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Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

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May 12, 2011

Mr. Matthew Schweisberg, Manager
Office of Ecosystem Protection (OEP05-2)
U.S. EPA – New England Region
5 Post Office Square, Suite 100
Boston MA 02109-3912

RE: EPA-REG-1 2009 Wetland Program Development Grant
Report: Development and Use of Aquatic Life Use
Standards for Wetlands in Massachusetts

Dear Mr. Schweisberg,

This letter is to transmit the attached report entitled *Development and Use of Aquatic Life Use Standards for Wetlands in Massachusetts*. This report is a commitment pursuant to our 2009 Wetland Program Development Grant awarded in July 17, 2009. On October 30, 2009 we requested a scope amendment to our original grant proposal that would allow us to study the tiered aquatic life use model and water quality standards. This scope change was approved by EPA in a letter dated November 19, 2009. The attached report describes our ongoing effort to monitor and assess wetlands for the purpose of restoring and maintaining the chemical, physical, and biological integrity of Massachusetts waters.

Please do not hesitate to contact me or Lisa Rhodes if you have any questions regarding this report.

Sincerely,

Lealdon Langley, Director
Wetlands and Waterways Program

Development and Use of Aquatic Life Use Standards For Wetlands in Massachusetts

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Development and Use of Aquatic Life Use Standards For Wetlands in Massachusetts

Background

The Clean Water Act requires states to develop Water Quality Standards for Waters of the United States. These Standards serve as goals for protecting and restoring water bodies and wetlands to ensure that they support the designated uses for those Waters. Components of this process include classification, determination of designated uses and the development of narrative and numeric criteria for water bodies and wetlands.

In Massachusetts the primary classification system for water bodies and wetlands centers on the role of those Waters for providing drinking water. In general, water bodies that serve as drinking water supplies, as well as tributaries to those water bodies and associated wetlands, are included in Class A. Other wetlands and water bodies are included in Class B or coastal Classes SA and SB.

Although "fish, other aquatic life and wildlife" is included as a designated use in all Classes of wetlands and water bodies the biological condition or quality of those Waters is not currently a consideration in the designation of Class A, B and C Waters. However, a variety of Qualifiers are used to further refine the classification system, some of which ("cold water," "warm water," "aquatic life," and "shellfishing") are relevant for aquatic life use.

Currently the Massachusetts Water Quality Standards include narrative criteria for aquatic life. The U.S. Environmental Protection Agency (EPA) is encouraging states to adopt numeric criteria in addition to narrative criteria in order to better determine and document whether Waters of the United States (including wetlands) are meeting standards for aquatic life use.

The Biological Condition Gradient

The Biological Condition Gradient (BCG) was developed to provide a conceptual basis for understanding biological condition and developing numeric criteria for aquatic life use. The BCG is a comprehensive model that describes the relationship between biological condition and stressors in the surrounding environment along a disturbance gradient. EPA has suggested that states consider designating Tiers corresponding to various levels of biological condition based on the BCG model. This is referred to as the Tiered Aquatic Life Use (TALU) approach.

In Massachusetts, we have characterized the disturbance gradient with a sophisticated modeling approach, the Conservation Assessment and Prioritization System (CAPS).The output of CAPS is referred to as the Index of Ecological Integrity (IEI). Ecological integrity is defined as the "the long-term capability of the ecological community to sustain its composition, structure and function and thus also its resiliency to stress." Neither BCG nor Ecological Integrity can be directly determined in the field. It is analogous to the concept of human health. There is no instrument or valuation system that can be used to measure health. Instead, we use various indicators of health (blood pressure, diet, weight, exercise, disease status) that can be combined into a composite score for evaluating health.

In order to develop narrative and/or numeric criteria for biological condition to be used in assessing attainment goals for fish, other aquatic life and wildlife, it will be necessary to use indices of biological integrity (IBIs). Indices of Biological Integrity are metrics used to quantify changes in biological communities in response to adverse human activity and can serve as indicators of particular stressors acting on a wetland or water body, as well as a composite score for biological condition. In order to implement the TALU approach it is first necessary to develop one or more IBIs for assessing biological condition. Presumably the aquatic life use Tiers would be based on IBI scores and would correspond to either water quality Classes or Qualifiers. Tying TALU to water quality Classes or Qualifiers is necessary because the biological condition of Waters is likely to be constrained by the amount of development (and associated stressors) in the surrounding landscape or watershed unless significant restoration measures are implemented. Wetlands or water bodies that occur within highly developed landscapes are likely to be limited in how good they can be from a biological perspective. The use of Classes or Qualifiers allows for the setting of numeric criteria (IBI scores) that are attainable for wetlands and water bodies in different landscape contexts.

