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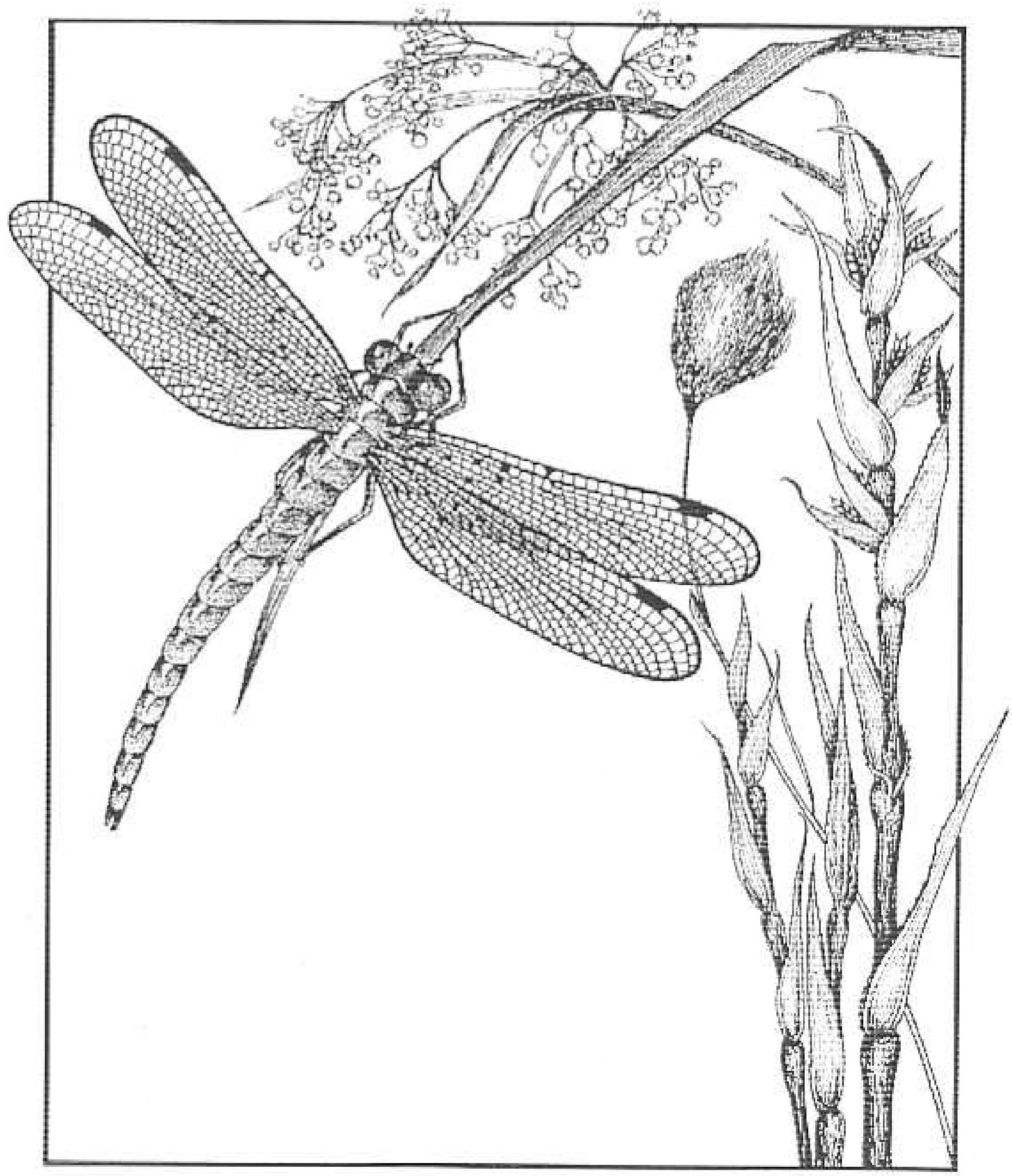
REVIEW OF RAPID ASSESSMENT METHODS FOR ASSESSING WETLAND CONDITION



Environmental Monitoring and
Assessment Program

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January 2004

REVIEW OF RAPID METHODS FOR ASSESSING WETLAND CONDITION

By

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NOTICE

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INTRODUCTION

A priority of the EPA's National Wetland Program is the development of wetland monitoring and assessment programs by States and Tribes. A primary goal of such programs is to report on the ambient condition of the wetland resource. Strategies for designing an effective monitoring program are described in what is known as the "three-tier framework" for wetland monitoring and assessment. This approach breaks assessment procedures into a hierarchy of three levels that vary in intensity and scale, ranging from broad, landscape-scale assessments (known as Level 1 methods), rapid field methods (Level 2) to intensive biological and physico-chemical measures (Level 3). Each level can be used to validate and inform the others, for example data collected with a rapid method can be used to validate and refine remote, landscape level techniques. Biological assessments (Level 3) are often used to calibrate or validate rapid methods (Level 2). Rapid assessment methods hold a central position in monitoring programs because once established, they can provide sound, quantitative information on the status of the wetland resource with a relatively small investment of time and effort.

This report provides an analysis of existing wetland rapid assessment methods that have been developed for use in state and tribal programs. There is an increasing number of wetland assessment procedures available. In this analysis we set out to identify the rapid methods that are most suitable for assessing the ecological condition of wetlands, whether it be for regulatory purposes, to assess the ambient condition of wetlands on a watershed basis, or to determine mitigation project success. The methods reviewed here were developed for a variety of purposes including use in regulatory decision making, local land use planning, and the assessment of ambient ecosystem condition. Despite the different program needs that sparked their development, many of these methods share common features.

As we began this work we recognized that there have been many rapid methods written over the past ten years, making available an abundance of very useful information on wetland assessment. This means that for wetland programs requiring an assessment method there are a wealth of tested ideas available, limiting the need to "reinvent the wheel." In our analysis we have highlighted the common ground that many of these methods share, particularly the metrics that appear to be very robust under a wide variety of circumstances. These metrics should be highly transferable among states or regions. Additionally, we identified some common pitfalls to avoid when developing a rapid assessment method specifically to evaluate wetland condition. We present many of the results of our review in the form of tables and bulleted text with the idea that the main points would be readily accessible to the reader. For those who would like more specifics on a method, we have provided complete citations and information on how to obtain copies of the 16 methods reviewed (Table 1).

Rapid assessment methods have been shown to be sensitive tools to assess anthropogenic impacts to wetland ecosystems (Fennessy et al. 1998; van Dam et al. 1998, Bartoldus 1999, Mack et al. 2000). As such they can serve as a means to evaluate best management practices, to assess restoration and mitigation projects, to prioritize wetland related resource management decisions, and to establish aquatic life use standards for wetlands. Our goal was to evaluate existing methods that were developed for a broad array of purposes for their use in assessing condition; this review is in no way a critique of each method relative to its intended use. An appropriate Level 2 method will be a valuable tool for many states that are moving toward developing state-wide wetland assessment programs. By building upon existing monitoring tools we will be able to more fully incorporate wetlands into water quality programs.

Criteria used to evaluation assessment methods

In adopting or developing a rapid assessment method for use in wetland monitoring and assessment programs, we felt the following four considerations were important:

1) The method can be used to measure condition. A principal goal of the Clean Water Act is to maintain and restore the physical, chemical and biological integrity of the waters of the United States. According to 33 U.S.C. §1251(a) integrity can be defined as the ability of a system to support and maintain a "…balanced integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitat of the region" (Karr and Dudley 1981, U.S. EPA 2002a). By contrast, ecological condition describes the extent to which a given site departs from full ecological integrity (if at all). Condition can be defined as the relative ability of a wetland to support and maintain its complexity and capacity for self-organization with respect to species composition, physico-chemical characteristics and functional processes as compared to wetlands of a similar class without human alterations. Ultimately, condition results from the integration of the chemical, physical and biological processes that maintain the system over time. Methods best suited to measure condition reflect this by providing a quantitative measure describing where a wetland lies on the continuum ranging from full ecological integrity (or the least impacted condition) to highly impaired (poor condition). A single numeric score is the result. This score is not meant to measure absolute value or have intrinsic meaning, but allow comparisons between wetlands to be made.

By contrast, many of the wetland assessment methods developed to date report on a suite of functions and values, or assess only the habitat value of a given area. Many rapid functional assessment methods assign qualitative scores (high, medium, low) to each function individually, an approach that makes comparisons between wetlands sites difficult. Because a primary goal of monitoring and assessment programs is to report on the ambient condition of the wetland resource (U.S. EPA 2003), methods that evaluate condition directly should effectively serve program needs. Information derived from monitoring programs can also be used to develop and support aquatic life use designations for the implementation of wetland water quality standards. Condition can describe the relative ability of a waterbody to support its designated uses, thus the adoption of a rapid method is a key in the implementation of such standards. The issues associated with evaluating condition versus function are discussed in more detail below.

2) The method should be rapid. Consideration was given to how much time a method would take to complete. A rapid method must be able to provide an accurate assessment of condition in a relatively short time period. For this reason we define "rapid" as taking no more than two people a half day in the field and requiring no more than a half day of office preparation and data analysis to come to an answer. We also considered the relative ease of collecting field data required by each method. The time required to complete the methods evaluated here ranged from a few hours to more than two days.

