type: none"> ✓ Professional biologists ✓ Taxonomists ✓ Field support staff ✓ Statistician ✓ Database managers 	<p><i>Initial concept formulation:</i></p> <ul style="list-style-type: none"> ✓ Senior professional biologists ✓ WQS managers <p><i>Later stages:</i></p> <p>All of the above plus...</p> <ul style="list-style-type: none"> ✓ Senior management ✓ State legal counsel ✓ Legislature or WQS board ✓ Stakeholders
Milestones 1, 2 and 4	Milestones 3 and 4	Milestones 1, 2 and 4
<i>Essential Elements</i>		
<ul style="list-style-type: none"> ▪ Literature review of stress ecology studies for locale ▪ Develop regional BCG model ▪ Determine expected biological assemblage response to typical stressor scenarios; ▪ Identify ecological attributes necessary to maintain a functioning ecosystem (that TALU must protect or restore) 	<ul style="list-style-type: none"> ▪ Clarify classification issues (confounding natural gradients of locale); ▪ Define reference conditions ▪ Determine monitoring approach and strategy ▪ Exploratory data analyses to validate/refine BCG model ▪ Best available, best tested metrics to assess status of ecological attributes of interest ▪ Set thresholds that correspond to BCG tiers, that protect essential ecological attributes 	<ul style="list-style-type: none"> ▪ Determine management objectives; ▪ Identify priority aquatic resources ▪ Cross-walk BCG to WQS context- (how good a fit is provisional BCG/TALU conceptual model to existing use classes and WQ criteria) ▪ Seek early review of the legal standing of any proposed changes to WQS- strengthen and clarify language ▪ Account for public values and economic constraints/realities



1. Establish Conceptual Foundation <ul style="list-style-type: none"> Science Policy 	2. Merge Scientific & Policy Foundations <ul style="list-style-type: none"> Link conceptual TALU tiers to regional BCG conceptual model 		<ul style="list-style-type: none"> Evaluate for consistency with existing WQS framework Draft or refine narrative ALU descriptions
Start-Up Tasks: Initial Technical Development Tasks	Start-Up Tasks: Initiate Monitoring Strategy	Program Implementation	Program Maintenance
Acquire Staffing <ul style="list-style-type: none"> Professional biologists with taxonomic expertise & training Database manager Interns/technicians (field work, lab tasks) Acquire Facilities & Equipment <ul style="list-style-type: none"> Outfit laboratory and field facility Office accommodations Database support infrastructure Methods Development <ul style="list-style-type: none"> Review and select candidate methods and protocols Consider MQO/DQO needs Test methods for applicability Analyze test results – select methods 	Initiate Field Sampling <ul style="list-style-type: none"> Review spatial designs Develop QA/QC and QAPP Develop sampling plans in accordance with monitoring strategy Pilot assessments Classification Issues <ul style="list-style-type: none"> Consider spatial stratification issues Develop and test reference condition approach Select and sample reference sites Develop index development and calibration strategy Assessment Issues <ul style="list-style-type: none"> Use data for “makeable” decisions Initiate exploratory analysis of biological responses to stressors 	Biocriteria Development <ul style="list-style-type: none"> Select candidate metrics and/or assessment tools Develop refined uses - narratives Test metrics and develop calibrated indices Evaluate via bioassessments 	Biocriteria Development <ul style="list-style-type: none"> Refine metrics and develop calibrated indices Develop reference benchmarks for calibrated indices according to classification scheme and by major aquatic ecotype Link to TALUs via BCG
3. Establish Technical Program		4. Develop & Validate Quantitative Thresholds	
5. Application in WQ Management			
Water Quality Program Support <ul style="list-style-type: none"> Develop capacity to support WQ programs (WQS/UAs, TMDLs, permits, planning) Formalize and increase water quality program support as capacity is developed (biological data should support more decisions) 		Water Quality Program Support <ul style="list-style-type: none"> Fully functioning bioassessment program supports WQS (UAs, ALU, biocriteria) and basic program needs (305b/303d) Program dev't should be fully initiated – e.g., integrated chemical, physical, and biological database supports tool, criteria, & policy dev't. (ongoing) 	



MPCA Biological Assessment and Biological Criteria Development Program

Region V Best Practices Workshop
Chicago, IL
December 2006



Key Elements in Minnesota's Bioassessment Program

Critical (Key) Technical Elements

- Design
1. Index period
 2. Spatial coverage
 3. Natural Classification
 4. Reference conditions
 5. Criteria for reference sites