The current approach for assigning Classes and Qualifiers to Waters in Massachusetts is not suitable for implementing the TALU approach because the system of Classes and Qualifiers are not tied to biological integrity.

From TALU to CALU

The Biological Condition Gradient model depicts a theoretical relationship between biological condition on the vertical axis and a Generalized Stressor Gradient on the horizontal axis (figure 1.)

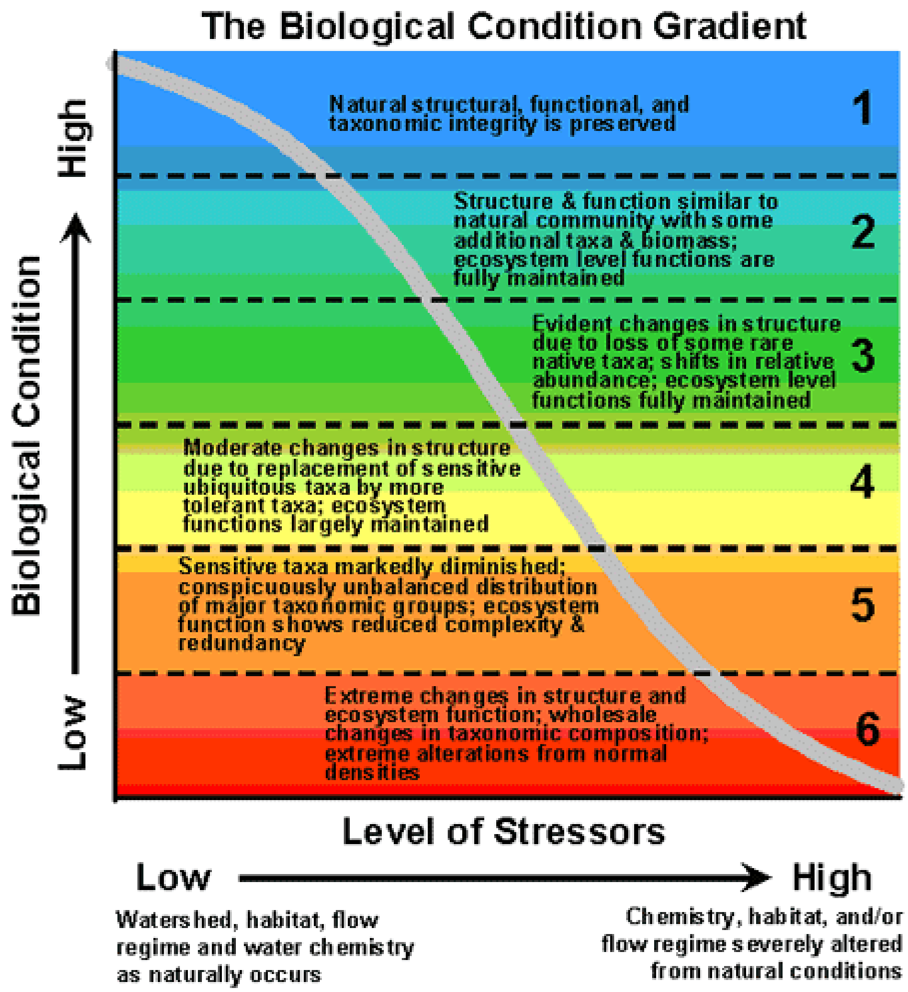

Figure 1 Theoretical Relationship between biological condition and a generalized stressor gradient as part of the Biological Condition Gradient model.

CAPS is a tool that can be used to approximate the Generalized Stressor Gradient (GSG) used in the Biological Condition Gradient model for wetlands and water bodies. The results of the CAPS assessment are scores for every undeveloped cell in the landscape along a continuous gradient (Index of Ecological Integrity – IEI) ranging from 0-1. High IEI scores (approaching 1.0) are indicative of communities that are relatively free from stressors. In our approach the GSG is simply the inverse of the Index of Ecological Integrity (1/IEI) (figure 2).