3) The method must be an on-site assessment. An accurate evaluation using a rapid method requires a site visit to ensure that the method captures the current condition of the wetland and does not infer condition based solely on surrounding landscape characteristics or the potential of a wetland to perform certain wetland functions. The notion of awarding points to a wetland because it has the *opportunity* to perform certain functions (regardless of whether or not it is doing so) dates back to some of the earliest wetland assessment methods (e.g., WET; Adamus 1987). This information, while valuable, does not relate directly to the measurement of ecological condition.

The requirement of a site visit implies that field protocols must be developed to ensure consistency and repeatability between users. One important decision is how to define the area of wetland to be included in the assessment. This is referred to as the 'wetland assessment area' or the area within a 'scoring boundary.' In many instances this is a simple matter of assessing the entire wetland, for example, when assessing a relatively small wetland the scoring boundaries will generally coincide with jurisdictional boundaries. When dealing with very large wetlands or a smaller area that is part of a larger wetland complex, decision rules to identify what area to include in the assessment must be developed. Misidentification of the assessment area can result in either the under- or over- scoring of a given wetland (e.g., Mack 2001).

4) The method can be verified. Verification may be achieved based on information gathered through empirical studies using results from more intensive wetland monitoring activities (i.e., Level 3 assessments). In this way the assumptions behind the assessment can be tested.

Study Approach

Over 40 methods were originally considered for analysis. We focused on the methods reviewed by Bartoldus (2000) and those that were subsequently published. We quickly evaluated each method; if it was obvious that the method was not a rapid assessment it was eliminated from further consideration. For example, the original list included many Level 3 methods such as full HGM functional assessments (e.g., Brinson 1993, Smith et al. 1995) and wetland indexes of biotic integrity (IBIs; see Karr and Chu 1997). Several landscape level assessments (Level 1) such as the Synoptic Approach for Wetlands Cumulative Effects Assessment (Leibowitz et al. 1992, Abbruzzese and Leibowitz. 1997) were also listed. When these methods were eliminated, 25 of the 41 methods had been disqualified.

The remaining 16 methods were kept for a more detailed analysis using the four criteria described above (see Tables 1 and 2 and Appendix C: Overview of Methods). This report describes the results of our more detailed review culminating with the identification of seven methods that meet the four criteria outlined above. These seven were further evaluated relative to a conceptual model describing the components of an ecologically sound wetland assessment method (Figure 1 and Appendix A). All 16 methods were considered for ideas on indicators, scoring or regionalization (Table 3).

Implementing a Rapid Assessment Method

Several operational issues must be addressed to successfully develop or adapt a rapid assessment method and put it to use in the field. These include how wetlands in the state or region will be classified, how the method will be scored (e.g., will some indicators be weighted more heavily than others), and ways in which the values that we place on certain wetland functions or characteristics can be recognized.

Wetland classification schemes have been developed to help reduce the variability inherent in wetland ecosystems. Classification systems typically define wetland types according to differences in hydrologic conditions (source of water, hydroperiod, hydrodynamics), vegetation (emergent, shrub-scrub), topography (depressional, riverine), and to a lesser degree, soils (muck, peat, unconsolidated). The goal of classification is to reduce variability within a class and enable more sensitivity in detecting differences between least-impacted and impaired wetlands. Classification schemes may be based on landscape characteristics (for example Omernik's or Bailey's ecoregions), or local environmental conditions (Cowardin classification, or the hydrogeomorphic (HGM) approach (U.S. EPA 2002b). Some assessment methods embed the issue of classification within the method while others, particularly those that are based on indicators of stressors, are "blind" to wetland type.

Finally, many rapid methods acknowledge that some wetland types or features are particularly valuable regardless of condition. For instance, wetlands in urban settings may have a high degree of human disturbance and therefore be of low condition, but they may be highly valued as green space or for the educational opportunities they provide. We term metrics that award extra points for these reasons “value added metrics”. These can substantially increase the flexibility of the method to meet program needs.

Table 1. Citations and sources for the 16 wetland assessment methods reviewed.

Name	Citation	Source
Delaware Method *(Draft)*	Jacobs, A.D. Working Draft. Delaware Rapid Assessment Procedure. Delaware Department of Natural Resources and Environmental Control, Dover DE.	Delaware Dept. of Natural Resources and Environmental Control, Water Resources Division/Watershed Assessment Section, 820 Silver Lake Blvd., Suite 220, Dover, DE 19904
Florida Wetland Quality Index (FWQI)	Lodge, T.E., H.O. Hillestad, S.W. Carney, and R.B. Darling. 1995. Wetland Quality Index (WQI): A Method for Determining Compensatory Mitigation Requirements for Ecologically Impacted Wetlands. Proceedings of the American Society of Civil Engineers South Florida Section, Annual Meeting, Sept 22-23, 1995, Miami, FL.	Law Engineering, 3301 Atlantic Ave., Raleigh, NC 27604
Florida Wetland Rapid Assessment Procedure (FWRAP)	Miller, R.E., Jr. and B.E. Gunsalus. 1999. Wetland Rapid Assessment Procedure. Technical Publication REG-001. Natural Resource Management Division, Regulation Department, South Florida Water Management District, West Palm Beach, FL.	The document can be downloaded from http://www.sfwmd.gov/org/reg/nrm/wrap99.htm
Maryland Department of the Environment Method (MDE method)	Furgro East, Inc. 1995. A Method for the Assessment of Wetland Function. Maryland Department of the Environment, Baltimore, MD. 240pp.	Fugro East Inc., Six Maple Street, Northborough, MA 01532
Massachusetts Coastal Zone Management Method	Hicks, A. L. and B. K. Carlisle. 1998. Rapid Habitat Assessment of Wetlands, Macro-Invertebrate Survey Version: Brief Description and Methodology. Massachusetts Coastal Zone Management Wetland Assessment Program, Amherst, MA.	Bruce K. Carlisle Massachusetts Coastal Zone Management 100 Cambridge Street Boston, MA 02202 (617) 626-1200
Minnesota Routine Assessment Method	Minnesota Board of Water and Soil Resources. 2003. Minnesota Routine Assessment Method for Evaluating Wetland Functions (MNRAM) Version 3.0. Minnesota Board of Water and Soil Resources, St. Paul, MN.	Minnesota Board of Water and Soil Resources (651) 296-3767, http://www.bwsr.state.mn.us/wetlands/mnram/index.html

Name	Citation	Source
Montana Wetland Assessment Method	Burglund, J. 1999. Montana Wetland Assessment Method. Montana Department of Transportation and Morrison-Maierle, Inc., Helena, MT	Montana Department of Transportation, Environmental Services, 2701 Prospect Ave., P.O. Box 201001, Helena, MT 59620-1001
New Hampshire Coastal Method	Cook, R.A., A.J. Lindley Stone, and A.P. Ammann. 1993. Method for the Evaluation and Inventory of Vegetated Tidal Marshes in New Hampshire: Coastal Method. Audubon Society of New Hampshire, Concord, NH.	The Audubon Society of New Hampshire, 3 Silk Farm Road, Concord, NH 03301
New Hampshire Method	Ammann, A.P. and A. Lindley Stone. 1991. Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. NHDES-WRD-1991-3. New Hampshire Department of Environmental Services, Concord, NH.	NH Department of Environmental Services, Water Resource Division, Wetlands Bureau, P.O. Box 2008, Concord, NH 03302 (603) 271-2147
Ohio Rapid Assessment Method (ORAM)	Mack, J.J. 2001. Ohio Rapid Assessment Method for Wetlands v. 5.0: User's Manual and Forms. Ohio EPA Technical Report WET/2001-1. Ohio Environmental Protection Agency Division of Surface Water, 401/Wetland Ecology Unit, Columbus, OH.	The document can be downloaded from http://www.epa.state.oh.us/dsw/401/
Oregon Freshwater Wetlands Assessment Method	Roth, E., R. Olsen, P. Snow, and R. Sumner. 1996. Oregon Freshwater Wetland Assessment Methodology. Wetlands Program, Oregon Division of State Lands, Salem, OR.	Wetlands Program, Oregon Division of State Lands, 775 Summer St. NE, Salem, OR 97310
Penn State Stressor Checklist	Brooks, R.P., D.H. Wardrop, and J.A. Bishop. 2002. Watershed-Based Protection for Wetlands in Pennsylvania: Levels 1 & 2 - Synoptic Maps and Rapid Field Assessments, Final Report. Report No. 2002-1 of the Penn State Cooperative Wetlands Center, University Park, PA 16802. 64 pp.	The Penn State Cooperative Wetlands Center, University Park, PA 16802
Virginia Institute of Marine Science Method (VIMS)	Bradshaw, J.G. 1991. A Technique for the Functional Assessment of Nontidal Wetlands in the Coastal Plain of Virginia. Special Report No. 315 in Applied Marine Science and Ocean Engineering. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA.	The document can be downloaded from http://ccrm.vims.edu/VIMSMethodReport-No315.pdf

Name	Citation	Source
Washington State Wetland Rating System (Eastern)	Washington State Department of Ecology. Draft revision. Washington State Wetlands Rating System: Eastern Washington. Second Edition. Publication #02-06-019. Washington State Department of Ecology, Olympia, WA.	The documents can be downloaded from http://www.ecy.wa.gov/biblio/0206019a.html
Washington State Wetland Rating System (Western)	Washington State Department of Ecology. 1993. Washington State Wetlands Rating System: Western Washington. Second Edition. Publication #93-74. Washington State Department of Ecology, Olympia, WA	The documents can be downloaded from http://www.ecy.wa.gov/biblio/93074.html
Wisconsin Rapid Assessment Method	Wisconsin Department of Natural Resources. 1992. Rapid Assessment Methodology for Evaluating Wetland Functional Values. Wisconsin Department of Natural Resources. 9pp.Madison, WI.	Wisconsin Department of Natural Resources, PO Box 7921, Madison, WI 53707

Table 2. Summary of the 16 rapid assessment methods reviewed in the report including information on the method's suitability for assessing condition, the wetlands types the method was designed for, an estimate of how long a typical wetland assessment might take using the method, and a summary of the pros and cons for using each method to assess condition.