Sampling takes place during summer base flow conditions:

- Methods
6. Taxonomic resolution
 7. Sample collection
 8. Sample processing
 9. Data management

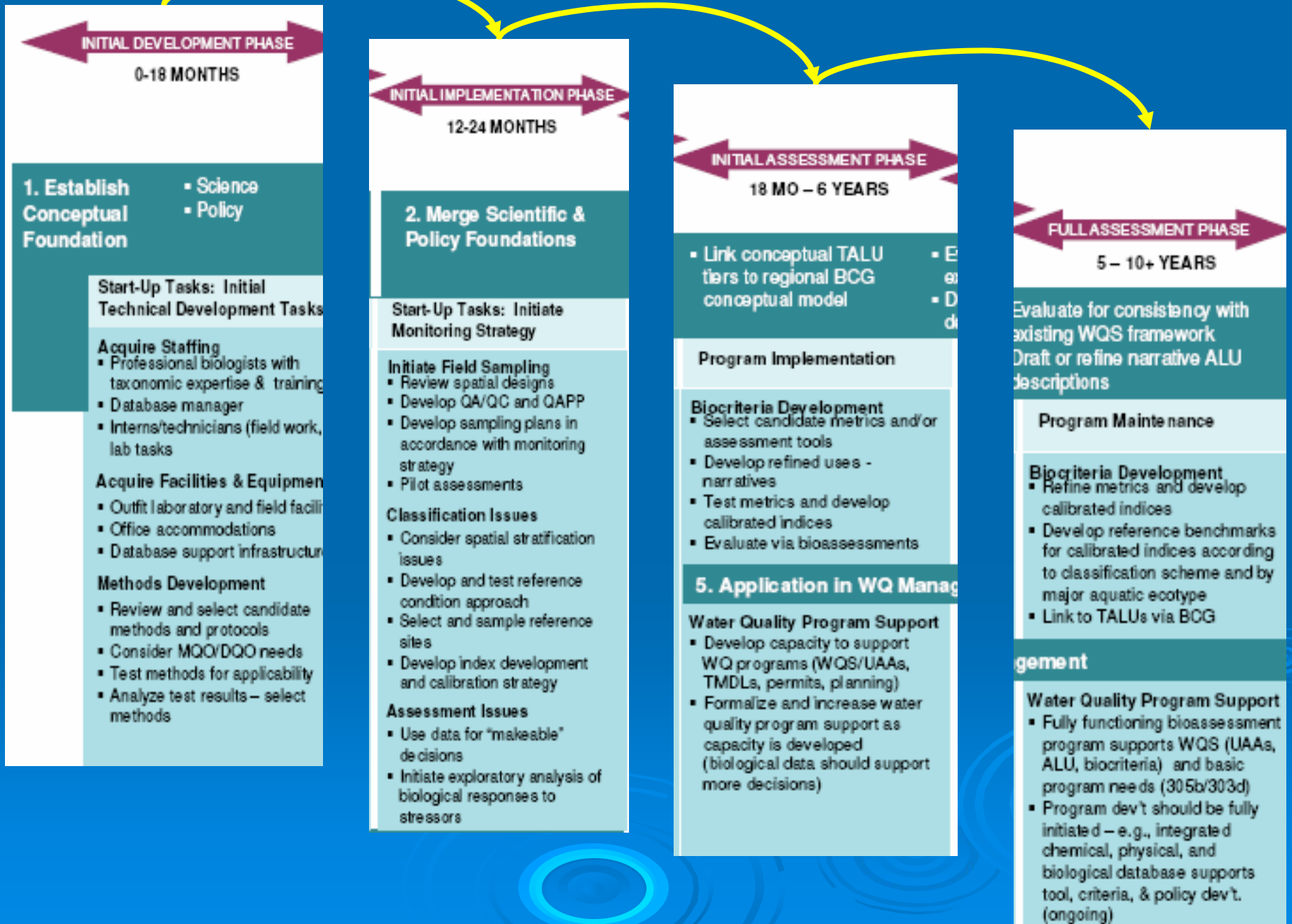
Fish are sampled from mid-June to mid-September

Invertebrates are sampled from early August to late September

- Interpretation
10. Ecological attributes
 11. Biological endpoint
 12. Diagnostic capability
 13. Professional review



Minnesota's TALU Timeline Status



Minnesota's TALU Timeline

INITIAL DEVELOPMENT PHASE

0-18 MONTHS

1. Establish Conceptual Foundation

- Science
- Policy

Start-Up Tasks: Initial Technical Development Tasks

Acquire Staffing

- Professional biologists with taxonomic expertise & training
- Database manager
- Interns/technicians (field work, lab tasks)