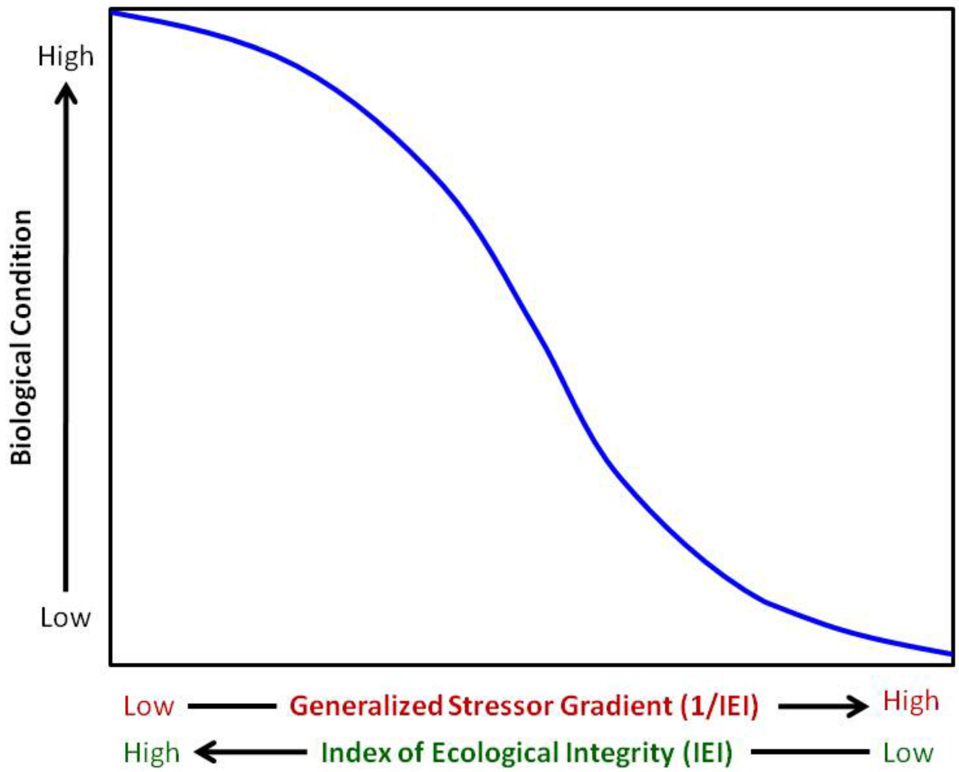

Figure 2 CAPS IEI scores are inversely related to the Generalized Stressor Gradient. Ecological Integrity scores are positively correlated with biological condition.

Many IBIs are developed using reference sites and test (impacted) sites but not the full disturbance gradient. Tiers are essentially a means for dealing with uncertainty when IBIs are not developed as dose-dependent relationships between biological condition and stressors. CAPS IEI scores are a continuous rather than binary approach for defining reference conditions used in the development of IBIs. When IBIs are developed to correspond to a continuous stressor gradient (consistent with the Biological Condition Gradient concept) then it is no longer necessary to have tiered criteria tied to specific Classes or Qualifiers.

CAPS provides an approach to the establishment of numeric criteria for aquatic life use that is consistent with TALU but eliminates the need to develop tiers. We call this new approach CALU for Continuous Aquatic Life Use standards. Because both IEI and IBI yield scores that are continuous throughout their range it is not necessary to create Tiers or Classes for wetlands and water bodies in order to have meaningful criteria for aquatic life use.

The CALU approach is based on the relationship between IEI (representing the constraints on biological condition due to the nature of the surrounding landscape) and IBI, which represents the actual condition of a site based on assessments conducted in the field (figure 3). By defining an acceptable range of variability around this relationship it is possible to create numeric criteria for biological condition (a range of acceptable IBI scores) based on each site's particular landscape context (IEI score).