Procedure	**Assesses Condition?**	**Wetland Types Assessed**	**Time to Do**	**Pros**	**Cons**
Delaware Method *(Draft)*	Yes	Tidal and non tidal wetlands in Delaware	< 0.5 day	Can be used on all HGM subclasses Rapid and easy to use	May not work where stressors are not obvious, i.e., non-point source impacts Stressor list would require regionalization
Florida Wetland Quality Index (FWQI)	No Evaluates mitigation site compliance	Mitigation wetlands	Day +	Combines indicators for an overall score Weights indicators based on their importance Easy to use	Not a rapid assessment Developed specifically for mitigation sites, may not be applicable for naturally occurring wetlands
Florida Wetland Rapid Assessment Procedure (FWRAP)	Yes Designed for mitigation projects with a habitat emphasis but does provide a single score that may be interpreted as condition.	Designed for mitigation projects, but may have broader applications	< Day	Rapid Easy to follow directions Allows user to adjust scores based on the site conditions	Narrative descriptions of variables combine many indicators into one score Heavily weighted to evaluate wildlife habitat

Procedure	Assesses Condition?	Wetland Types Assessed	Time to Do	Pros	Cons
Maryland Department of the Environment Method (MDE method)	No Functional capacity for each of 8 functions. Results in an overall score but does not represent condition because opportunity metrics are included	Non tidal palustrine vegetated wetlands	Day +	Comprehensive list of indicators and wetland characteristics Flow charts easy to read, providing a well organized layout for scoring	Not a rapid assessment Does not include many stressor indicators
Massachusetts Coastal Zone Management Method	Yes Provides a single score for habitat and surrounding landscape	Separate versions for freshwater wetlands and salt marshes	0.5 day	Rapid Developed specifically to evaluate macroinvertebrate habitat but metrics have much wider applicability Evaluates both tidal and nontidal systems Format is easy to follow Flexible scoring allows observer to assign scores within a range	Combines numerous metrics into one indicator Combines all human stressors into one indicator
Minnesota Routine Assessment Method	No	Freshwater wetlands	0.5 day	Comprehensive list of indicators	Some questions difficult to assess rapidly in the field and may require GIS

Procedure	Assesses Condition?	Wetland Types Assessed	Time to Do	Pros	Cons
Minnesota Routine Assessment Method *(continued)*	Scores of 12 functions and restoration potential, sensitivity to development, and stormwater treatment needs Includes measures of value and opportunity				A computer program is required to score each function
Montana Wetland Assessment Method	Yes Designed to evaluate 12 functions but provides single score that may be interpreted as condition Score relates to a regulatory category based, in part, on degree of disturbance and replacement potential	Freshwater wetlands	0.5 Day	Easy to use Good ideas for rapid field indicators	Some indicators not rapid and may be difficult to determine in the field Emphasis is on identifying unique and high value wetlands
New Hampshire Coastal Method	No Scores 12 separate functions	Tidal marshes of New Hampshire	Day +	Good list of indicators Ideas for adapting nontidal methods to tidal systems	Not a rapid assessment No overall score produced
New Hampshire Method	No Scores each of 14 functional values	Nontidal wetlands of New Hampshire	Day +	Good list of indicators	Not rapid No overall score produced

Procedure	Assesses Condition?	Wetland Types Assessed	Time to Do	Pros	Cons
Ohio Rapid Assessment Method (ORAM)	Yes	Freshwater wetlands	< 0.5 day	Questions are clearly stated Rapid Provides an overall rating Easy to calculate final score	Includes some value measurements therefore scores some types of wetlands higher not necessarily due to condition
Oregon Freshwater Wetlands Assessment Method	No Scores each of 9 functions Weighted heavily on measures of value and opportunity	Freshwater wetlands	Day +	Comprehensive list of value-added indicators	Not a rapid assessment Function category descriptions are vague (e.g., provides habitat for some wildlife species)
Penn State Stressor Checklist	Yes Weights all stressors as being equal	Freshwater wetlands	< 0.5 day	Field portion of method is easy to use Rapid	Method is not rapid due to landscape analysis that is required prior to field use Stressor list would need to regionalization
Virginia Institute of Marine Science Method (VIMS)	No Scores each of 7 functions Weighted heavily on measures of opportunity	Freshwater wetlands, primarily streams	Day +	Approach to using landscape attributes in functional assessment may be useful in the development of landscape assessment techniques	Not a rapid assessment Primarily a desktop evaluation Evaluates opportunity not condition Complex data needs

Procedure	Assesses Condition?	Wetland Types Assessed	Time to Do	Pros	Cons
Washington State Wetland Rating System (Eastern/ HGM-based)	No Evaluates functions and special characteristics Weighted heavily on opportunity	Freshwater wetlands in eastern Washington	0.5 day	Rapid Questions clearly stated Easy to perform Provides overall score	Includes some value measurements Rates wetlands higher based on opportunity
Washington State Wetland Rating System (Western)	Yes Also evaluates sensitivity to disturbance, rarity, and irreplaceability	Freshwater wetlands in western Washington	0.5 day	Rapid Easy to use Includes measures of condition	Includes some value measurements Certain types of wetlands score higher because of opportunity Not all wetlands receive a numerical score
Wisconsin Rapid Assessment Method	No Scores each of 7 functions and values Weighted heavily on measures of value and opportunity	Freshwater wetlands	Day	Rapid assessment Questions clearly stated Easy to perform	Relationship between indicators and function scores based on best professional judgment Includes opportunity and value measurements

ANALYSIS OF METHODS

Of the sixteen methods analyzed, seven met the four criteria we established (assess condition, are rapid, require a site visit, and can be validated), indicating that they could be considered for use in developing and implementing a wetland monitoring and assessment program (see Appendix A – C for details on the methods). These methods were, the draft Delaware Method, the FWRAP, Massachusetts Coastal Zone Management Method, Montana Method, ORAM, the Penn State Stressor Checklist, and the Washington State Wetland Rating System-Western. Each method was evaluated relative to a conceptual model (Figure 1) showing the relationship between the ecological features that define wetlands (ovals on the left) and the indicators used to evaluate the resulting wetland condition (boxes on right). The model illustrates how method development proceeds from an understanding of the ecological factors that create and sustain wetlands, of how regional hydrogeologic conditions such as geomorphology and the pathways of water flow drive the formation of regional wetland classes with characteristic structure and functions, and how these wetland types respond to anthropogenic disturbance (stressors). Effective rapid assessment techniques are based on indicators of wetland condition that are derived from an understanding of the processes that create, maintain and degrade wetlands on the landscape.

Wetlands by definition are characterized by three features: hydrology (hydroperiod, mean depth, etc.), the presence of hydric soils and the resulting biotic communities, particularly the presence of hydrophytic vegetation. Hydrology is considered the master variable of wetland ecosystems, driving the development of wetland soils and leading to the development of the biotic communities (Mitsch and Gosselink 2000). We term these the *universal features* of wetlands and they serve as the foundation of any assessment method (Table A-1).