Acquire Facilities & Equipment

- Outfit laboratory and field facility
- Office accommodations
- Database support infrastructure

Methods Development

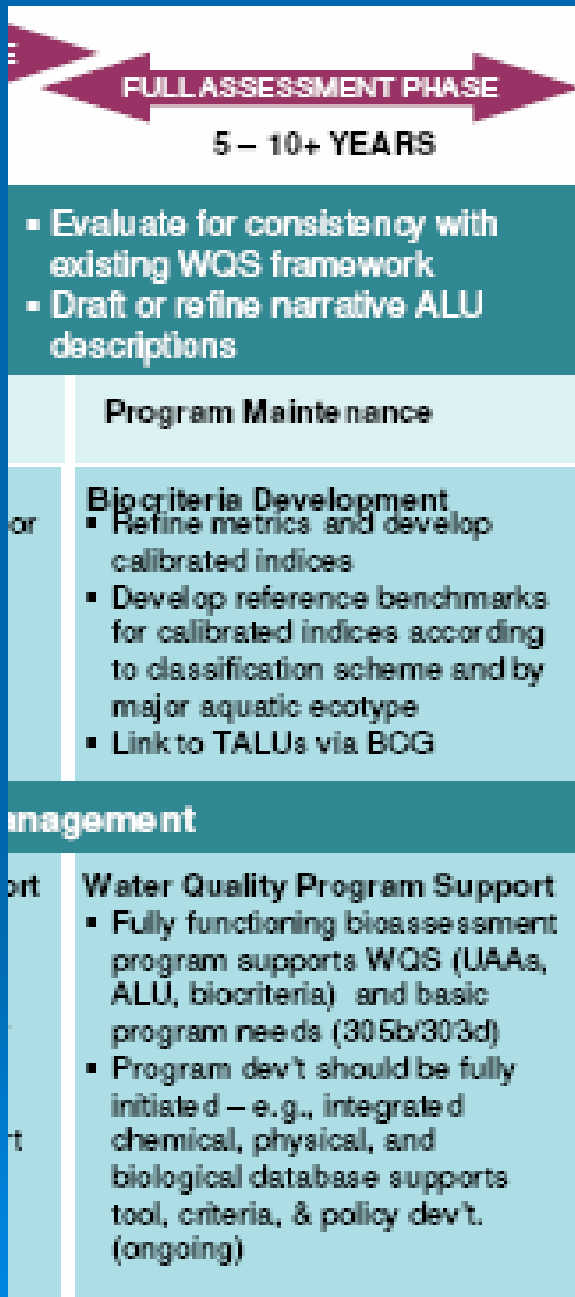
- Review and select candidate methods and protocols
- Consider MQO/DQO needs
- Test methods for applicability
- Analyze test results – select methods

- 5 fulltime and 1 seasonal fish biologist
- 1 fulltime invertebrate biologist
- 13 Summer interns
- Biological database and database administrator

- Field operations center with 2 fulltime staff
- Equipment and vehicles for 4 fish crews and 3 invert crews.

- Established SOPs for fish collection, macroinvertebrate collection, qualitative and quantitative p-hab.
- Methods have been compared with other regional collection methods (in progress)

Minnesota's TALU Timeline



•Finalized, regional IBIs will be developed over the next 2 years.

•Reference benchmarks will be developed based on the existing and future reference network within the classification scheme selected for IBI development.

•WQS implementation and full adoption of TALU will take place during the 2010 rulemaking process.

TALU Conclusions & Benefits

- *TALUs* are essential to fill a technological gap left by general uses and status driven M&A.
- *TALUs* can address the fundamental convergence of restoration goals and legacy impacts - a key contemporary issue.
- *TALU* "forces" the explicit integration of WQS and M&A.

Administrative Output vs. Resource Outcomes Based Management

ADMINISTRATIVE OUTPUTS BASED

RESOURCE END OUTCOMES BASED

<u>Goal:</u>	Program Performance (Program execution)	Environmental Performance (<u>Attain designated uses</u>)
<u>Measures:</u>	Administrative Actions (Lists, Permits, Funding, Rules)	Indicator End-points (<u>Biological</u> , Chemical, Physical)
<u>Results:</u>	Improve Programs (Reduce backlogs, improve timeliness)	Programs are Tools to Improve the Environment (Admin. outputs evaluated by environmental end outcomes)