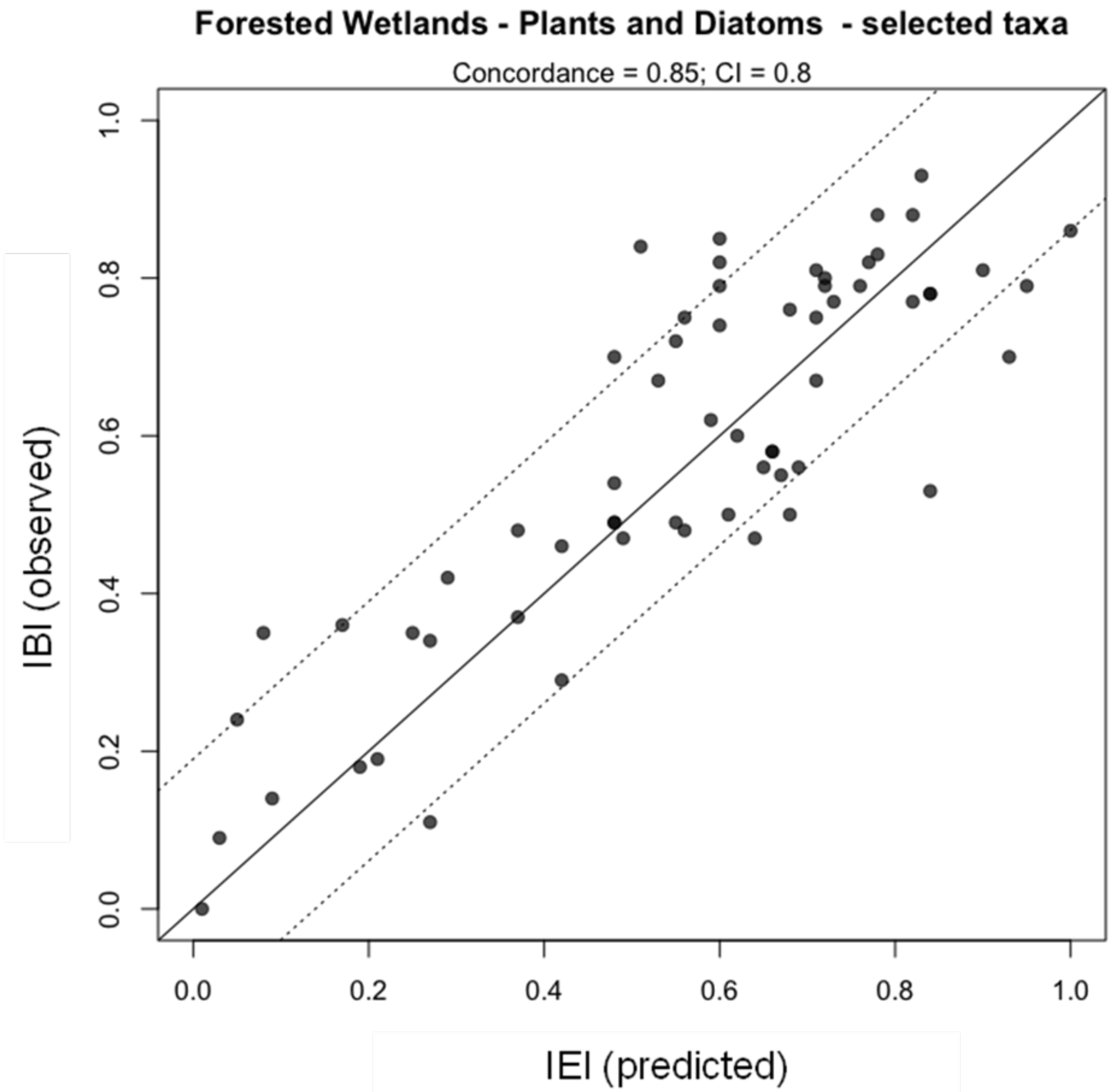

Figure 3 Using the relationship between IEI and IBI scores to define an acceptable range of variability for wetland biological condition.

The CALU approach provides a rigorous and quantitative system for establishing criteria for aquatic life use that avoids undesirable effects from cutting up a continuous environmental gradient into discrete Classes or Tiers. A site's biological condition relative to its landscape context can be assessed by noting its position relative to the lines on figure 3. Sites between the dotted lines (acceptable range of variability) would be considered to meet standards. Sites that are above the highest dotted line would exceed expectations. Those falling below the lowest dotted line would be flagged as potentially degraded. Improvement at a site can be measured using CALU by documenting upward movement of a site relative to the solid diagonal line.

Even though it may not be necessary to create Tiers, Classes or Qualifiers to establish numeric criteria for aquatic life, Classes or Qualifiers may still be useful for policies designed to prevent degradation, such as regulatory restrictions aimed at protecting Waters with the highest biological integrity.

Existing Massachusetts Wetland Water Quality Standards

Massachusetts currently has an extremely strong wetland protection program including two statutes and three sets of regulations that implement wetland water quality standards:

1) Massachusetts Clean Water Act (M.G.L. Ch. 21 §26-53) and it's implementing regulations 314 CMR 4.00 - the Massachusetts Surface Water Quality Standards; and 314 CMR 9.00 - the Massachusetts 401 Water Quality Certification Standards.