The model also recognizes that wetlands vary regionally and that this variability must be accounted for when developing reliable indicators of condition. Regionalization

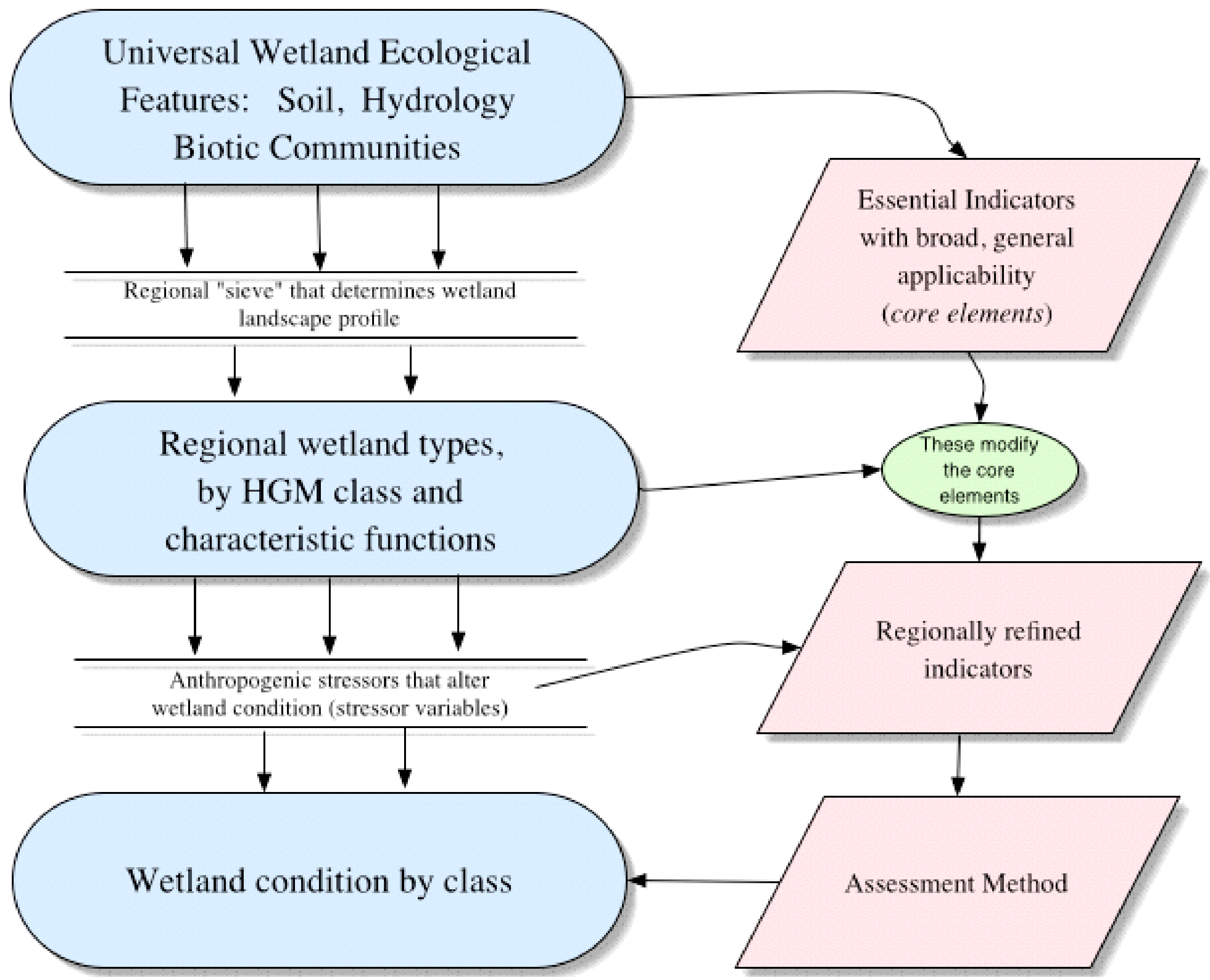

Figure 1. Conceptual model showing the links between the wetlands being evaluated and the core elements of a rapid assessment method. The model is hierarchical with respect to the ecological features that define wetlands (ovals on the left) and the indicators that can be adapted to evaluate wetland condition (boxes on right).

in this case is described in terms of the hydrogeologic settings and the hydrogeomorphology that dictate wetland form and function and that influence the selection or calibration of indicators (Table A-2). The values placed on specific wetland classes or ecosystem services are also addressed here. Hydrogeologic settings are defined as the position of wetlands relative to surface and ground water inflows and the characteristics of the surficial geology that control water movement (Winter 1988, 1992, Bedford 1996). The specific landscape settings that support wetlands are termed "templates" by Bedford (1999). Templates are the result of hydrologic variables operating at the landscape scale that generate and maintain different wetland types, or *classes*. The diversity of wetland types (kinds, numbers, relative abundance, and spatial distribution) can be summarized in a wetland landscape profile. In this way regional hydrogeologic and hydrogeomorphic characteristics act as a sieve, selecting for the wetland types and locations (i.e., the profile) that are sustainable in a particular landscape.

The ecological factors that define wetlands (hydrology, soils, and biota) are the basis for indicators (or assessment questions) with broad applicability under a wide range of circumstances and are expected to be components of any method. We define these as the *core elements* of a method. Common indicators reflecting the core elements are shown in Table 3 and include those on hydrology, soils, vegetation, and landscape setting. All sixteen methods reviewed address hydrology; many emphasize the stressors that affect hydrologic processes (e.g., ditching and culverts; Table 3). Hydroperiod is another important consideration; half of the methods use the duration of flooding and the sources of water to the wetland as core indicators. Soils received the least attention with several methods not mentioning soils at all. Features of the biotic communities, particularly vegetation, were the basis for many indicators. Most methods rely on the structural characteristics of the plant community (number of communities present, degree of interspersion, vegetation cover) as indicators of overall biotic richness. Plants are considered "one of the best indicators of the factors that shape wetlands within their landscape" (Bedford 1996). Wetland vegetation provides critical habitat structure for

Table 3. Major categories of indicators used in the rapid assessment methods reviewed, the characteristic(s) on which the indicator is based on and a tally of methods using that indicator (from high to low). A more detailed list of indicators can be found in Appendix B.

I. Core Element	**Indicators developed for, or based on:**	**Number of methods employing indicator (16 maximum)**
Hydrology:	Hydrologic alterations (stressors)	**14**
	Hydroperiod	**9**
	Type of outlet restriction	**8**
	Water quality	**8**
	Surface water connectivity	**7**
	Flood storage potential	**7**
	Groundwater recharge and/or discharge	**4**
	Water source(s)	**3**
	Degree of water level fluctuation	**3**
	Maximum water depth	**1**
Soils/substrate:	Soil type	**4**
	Substrate disturbance	**2**
	Presence of mottles	**1**
	Depth of A horizon	**1**
	Munsell color (matrix/mottles)	**1**
	Microtopography	**1**
	Sediment composition	**1**
Vegetation:	Number of vegetation classes	**12**
	Degree of interspersion (community types or open water)	**8**
	Extent of invasive species	**8**
	Vegetation alterations	**6**
	Habitat value to wildlife	**5**
	Endangered/threatened species, their habitat or communities	**4**
	Coarse woody debris	**3**
	Dominant Vegetation	**2**
	Plant species diversity	**2**
	Area of open water	**1**
Landscape setting:	Surrounding land use cover	**14**
	Connectivity to other wetlands or corridors	**8**
	Extent of and/or vegetation type in buffer zone	**7**
	Extent of human land use in buffer	**5**
	Wetland size	**5**
	Ratio of wetland to watershed size or watershed size	**3**
	Land use in watershed	**3**
	Wetland morphology	**2**
	Position of wetland in watershed	**1**

other taxonomic groups, such as epiphytic bacteria, phytoplankton and some species of algae, periphyton, macroinvertebrates, amphibians, and fish. The composition and diversity of plant community influences diversity in these other taxonomic groups.

Finally, wetlands are subject to human activities (e.g., changes in land use or hydrology) that stress the system and degrade its ecological integrity (Table A-3). One of the assumptions underlying any condition assessment method is that wetlands respond predictably to stressors. Indicators of wetland condition can be based either on the response of the wetland to these stressors (e.g., the percent cover of invasive species, the number of vegetation communities present) or on the stressors themselves (hydrologic modification). Stressor indicators can be very robust since the stressors have a negative effect on condition regardless of wetland type, for instance hydrologic modification has a negative impact whether it be in a coastal marsh or a riparian forest. The most robust rapid methods appear to combine both types of indicators.

OBSERVATIONS AND CONCLUSIONS

Our review of existing rapid assessment methods and experience leads to the following conclusions and observations on the adoption of such methods for wetland monitoring and assessment programs.

Definition of the wetland assessment area

The definition of the wetland assessment area varies by method, ranging from sampling a fixed area around a point (for instance, a 0.5-ha area; the Draft Delaware Method), to sampling the wetland as a whole (the New Hampshire Coastal Method). The latter approach can be problematic when large complexes made up of different wetland types are encountered, making it difficult to define a single wetland, or when very large wetlands require sampling. Some methods use a combination of approaches, for instance, the Ohio Rapid Assessment Method defines the assessment area using a 'scoring boundary' which can be based either on the wetland's natural (jurisdictional) boundary (i.e., the whole site) or on boundaries defined by natural breaks in hydrology (much as stream sampling is done by a defined stream reach). This can mean that 'whole' wetlands are not being sampled in the traditional sense, but the data collected will be consistent and provide an assessment of the ambient condition of the resource. The seven methods that we applied to our model could all be easily adapted for use in whole wetlands or a defined assessment area within a wetland, depending on the user's objectives.

The definition of the assessment area is important because it influences how the data are collected and how the results are reported (e.g., by area of wetland resource, by wetland), understood, and, therefore, used. It is vital that the definition of the assessment area be thoroughly evaluated prior to the implementation of a monitoring effort. This evaluation should consider 1) how well the definition can be applied in sample design and site selection, e.g., can it be used with mapped or GIS information, 2) how well and consistently the definition can be applied in the field, 3) how ecologically meaningful the results will be, and 4) how useful the results will be in achieving the objectives of the monitoring or management program.

Issues of classification

A key consideration in the development of a rapid method is the issue of wetland type and the need for classification. It is crucial to avoid the pitfall of creating a different version of the method for each wetland class in the region. However, recognizing that there are different wetland classes, for instance, using the hydrogeomorphic classification system (HGM), is an important consideration in the development and use of a rapid method for two reasons: 1) different classes may be subject to different stressors, and 2) different classes may vary in their relative susceptibility to particular stressors. The reference condition for a given class, defined by wetlands least impacted by human activities, is used to set the benchmark for the attainable ecological condition within that class. This can be accomplished in several ways: 1) use an *a priori* classification scheme to segregate sites before use of the rapid assessment method, 2) weigh the indicators according to wetland type within the method itself, or 3) stratify *a posteriori* as the data allow. The first approach implies that different versions of a method will be required, one for each class. This can be problematic for several reasons including the fact that each version will have to be separately validated and the fact that some wetlands, or some mosaics of wetlands, are not cleanly placed into a category without making the classification system very detailed, thus increasing the need for more versions (see below). The second and third approaches allow the creation of a single method for use in all wetland types and are therefore more robust. The latter type of method sometimes embeds the issues of class within the method itself, for instance, in the Ohio Rapid Assessment Method the rater is asked to evaluate the wetland being assessed relative to other wetlands of similar type and hydrology, i.e., to other sites of the same HGM class. The result is that wetlands of different classes but the same relative level of human impact will receive relatively similar scores. In this approach the scoring expectations may differ for each class (including for their reference sites) due to the different levels of human impacts. For instance, riparian wetlands, because of their landscape position, may suffer more anthropogenic influence than do depressional bogs.

Another method that embeds class within the method is the draft Delaware method that includes a suite of stressors, some of which are only found in certain types of wetlands. Only scores for the same wetland type can be compared after the data are collected since the range of possible scores may vary by class.

The costs in time and resources needed to develop different versions of a method must also be recognized. For instance, the sample size needed to statistically detect differences (or lack thereof) between classes or other groupings is influenced by the variability of the parameter(s) being measured. The USEPA Environmental Monitoring and Assessment Program has arrived at a "rule of thumb" that, absent any information on the variability of what is being measured, 50 sites *per class* should be assessed to increase the likelihood that the sample will be adequate. (See www.epa.gov/nheerl/arm/surdesignfaqs.htm for information on sample size and other monitoring design issues.) Therefore, a single method can be brought on line, evaluated and developed much more quickly than a suite of methods.

We have found that most methods are blind to wetland class, but at the same time most also track the type of wetland being assessed for uses such as ground-truthing wetland inventories, or for post-stratification of the data. Evidence provided by the methods we have reviewed suggests that diverse wetlands types can be "clumped" without losing any of the power of the rapid assessment. Wetlands may differ in terms of their HGM class or floristic composition, but all are degraded by stressors.

Methods that assess functions versus condition

A major focus of our analysis was to identify those methods that could assess the ecological condition of a site. These methods provide a single score as an overall evaluation of the ecological status of a site. Many of the existing functional assessment methods do not provide information on ecosystem condition because results are provided in terms of an "answer" for each function assessed (8 to 14 in the methods reviewed here), making it difficult to compare the relative condition or extent of anthropogenic impacts between sites. For example, the results of both the Minnesota Routine Assessment Method (Version 1.0) and the Oregon Freshwater Wetlands Assessment Method are expressed as a series of ratings for each of nine functions. The Oregon Method uses qualitative scores to indicate that the wetland "has the function" (earning a high score), that the "function is impacted or degraded" (mid) or that the "function is lost or not present" (low). For the Minnesota Method each function assessed is assigned one of four ratings ranging from "exceptional" to "low." In a test of ten depressional wetlands, approximately 40 percent of the functions evaluated by the Minnesota method scored "medium" while 65 percent of the functions received a score of “mid” using the Oregon method (Fennessy et al. 1998). Only one function at one site received an “exceptional” score using the Minnesota method, in this case for the floral diversity function where a state endangered sedge species was found. It should be noted that the ten wetlands included in this study were selected to represent the full gradient of human disturbance (least impacted to highly impaired), so despite the large apparent differences in condition, all ten wetlands received very similar scores, making it difficult to distinguish between them, limiting the sensitivity of the method. Assigning qualitative scores on a function by function basis also makes it virtually impossible to report on the condition of the resource as a whole.

Another concern is that in some functional methods, defining the highest level of a function doesn’t necessarily equate with high ecological condition. Scoring by the highest degree of functionality can be a trap because maximizing one function (e.g., water quality improvement) may cause a reduction in others (e.g., supporting characteristic diversity). Ultimately, if a wetland is functioning as an integrated system with a high degree of ecological integrity it will perform all of its characteristic functions at the full levels typical of its class (i.e., at the level of the reference condition). If in adopting a method there is a desire to recognize wetlands that provide valuable functions despite moderate to high levels of degradation, points could be awarded to acknowledge this value, after the score for condition has been determined.

From an ecological standpoint, wetlands perform a wide variety of functions at a hierarchy of scales ranging from the specific (e.g., nitrogen retention) to the more encompassing (e.g., biogeochemical cycling) as a result of their physical, chemical and biological attributes. At the highest level of this hierarchy is the maintenance of ecological integrity, the function that encompasses all ecosystem structure and processes (Figure 2, Smith et. al., 1995). The link between function and condition lies in the assumption that ecological integrity is an integrating “super” function of wetlands. If condition is excellent (i.e., equal to reference condition), then the ecological integrity of the wetland is intact and the functions typical of that wetland type will also occur at reference levels.

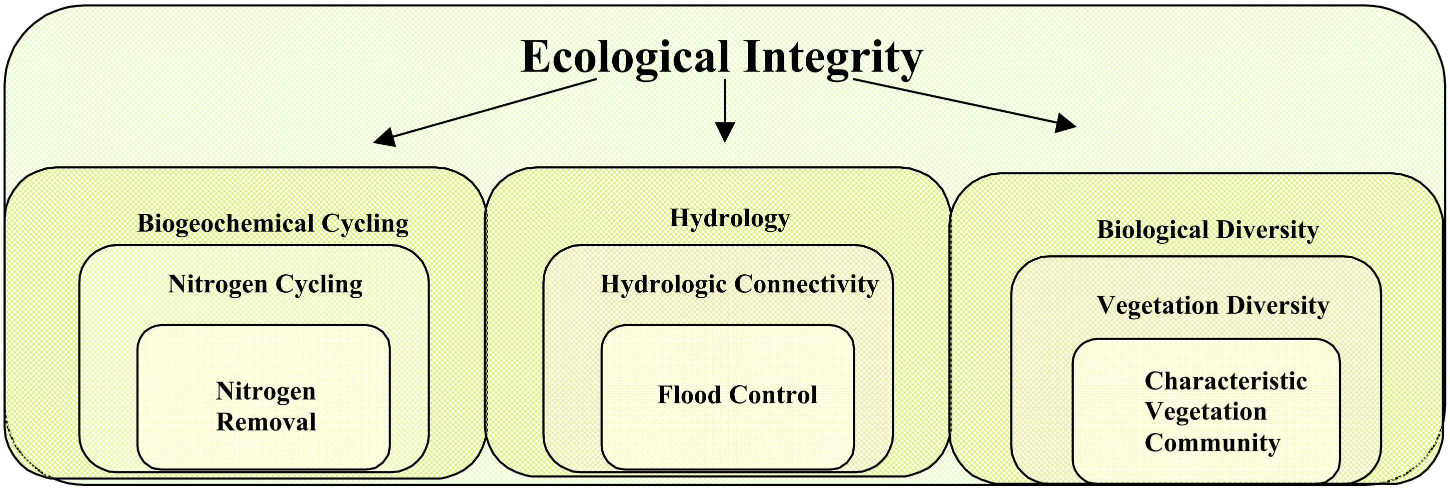

Figure 2. A schematic to illustrate the concept of ecological integrity as the integrating function of wetlands, encompassing both ecosystem structure and processes. In this case integrity is shown to include biogeochemical processes that lead to functions such as nitrogen removal and hydrological processes that lead to the flood control function, and habitat functions (based on Smith et. al., 1995).

Scoring

The approach used for scoring a rapid method must also be established. A common approach is to assign scores by placing the 'answers' to assessment questions into different categories and then assigning a score by category. For example, an assessment of the average buffer width around a wetland could be scored using categories such as "narrow" (e.g., 10 – 25m), "medium" (25 – 75m), or "wide" (greater than 75m). Different points would be awarded for each of the three categories. This approach tends to dampen the variability in scoring, resulting in less measurement error, i.e., different people are likely to get the same answer making results repeatable and the method robust.

Several methods included in this review (e.g., New Hampshire Method, Minnesota Routine Assessment Method) calculate the level of a function assigned to a wetland using simple equations that combine different variables. This can be problematic because it makes the functional scores more difficult to validate (more variables, as well as their interactions, must be validated for each function). We also note that in arriving at a final score, many of the methods reviewed lead the person doing the assessment through a relatively detailed analysis requiring a lot of detail, but then leave the ultimate result of the assessment to the "best professional judgment" of the user, or to some "gut level reaction" that appears hard to defend. There needs to be a transparent process for coming to a result for the assessment if it is to be repeatable and defensible.