2) The Massachusetts Wetland Protection Act (M.G.L. C131, §40) and it's implementing regulations (310 CMR 10.00);

The Massachusetts Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972, as amended in 1977, is commonly known as the Clean Water Act (33 U.S.C. 1251 *et seq*.). The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters in part by setting water quality standards for all contaminants in surface waters. The Massachusetts Clean Water Act (MCWA), MGL Ch. 21, § 26-53 gave MassDEP the responsibility to adopt Massachusetts Surface Water Quality Standards (MSWQS) to achieve the CWA goals.

The Massachusetts Surface Water Quality Standards

The MSWQS were promulgated in regulations (314 CMR 4.00) that designate the most sensitive uses for which the Massachusetts waters shall be enhanced, maintained and protected (i.e. aquatic life, fish consumption, drinking water, shellfish harvesting, primary contact recreation, secondary contact recreation and aesthetics). The standards prescribe the minimum water quality criteria required to sustain the designated uses; and contain regulations necessary to achieve the designated uses and maintain existing water quality including, where appropriate, the prohibition of discharges. The regulations specifically include "wetlands" as "Waters of the Commonwealth" as follows: "All waters within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters, groundwaters, and vernal pools." Designated uses for wetlands are dependent on the broader designated uses for all waters, and limited water quality standards applicable to wetlands are adopted in 314 CMR 4.06 as follows:

> "Wetlands bordering Class A, Outstanding Resource Waters are designated Class A, Outstanding Resource Waters. Vernal pools are designated Class B, Outstanding Resource Waters. All wetlands bordering other Class B, SB or SA Outstanding Resource Waters are designated as Outstanding Resource Waters to the boundary of the defined area. All other wetlands are designated Class B, High Quality Waters for inland waters and Class SA, High Quality Waters for coastal and marine waters."

Massachusetts water quality regulations (314 CMR 4.06) establish numeric criteria for all Classes of waters for dissolved oxygen, temperature, pH, bacteria, soils, color and turbidity, oil and grease, and taste and odor. Narrative criteria are established for wetlands near public water supplies and vernal pools as follows:

> "No discharge of dredged or fill material into wetlands and waters of the Commonwealth shall be allowed within 400 feet of the high water mark of a Class A surface water (exclusive of tributaries), unless conducted by a public water supply system…maintenance or repair of existing public roads or railways, or conducted by a person granted a variance…"

> "No point source discharge shall be allowed to a vernal pool certified by the Massachusetts Division of Fisheries and Wildlife; and no discharge of dredged or fill material shall be allowed to a vernal pool certified by the Massachusetts Division of Fisheries and Wildlife unless a variance is granted under 314 CMR 9.08."

Massachusetts has an anti-degradation policy for protection of existing uses of all waters (314 CMR 4.04) that states:

> "In all cases existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected."

Additional anti-degradation provisions apply to high quality waters, outstanding resource waters and other significant waters.

Massachusetts 401 Water Quality Certification

In order to establish procedures and criteria for the administration of Section 401 of the Federal Clean Water Act, 33 USC 1251 et seq. the Commonwealth adopted the Massachusetts Clean Water Act (MGL c. 21 s. 26 through 53) and developed pertinent regulations (314 CMR 9.00). MassDEP is responsible for the issuance of Water Quality Certifications (WQC) under the Massachusetts Clean Water Act and under Section 401 of the Clean Water Act A WQC is required for the discharge of dredged or fill material, and dredging and dredged material disposal in wetlands and waters. The purpose of WQC review is to ensure that a project will comply with MSWQS and other appropriate requirements of state and federal law. In many cases, the Wetland Protection Act Order of Conditions serves as the WQC. However projects or activities which, for some reason are exempt from state statute are still required to be reviewed and approved pursuant to the Mass. Clean Water Act.

The Massachusetts Wetland Protection Act

Since the Massachusetts Wetland Protection Act (WPA) was passed in 1972 (M.G.L. Ch. 131 § 40), MassDEP has regulated removal, fill, dredging or altering of coastal and freshwater wetlands. Coastal wetlands are defined as: "any bank, marsh, swamp, meadow, flat or other lowland subject to tidal action or coastal storm flowage." Freshwater wetlands are defined as: "wet meadows, marshes, swamps, bogs, areas where groundwater, flowing or standing surface water or ice provide a significant part of the supporting substrate for a plant community for at least five months of the year; emergent and submergent plant communities in inland waters; that portion of any bank which touches any inland waters." The WPA regulations (310 CMR 10.00) contain strong protection of bordering vegetated wetlands, allowing for no more than 5000 s.f. of alteration in most cases, and only if the altered area is replaced in a manner that will function similar to the lost area. Other types of resource areas such as waterways and waterbodies, floodplains, riverfront area and a 100 foot buffer zone around freshwater wetlands are also protected rigorously. In Massachusetts, implementation of the WPA is administered by local Conservation Commissions in coordination with MassDEP. MassDEP has authority to issue Superseding Orders of Conditions when local Orders are appealed and to enforce all provisions of the WPA.