Enhancing scores for highly valued wetlands or features

Some of the methods reviewed include what might be termed "value added metrics." These are metrics that provide the opportunity for points to be added for a specific wetland type or feature that is deemed particularly valuable in that region. For example, Metric 5 in the ORAM addresses regional values by adding points for wetland types that are rare and support a high level of plant diversity such as the Oak Openings wetlands on the sand plains of Lake Erie. The Western Washington Method (from which the Ohio method was developed) does the same for eelgrass beds. Enhancing the score in this way might be done for several reasons: 1) if the results of the rapid assessment are considered in regulatory decisions then more weight can be given to valued wetland types that are deserving of protection regardless of their condition, and 2) some stakeholders who have a say in the development and use of such a method may feel more satisfied about its validity if scores are enhanced for wetlands or habitat features that they view as particularly important. For instance, some wetlands that provide important waterfowl or amphibian habitat may be weighted more heavily. Additional metrics may also be added for use in evaluating mitigation wetlands. If this approach is taken, it is important that such "value added metrics" be kept separate from the metrics that indicate condition or stressors. By keeping condition metrics and value added metrics separate, the metrics that reflect ecological condition can be combined for a condition score that can be used to track the status of the site or the resource, then the "value added metrics" can be added in to get an overall score to be used in the regulatory process.

Validation with comprehensive ecological data

A central component in the development of a rapid method is its validation with more comprehensive ecological assessment data (Level 3 assessments such as IBI or HGM type data). The relationship between the rapid method and Level 3 data must be established so that the rapid method, with careful sampling design, can be used to extrapolate the more detailed results to the resource base as a whole (i.e., through probability-based sample design). It will also allow confidence limits on the use of a rapid assessment to be determined, increasing the reliability and defensibility of the method.

Summary

This report provides a first step in developing guidance for the U.S. Environmental Protection Agency to the states and tribes on how to develop a rapid assessment method or to adapt an existing method for use in a wetland monitoring program. From an initial review of 40 methods, 16 were selected for an in-depth analysis and seven were selected for an in-depth evaluation. We used four criteria to select these methods: 1) the method must measure the current condition of the wetland, 2) its use requires a site visit to complete the assessment, 3) the method is truly rapid, and 4) the assumptions that underlie the method can be verified. The wetland assessment methods reviewed have multiple programmatic and regulatory uses, including ambient condition monitoring, mitigation planning and establishment of performance criteria, monitoring status and trends, local land use planning to protect the ecological integrity of wetlands, and for use in regulatory decision making. These uses highlight the fact that a scientifically sound rapid assessment method can serve as a cornerstone in a state or tribe's wetland protection program.

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APPENDICES

Appendix A: Comparison of Methods to Conceptual Model.

Table A-1. Comparison relative to core elements.

Table A-2. Comparison relative to wetland type, and services and values.

Table A-3. Comparison relative to stressors.

Appendix B: List of Indicators from the Methods

Appendix C: Overview of Methods

APPENDIX A: COMPARISON OF METHODS TO CONCEPTUAL MODEL

Table A-1. A comparison of the seven methods that may be used to assess condition relative to how each method addresses the universal features that define wetland ecosystems.

Method	Hydrology	Soils	Biotic Communities
Delaware Method (*Draft*)	Incorporated into method by evaluation of stressors that affect hydrologic processes.	Incorporated into portion of the method evaluating biogeochemical cycling and the stressors that affect soil processes.	Incorporated into the method by the evaluation of stressors that affect the biotic communities.
Florida Wetland Rapid Assessment Procedure	Considers evidence that hydrologic regime is a adequate to maintain a viable wetland system	Not considered	Considers wildlife utilization in terms of habitat, disturbance, food sources; tree and shrub canopy in terms of likelihood of providing habitat; herbaceous plants in terms of cover, disturbance, native vs exotic
Massachusetts Coastal Zone Management Rapid Habitat Assessment Method	Evaluated in terms of stressors and degree of alteration, e.g., restriction of inlets and outlets.	Ranks by type with rocks and gravel with little organic matter rated the lowest.	Considers number of Cowardin vegetation classes (more is better), number and types of food sources, presence of buffer.
Montana Wetland Assessment Method	Considers duration of surface water. Rates flood attenuation as amount of site subject to periodic flooding. Rates surface water storage as area of site subject to periodic flooding or ponding relative to frequency and duration of flooding. Rates groundwater	Not considered	Rates structural diversity as number of Cowardin vegetation classes present and relates to general wildlife habitat. Considers habitat for federally listed or proposed threatened or endangered species. Considers fish/aquatic habitat

Method	Hydrology	Soils	Biotic Communities
Montana Wetland Assessment Method *(continued)*	discharge/recharge based on presence of indicators (e.g., springs, seeps, inlet but no outlet).		relative to duration and frequency of flooding, cover (e.g., rocks, logs), and shading. Rates food chain support relative to vegetation cover and structural diversity, and hydrologic characteristics.
Ohio Rapid Assessment Method	Considers source; maximum water depth, duration of inundation (the more permanent and deeper the water the higher the score); and connectivity to other surface waters and upland.	Rates in terms of disturbance	Rates overall habitat development and also degree of alteration (see stressors). Vegetation ranked as to: number of communities present, degree of interspersion. Considers microtopography —presence of hummocks, woody debris, standing dead, pools.
Penn State Stressor Checklist	Evaluates in terms of the stressors that affect hydrology, for example, ditching and culverts.	Evaluates in terms of the stressors that affect substrate characteristics, in particular, sedimentation.	Evaluates in terms of the stressors that affect habitat, in particular, vegetation alteration.
Washington State Wetland Rating System, Western Version	Considers amount of inundation and flow	Gives extra points to wetlands with a deep organic layer.	Considers plants, mosses, woody vegetation; plant diversity; structural diversity; degree of interspersion; habitat features (nests, snags, open water), connection with a stream; part of a corridor; cover of vegetation types, proximity to priority habitats

Table A-2. A comparison of the seven methods that may be used to assess condition relative to how each method addresses regional factors including the wetland types specific to the region as well as any consideration given to the ecosystem services provided by and/or special values placed on some wetlands.

Method	Wetland Types	Services and Values
Delaware Method (*Draft*)	HGM Classes. Regionalizes by changing the thresholds for interpretation of the assessment relative to HGM class.	Not included.
Florida Wetland Rapid Assessment Procedure	Does not consider wetland type in the assessment. Is designed for use in a wide range of systems, but is not intended to be used to compare types.	Primary focus of the assessment is habitat, also considers water treatment.
Massachusetts Coastal Zone Management Rapid Habitat Assessment Method	Has a form for all freshwater wetlands and another for salt marshes.	Not included.
Montana Wetland Assessment Method	Uses regional versions of the national HGM classes and vegetation classes (aquatic bed, emergent, scrub-shrub, forested, moss-lichen). Rates relative abundance of similarly classified sites within the basin.	Considers Habitat for Montana Natural Heritage Program listed species. Flood attenuation – considers residences or businesses downstream of wetland Sediment/Nutrient/Toxicant Retention and Removal - opportunity (i.e., probable or actual source); presence and amount of vegetation, of flooding and ponding, and of restriction of outlet. Sediment/Shoreline Stabilization – cover and flooding of plant species with deep, binding roots. Uniqueness - rareness of wetland type or species present, and amount of disturbance. Recreation or Education - potential for use, ownership, and amount of disturbance.

Method	Wetland Types	Services and Values
Ohio Rapid Assessment Method	Does not consider wetland type in the assessment except in terms of special value. Wetland Area is used as an assessment factor with larger being better.	Gives extra points to wetlands of special significance and wetlands that are habitat for threatened or endangered species or migratory bird habitat.
Penn State Stressor Checklist	Does not consider wetland type in the assessment, but can present the results by wetland classes.	Not included.
Washington State Wetland Rating System, Western Version	Tidal and non-tidal evaluation is not type specific. Bigger is better, especially if wetland is part of a complex.	The office form of the assessment is focused on determining the regulatory category of the wetland based on whether it has been designated by the State, Heritage Program, Federal agency or local government as having sensitive or endangered species, or is considered significant locally for functions such as shoreline protection, and water storage.

Table A-3. A comparison of the seven methods that may be used to assess condition relative to how each method addresses the stressors that act to degrade wetland condition.