Water Quality Standards versus Wetland Standards

Up until this point, traditional surface water quality standards to restore and maintain the chemical, physical, and biological integrity of Massachusetts waters have been developed primarily for water bodies (rivers, streams, lakes and ponds). Those standards are used as the basis for anti-degradation policies and monitoring/assessment programs tied to federal reporting requirements under the Clean Water Act. Although the Massachusetts water quality standards are applicable to wetlands, wetlands are primarily protected through the Wetland Protection Act and 401 Water Quality Certification requirements which primarily implement criteria for physical alterations such as dredging and filling and chemical alterations such as stormwater discharges. The work described in this report will better help us to develop additional biological criteria for wetlands.

Much of the current system of surface water quality standards is focused on designated uses related to human health and safety (drinking water, irrigation, recreation), fisheries and shellfish that are strongly influenced by water quality (dissolved oxygen, bacteria, nutrients, pH, temperature, solids, turbidity, color, oil & grease, taste and odor). Regular mixing of water in water bodies makes it possible to sample for water quality parameters in one or a few areas within a water body or stream reach and make generalizations about the entire water body or reach.

Our ability to generalize about water quality conditions from a limited number of sampling points is much more problematic for wetlands. Further, it is not clear what the relationships are between water quality parameters and designated uses for wetlands.

Fish, other aquatic life and wildlife as a designated use is much more difficult to assess in the field than water quality based uses. Biological integrity is affected by habitat connectivity and continuity as well as stressors that are derived from surrounding land uses and are difficult to detect in the field (e.g. domestic predators, edge predators and brood parasites, microclimatic alterations, traffic related road kill). Indices of Biological Integrity can be used as indicators of fish, wildlife and aquatic life use, but they involve time-consuming data collection techniques and specimen identification.

Differences between wetlands and water bodies makes it likely that the way that water quality standards are used for wetlands will differ from how they are used in water bodies. Site-level assessment methodologies (SLAM's) for wetlands are time consuming and expensive to develop, requiring the identification of specimens by a variety of taxonomic experts. Our limited ability to generalize about wetland condition from SLAMs means that many more wetland sites would need to be surveyed to generate a comprehensive assessment than for water bodies or waterways. Any attempt to implement a comprehensive assessment and monitoring program like the rotating basin system used for water bodies would likely be impractical for wetlands. Further, it would be inappropriate to apply a TMDL approach in wetlands. Anti-degradation policies will have to focus on other policy and regulatory options such as protection and restoration.

Potential Future CALU Wetland Water Quality Standards

Because of funding and other resource constraints, monitoring and assessment capabilities in Massachusetts are still under development. We expect it will be several years before new policies, standards or other regulatory options can be implemented. However, below are several concepts that, if implemented, could potentially help us to better maintain and restore wetland condition by implementation of biological criteria.

1. <u>Use IBI's in the CALU Framework to Establish Biological Criteria for Wetlands</u>

Using the IBI and the IEI of a site, and considering its "natural range of variability" (See Figure 4) we can set biological criteria for wetlands based on the classification goals.

- **Use CALU to Assess Wetlands and Identify Degraded Sites Needing Restoration.** Sampling in accordance with our SLAM and assessment using our IEI/IBI framework allows us to determine whether biological condition (i.e. IBI score) is below, meets or exceeds what is predicted for that site based on the surrounding landscape. Sites where the IBI score falls below the acceptable range of variability for that site could be targeted for restoration.

- **Use IEI and/or CALU to assess Recovery Potential (prioritize restoration efforts).** Wetlands that are determined to be "impaired" because IBI scores are lower than the acceptable range for those sites (based on IEI) can be further evaluated for their recovery potential. Recovery potential can then be used to target §319 or other restoration funding. Recovery potential can be based solely on IEI scores (seeking to restore wetlands that should be able to support high biological integrity) or on the difference between IBI and IEI scores (the larger the difference the greater the recovery potential).

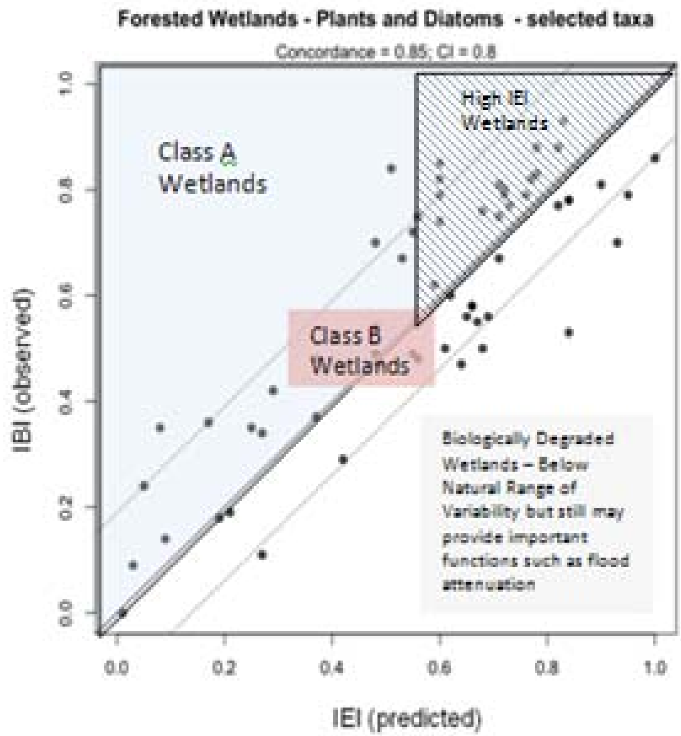

Figure 4 Potential Use of CALU to Implement Biological Criteria

- **Protection of Wetlands with High Ecological Integrity** Wetlands with High Ecological Integrity could be designated – for example, those wetlands that have an IEI between 0.60 and 1.0 could be designated in the anti-degradation and qualifier sections of the MSWQS. Biological criteria could include having an IBI in the range that is above the average natural range of variability for that site. Certain standards could apply, such as no discharge, or increased buffer zone protection (see below) for impacts to these high IEI wetlands. This standard would be applicable to maintaining and improving the designated use of "Fish, Other Aquatic Life and Wildlife." Note that MassDEP considers important wildlife habitat – or "Habitat of Potential Regional or Statewide Importance" – to be where the CAPS IEI is 0.6-10. [1]

[1] *Massachusetts Wildlife Habitat Protection Guidance for Inland Wetlands*, Department of Environmental Protection – Bureau of Resource Protection – Wetlands and Waterways Program, 1 Winter Street, Boston MA 02108 – March 2006
http://www.mass.gov/dep/water/laws/wldhab.pdf

2. Use CALU as a Basis for Evaluating Mitigation Success

Ensuring successful mitigation is one way to meet anti-degradation goals. There is a critical need to establish measures of success for mitigation areas (i.e. replacement or restoration) and to provide monitoring and follow up to ensure success.

- **Monitoring Mitigation Sites (i.e. replacement or restoration)** Where either on-site or off-site wetland replication or restoration is proposed an evaluation of the landscape context (IEI score) for the mitigation site can be used to establish a target for fish, other aquatic life and wildlife use (IBI score) after a reasonable number of years. Annual or bi-annual monitoring of replicated or restored wetlands using the appropriate SLAM and IBIs can be used to track progress toward meeting the CALU target. MassDEP in coordination with its partners at UMass and Coastal Zone Management have begun to target mitigation sites for follow up monitoring in accordance with the SLAMs that have been developed to date. Data collected by project proponents in accordance with specifications developed by our agencies, or data collected by our agencies directly will be assessed over time to see if wetland replacement or restoration sites are meeting biological goals as well as physical and chemical goals. Unfortunately, we are currently limited to monitoring and assessment of forested wetlands and salt marshes until we develop SLAMs and IBI's for other wetland types such as shrub swamps and emergent marshes. Funding will be required to accomplish this and to conduct the necessary sampling.

- **Use CALU as basis for monitoring impacts.** Where a permit is issued for work in or near a wetland under an assumption of no adverse impacts (e.g. groundwater withdrawal permits) monitoring using appropriate SLAMs and IBIs can be used to determine whether those activities actually result in degradation of the biological integrity of the wetland. Such information can be useful when permitting similar projects in the future.

- **Use Class/Qualifiers as basis for mitigation ratios**. Mitigation ratios could be set based on the wetland classification (e.g. Class A wetlands could have mitigation requirements that are greater than 1:1) or Qualifiers such as IEI (e.g. wetlands with higher IEI could have mitigation requirements that are greater than 1:1.) However, it may be more important to better protect these high quality wetlands rather than increase mitigation ratios. Improved buffer zone protection is one option for implementing better protection (see #3 below).