Method	Stressors
Delaware Method (*Draft*)	Entire method scores stressors relative to their potential effect on hydrology, biogechemical cycling, and habitat/plant community. Also includes potential for effects (positive and negative) of what is in the area 100m around the wetland.
Florida Wetland Rapid Assessment Procedure	Hydrologic modification Adjacent land use as ameliorated by a buffer
Massachusetts Coastal Zone Management Rapid Habitat Assessment Method	From surrounding landscape: Land use – commercial, industrial, transportation rated lowest; forestry and open space rated highest Amount impervious cover -- >20% rated lowest; <5% rated highest % Natural vegetation -- <10% rated lowest; >50% rated highest Ratio wetland/drainage basin area -- <2% rated lowest; >10% rated highest Possible sources of pollution -- industrial, commercial effluent and urban stormwater rated lowest; no source rated highest Onsite: Hydrology-- variability in water levels (altered or human controlled ranked lower); restriction of outlet (presence gets lower rating); degree of tidal flushing for tidal systems Soils -- high sedimentation given lowest rating; high erosion gets lowest rating for tidal systems. Human activities -- rated lowest if human activities severely degrade the wetland
Montana Wetland Assessment Method	Disturbance – considers the site and area adjacent (within 500 feet); categories considered are natural; not cultivated but moderately grazed, hayed or selectively logged, minor clearing, fill, or hydrologic alteration, few roads or buildings; cultivated or heavily grazed or logged, substantial grading, fill, clearing, or hydrologic alteration, high road or building density Vegetation alteration -- predominant weedy, alien and introduced species, degree of disturbance to vegetation Hydrology -- culverts, dikes and other structures, restriction of outlets if present

Method	Stressors
Ohio Rapid Assessment Method	Vegetated buffers scored as an ameliorating factor. Intensity of land use scored. Score decreases with increasing land use intensity. Modifications to hydrology, with highest score for none and lowest for recent or no recovery. Substrate disturbance rated. Habitat modification rated. Rates coverage of invasive plants.
Penn State Stressor Checklist	Considers categories of stressors and their indicators. Score is adjusted to account for ameliorating effects of a buffer, if present. The categories of stressors are: Hydrologic modification Sedimentation High biological oxygen demand Toxicity due to contaminants Vegetation alteration Nutrient enrichment or eutrophication, Acidification Turbidity Thermal alteration
Washington State Wetland Rating System, Western Version	Hydrologic modifications Grazing Impervious surface >12% in upstream watershed Exotic plants Runoff from roads or parking lots Dumping Vegetated buffers scored as an ameliorating factor

APPENDIX B: LIST OF INDICATORS USED IN THE METHODS

Table B-1. Indicators selected from the 16 rapid assessment methods included in our analysis. Note that this table is not comprehensive in that it does not include all indicators given in each method. Indicators of most interest and/or applicability have been selected, with an emphasis on rapid indicators that make up the core elements (universal features, regional factors, and stressors) of any assessment method.

I. Hydrology

Wetland Characteristic	**Indicator**	**Method(s) ***
Hydroperiod:	Hydrologic regime	MDE; MT; NH COASTAL; Oregon
	Ratio of wetland area to watershed area (determines water inflow)	MDE; VIMS
	Microrelief of wetland surface	MDE
	Upland plants encroaching into wetland	FWRAP
	Die-off of wetland plants (trees) due to increased hydroperiod	FWRAP; Penn State
Sources of water:	Observation: seeps springs, surface water inflows, precipitation	ORAM; WIRAM
	primary source of water (maps or in field)	Oregon
Water level fluctuation (degree of):	Water marks silt rings on trees	MDE
	Absence of leaf litter	MDE
	Drift Line deposition	MDE; Oregon
	Sediment deposits on plants	MDE; Oregon
	Debris deposited in channels	MDE
Flashy water level changes:	Debris marks, erosion lines, stormwater inflows	WIRAM
Outlet restriction:	Observation of the length (in feet) of the restriction	MDE; Mass
	Observation of degree of hydrological modification by artificial control (dams, weirs, etc.)	DE; Mass; MN RAM; NH Coastal
Outlet restriction:	Surface water outlet (none, intermittent, permanent)	Mass; MT; Oregon; WSWRS-east
Water quality/chemistry:	Extent of obvious visual indicators, e.g., algae, turbidity, odors, etc.	Florida WQI; MT; Penn State; VIMS; WIRAM; WSWRS-west

Wetland Characteristic	Indicator	Method(s) *
	Excess sedimentation (observe deposits, plumes)	New Hampshire; Penn State
	Pollution (obvious spills, plumes, odors; adjacent industry)	Mass; Penn State
A. Eutrophication	Excess algae	Florida WQI; Penn State; VIMS; WIRAM
	Direct discharge from agriculture feedlots, etc.	Penn State
	Direct discharge from septic or sewage treatment system	Penn State
	Dominance of nutrient tolerant plant species	Penn State
B. Acidification	Acid mine discharges, adjacent mined lands, absence of biota	Penn State
Maximum water depth	Observation	ORAM
Duration of inundation or saturation	Observation	ORAM; VIMS; WIRAM
Groundwater recharge and /or discharge:	Evidence of seeps and springs	MDE; MT; ORAM; WIRAM
Hydrologic alterations due to observed:	Evidence of ditching	DE; FWQI; FWRAP; MDE; MN RAM; MT; ORAM; Penn State; WSWRS-west; NH Coastal ; WIRAM
	Stream channelization	DE
	Stream channelization within one mile above wetland	Oregon
	Stormwater inputs	DE; ORAM; WIRAM; Penn State
	Point source discharge	DE; ORAM; Penn State
	Filling, grading dredging (% of site affected)	DE; Penn State
	Filling, grading dredging (presence/absence)	ORAM; MN RAM; WSWRS-west
	Tiles, culverts	ORAM; WIRAM; MN RAM; Penn State
	Road/railroad present that impedes flow	DE; ORAM; Penn State
	Dams, dikes	Mass; NH Method; Oregon; Penn State; WIRAM
Hydrologic alterations due to observed *(continued)*:	Tidal restriction in tidal wetlands	DE; NH Coastal
Surface hydrologic connectivity:	Direct observation in the field or aerial photo/maps	MDE; Oregon
	Direct observation in the field – landscape position	MN RAM; NH Method; ORAM; VIMS; WIRAM;

Wetland Characteristic	Indicator	Method(s) *
	Observation of streams connected to wetlands	Oregon
Flood storage potential:	Federal Emergency Management Agency flood maps or U.S. Geological Survey data sources.	MDE; Oregon
	Water-vegetation interspersion in flow-through wetlands	MN RAM; MT; NH Method
	Degree of channelization within wetland	MN RAM
	Wetland is located within enclosed basin (no inlets or outlets)	Oregon
	Ratio of wetland:watershed size	WIRAM; VIMS

II. Soils

Wetland Characteristic	Indicator	Method(s)*
Soil type:	Soil series from Natural Resource Conservation Service county soils maps	MDE; WIRAM; MN RAM
	1/4 acre of undisturbed organic soil > 16 inches deep	WSWRS-west
Soil morphology:	Evidence of soil subsidence	FWRAP
Mottles	Presence of	WIRAM
Depth of A horizon	Measure in field	WIRAM
Munsell color of matix, mottles	Munsell color chart	WIRAM
Microtopography:	Observation of hummocks, tussocks	ORAM
Sediment composition	Relative amounts of gravel, sand, silt/mud, organic material	Mass
Substrate disturbance	Observation of disturbance (none to recently occurred)	ORAM; MN RAM
Soil Anoxia (biogeochemical cycling)	Soil 2" below surface is clay, organic matter or has rotten egg smell	WSWRS- east

III. Vegetation

Wetland Characteristic	Indicator	Method(s)*
Dominant vegetation:	Most abundant plant species in a 30' radius plot	MDE
	Estimate dominant plant community type	Oregon
Number of vegetation classes:	Count number of community types within wetland	Mass; MDE; MN RAM; MT; NH Coastal; NH Method; ORAM; VIMS; WIRAM; WSWRS-west
	Estimate percent of area covered by each of four Cowardin classes	Oregon
Plant species diversity	Count number of species with cover > 5% (don't have to identify species)	WSWRS-west
Degree of interspersion:	Observation and comparison with diagrams	MDE; MT; NH Method; ORAM; Oregon; VIMS; WIRAM; WSWRS-west
Number of vegetation layers (vertical layers)	Observation	MDE
	Observation for those layers larger than 1/4 acre	WSWRS-west
Dead (coarse) woody debris	Observation (abundant to rare)	MDE; ORAM; VIMS
	Evidence of debris removal	ORAM; Penn State
Interspersion of vegetation and open water	Observation and comparison with diagrams	MDE; NH Method; VIMS; WIRAM; WSWRS-east
Area of open water	Estimate, in acres	Oregon
Wetland edge complexity:	Observation (high to low convolution)	MDE
Vegetation alterations due to observed:	Evidence of mowing	DE; ORAM; Penn State
	Evidence of tree harvesting	DE; ORAM; Penn State; WSWRS-west
Vegetation alterations due to observed *(continued)*:	Excessive herbivory	DE; Penn State
	Excessive sedimentation (presence of sediment tolerant plants)	Penn State
	Management or conversion	DE; ORAM
	Burning	DE
	Trails cut	DE
	Toxic contaminants (severe vegetation stress)	DE; ORAM; Penn State; VIMS

Wetland Characteristic	Indicator	Method(s)*
	Chemical defoliation	DE, Penn State
	Sedimentation	ORAM
	Nutrient enrichment	ORAM
	Nutrient enrichment as evidenced by algal mats, etc.	WIRAM
	Farming	ORAM; WSWRS-west
Presence of threatened & endangered species	Observation	MT; NH Method; ORAM; WSWRS-west
Presence of invasive species:	Estimate coverage or assess dominance of invasive plants	DE; FWRAP; NH Coastal Penn State
	Evaluate coverage of native species	WIRAM
	Estimate coverage of invasive plants using defined list of species	ORAM
	Cover of non-native species greater than 10% and appear to be invading	WSWRS-west
Habitat value:	Vegetation appropriate as food base	Mass; MT; NH Method; WIRAM
	Wetland area	WSWRS-west