3. Strengthen Buffer Zone Protection

Buffer zone protection has long been considered an important component of wetland protection but has been difficult to achieve. Massachusetts currently requires Wetland Protection Act approval for activities within a 100-foot buffer zone surrounding most wetland resource areas however discouraging or denying activity in the buffer zone is done infrequently. We are studying how buffer zones protect wetlands with the goal of better protecting these important areas – especially those that are adjacent to high quality wetlands.

- **Document Relationship between Development in the Buffer Zone and Biological Community Structure** An analysis of wetland biological community structure against the CAPS Wetlands Buffer Insults metric using all taxa collected in the Chicopee River watershed (i.e. vascular plants, lichens, earthworms, invertebrates, diatoms and bryophytes) suggests a strong relationship (concordance = 0.91). Analyses for the only data where specimen ID is complete to date (i.e. vascular plants, lichens and earthworms) in all three watersheds sampled to date (i.e. the Chicopee, the Concord and the Millers) yielded a lower concordance value. These analyses suggest that a relationship does exist between development in the buffer zone and wetland biological community structure and that this relationship may be a strong one. However, there are concerns including over fitting of the CAPS model, and that the full suite of data for all sites sampled are needed to fully evaluate this relationship (e.g. diatoms, which are believed to be a good indicator of stress) and specimen identification has not yet been completed. A better understanding of the strength of this relationship will have to wait for future analyses with more data and more sites.

- **Use Class/Qualifiers as basis for enhanced regulatory protection** Enhanced buffer zone protection may be one way to avoid or minimize degradation of fish, other aquatic life and wildlife use in wetlands of high biological integrity. It would be possible to create a set of Qualifiers based on IEI scores and set cumulative limits on the amount of allowable buffer zone impacts.

4. <u>Use CAPS to Develop Watershed Restoration Targets</u>

Development of Wetland Restoration Plans by Watershed could be done by using CAPS and can be used to prioritize grant money and other state actions in the watersheds that can contribute to meeting standards. The restoration plans should include:

- **Use stressor/metric based IBIs to diagnose impairment**. Once a wetland is identified as "impaired" based on overall IBI score, IBIs for individual metrics can be applied to help diagnose the potential cause of the impairment. Targeting interventions at likely causes of impairment should increase the likelihood of successful remediation.

- **Use stressor/metric scores from CAPS to prioritize and target restoration efforts in each watershed and when combined, would improve the overall IEI**. CAPS metrics provide insight into landscape-scale stressors that may be a threat to the biological integrity of wetlands. CAPS metrics related to road salt, sedimentation and impervious surfaces can be use to target storm water BMPs. The tidal restriction and aquatic connectivity metrics can identify areas with high restoration potential where roads and railroads cross streams and wetlands. Restoration measures could include any combination of improvements that could be modeled by CAPS such as stream crossings, dam removals, tidal restriction removals, meeting stormwater standards or TMDLs, pavement removal, fill removal, etc. Improvements in IEI would result in the potential for improvements in IBI (which could be monitored) however, the time lag for IBI improvement is unknown and will need to be documented through monitoring. In some cases it could be a very long time.

Conclusion

MassDEP, UMass-Amherst and the Massachusetts Office of Coastal Zone Management have been working to develop a scientifically sound program to monitor and assess wetlands in accordance with requirements of the Federal Clean Water Act. While an extensive effort has been accomplished since 2007 when this project began, currently, SLAMs have been developed only for forested wetlands and salt marshes and extensive sampling has been completed and used to calibrate the CAPS model. Analyses to develop IBI's for forested wetlands are underway but delays have been encountered due to the time consuming effort of specimen ID and the shortage of expertise. Development of IBI's for salt marshes have been delayed because funding available has not allowed for sampling of a sufficient number of sites needed. We are slowly working toward that goal. Identification of salt marsh data collected during the Summer of 2011 is nearing completion and it is still unclear whether there are enough sites to develop IBI's – we are hopeful.

Additional SLAMs and additional IBI's are needed for other wetland communities (e.g. shrub swamp, emergent marsh, etc) before we can fully implement wetland standards. However, we are advancing strategies described in the previous paragraphs to use IBI's under development in forested wetlands and salt marshes, and to use CAPS – calibrated using site condition data – to maintain and improve wetland condition.