IV. Landscape Setting

Wetland Characteristic	Indicator	Method(s)*
Presence of buffer zones	Width of buffer	ORAM; Penn State; WSWRS-west
Type of land use in buffer zones	Land use in buffer	FWQI; NH Method; ORAM; Penn State; WSWRS-west
	Percent of buffer (to 500’ in width) that is woodland or idle land	NH Coastal
	Ratio of square feet of paved surfaces within 150’ of wetland to wetland area	NH Coastal
	Percentage of wetland’s edge that is bordered by upland wildlife habitat (to 150’) or by natural vegetation (to 25’)	Oregon
Surrounding land use	Determine dominant land use in the 500’ zone surrounding site	Mass; NH Coastal; Oregon

Wetland Characteristic	**Indicator**	**Method(s)***
	Estimate percent of watershed in listed land use categories	MN RAM; WIRAM
	Percent of land use that is in forest or natural vegetation (within 300’)	VIMS
	Percent impervious surfaces	Mass
	Percent natural vegetation	Mass
Degree of human land use in buffer zones	Number of buildings per wetland area (number occupied dwellings/total wetland area)	NH Coastal
	Area around wetland relatively free of human impacts (yes, no)	MN RAM
	Intensity (density) of development in 100m around site	DE
	Presence of agriculture, foresty, marinas, golf courses, sand/gravel operations, forest harvesting in last 15 years	DE
	Density of buildings within the 500 feet of site	NH Coastal; NH Method
	Roads (types, number) in 100m around site	DE; NH Method
	Evidence of fragmentation	MDE
Wetland Morphology	Presence of distinct banks	NH Coastal; NH Method
Wetland Size	Estimate size of assessment area	MDE; NH Coastal; NH Method; ORAM; Oregon
Ratio of wetland to watershed size	Determine ratio	Mass; NH Method
Position of wetland in watershed	Topographic position	MDE
Land use in watershed	Dominant land use in watershed upstream from wetland	MDE; NH Method; Oregon
Zoning in 500’ area around wetland edge	Tabulate zoning categories, by percent	Oregon
Landscape position	Classify (similar to HGM classes)	VIMS
Connectivity to other wetlands or corridors	Presence of wetlands or corridors in target wetland’s vicinity	MDE; MN RAM; NH Coastal; NH Method; Oregon; VIMS
	Wetland part of or connected to riparian or upland corridor	ORAM; WSWRS-west

Wetland Characteristic	Indicator	Method(s)*
	Perennial surface water connection to stream	WSWRS-west
	Seasonal surface water connection to stream	WSWRS-west
	Organic matter always exported to perennial stream	WSWRS-west
	Organic matter exported to stream seasonally	WSWRS-west
	Wetland on a floodplain	ORAM

* Method abbreviations used in the Table above include the following:

Method Name	Method Abbreviation
Delaware Method *(Draft)*	DE
Florida Wetland Quality Index	FWQI
Florida Wetland Rapid Assessment Procedure	FWRAP
Maryland Department of the Environment Method	MDE method
Massachusetts Coastal Zone Management Method	Mass
Minnesota Routine Assessment Method	MN RAM
Montana Wetland Assessment Method	MT
New Hampshire Coastal Method	NH Coastal
New Hampshire Method	NH Method
Ohio Rapid Assessment Method	ORAM
Oregon Freshwater Wetlands Assessment Method	Oregon
Penn State Stressor Checklist	Penn State
Virginia Institute of Marine Science Method	VIMS
Washington State Wetland Rating System (Eastern)	WSWRS-east
Washington State Wetland Rating System (Western)	WSWRS-west
Wisconsin Rapid Assessment Method	WIRAM

APPENDIX C: OVERVIEW OF METHODS

DELAWARE METHOD (*Draft*)

Citation: Jacobs, A.J. WORKING DRAFT. Delaware Rapid Assessment. Delaware Department of Natural Resources and Environmental Control, Dover, DE.

Scoring: This method evaluates wetland condition based on the presence or absence of stressors. Four categories of stressors are evaluated; those that affect hydrology, habitat, biogeochemical cycling, and the surrounding landscape. An overall score for site condition is calculated using a formula that combines the four category scores. The overall score is scaled to determine a condition category based on the HGM subclass being evaluated.

List of Functions and stressors:
Hydrology
Ditching
Stream channelization
Weir or dam
Stormwater inputs
Point source
Filling, grading, dredging
Road/ railroad
Tidal restriction
Habitat/ Plant Community
Mowing
Farming
Grazing
Forest harvesting
Excessive herbivory
Invasive species
Chemical defoliation
Pine conversion
Managed burning
Trails
Dumping
Biogeochemical Cycling
Microtopography alterations
Sediment deposits
Eroding banks
Increase in nutrients
Dense algal mats
Forest harvesting
Landscape Setting
Development
Sewage disposal
Trails
Roads
Stormwater drains

Landfill
Direct run-off/ erosion
Agriculture
Forest harvesting
Marinas
Hydromodification
Golf Course
Mowed area
Sand/ gravel operation

General Conclusions: The Delaware Draft method was developed specifically to evaluate condition but is still being refined to include appropriate stressors and calibrate the weighting of stressors and the scores relative to different HGM subclasses. The method allows for regionalization by changing the thresholds for interpretation of the assessment relative to the HGM class. Further adjustment of the stressor weights would be required for use in areas outside of the mid-Atlantic coastal plain to reflect the impacts of stressors in the region being considered. A major assumption of this method is that the site is in good condition unless there is evidence to the contrary. This may be a problem for areas that have a lot of nonpoint source impacts that are difficult to evaluate using the stressors provided. The method is easy to use and can be conducted in less than half a day.

FLORIDA'S WETLAND QUALITY INDEX (FWQI)

Citation: Lodge, T.E., H.O. Hillestad, S.W. Carney, and R.B. Darling. 1995. Wetland Quality Index (WQI): A method for determining compensatory mitigation requirements for ecologically impacted wetlands. Proceedings of the American Society of Civil Engineers South Florida Section Annual Meeting, Sept 22-23, 1995, Miami, FL.

Scoring: The FWQI was developed to evaluate five wetland mitigation areas. The method assesses 17 indicators. Each indicator is scored 0.1, 0.5 or 1.0 and then multiplied by a weighting factor. An overall score for the site is calculated by summing the 17 weighted indicator scores and then dividing by the total possible points.

List of indicators:
Aquatic prey base abundance
Based on fish, prawns, and crayfish
Not rapid involves sampling and identification
Aquatic prey base diversity
Based on fish, amphibians, crayfish, prawn and apple snails
Not rapid same sampling as above
Category I exotic pest plant species
Involves aerial photo interpretation and some sampling plots
Diversity of macrophytes
Involves plot samples
Based on dominant species
Habitat diversity within 1000 feet
Number of different habitats
Hydroperiod
Requires long term monitoring data
Hydropattern
Requires long term monitoring data
Intactness of wetland resource
Peat/muck soil layer
Protected animal species use
Protected plant species
Proximity to aquatic refugia
Sheet flow (during inundation)
Surrounding landscape condition
Water quality
Wetland vegetation cover
Wildlife use

General Conclusions: The WQI method was developed to evaluate wetlands created for mitigation purposes and would not be applicable to assess condition on a wide variety of naturally occurring wetlands. Additionally, the method was not meant to be a rapid assessment because some of the indicators require quantitative data that needs to be collected over several sampling periods. However, the method was easy to follow and the questions for scoring indicators were clearly stated. We use this method for ideas on how to weight and combine indicators to calculate an overall score for each site.

FLORIDA WETLAND RAPID ASSESSMENT PROCEDURE (FWRAP)

Citation: Miller, R.E., Jr., and B.E. Gunsalus. 1999. Wetland rapid assessment procedure. Updated 2nd edition. Technical Publication REG-001. Natural Resource Management Division, Regulation Department, South Florida Water Management District, West Palm Beach, FL. (http://www.sfwmd.gov/newsr/3_publications.html)

Scoring: The FWRAP method is a rating index to evaluate created, enhanced, preserved, or restored wetlands and was developed to be a simple, accurate and consistent regulatory tool. The method incorporates concepts from the U.S. Fish and Wildlife Service's Habitat Evaluation Procedure (HEP) and, therefore, has a strong habitat emphasis. Six variables are evaluated on each site. Each variable is assessed with several indicators and scored between 0-3 based on a set of calibration descriptions. An overall score for the site is then calculated by summing the scores for the six variables and dividing by the total possible score.

List of variables and indicators:
Wildlife utilization
Evidence of wildlife utilization
Abundance of macroinvertebrates, amphibians and forage fish
Upland food sources
Human disturbance
Cover and habitat for wildlife
Wetland overstory/shrub category
Exotic and invasive canopy/ shrub species
Habitat
Recruitment of native canopy/ shrub species
Snags and den trees
Human disturbance
Condition of canopy trees
Wetland vegetation ground cover
Desirable species
Exotic species
Human disturbance
Seed germination
Managed burns
Adjacent upland wetland buffer
Buffer width
Species composition
Cover, food, and roosting areas for wildlife
Adjacency to wildlife corridor
Field indicators of wetland hydrology
Plant stress due to hydrology
Hydroperiod
Alterations to hydrology
Soil subsidence
Presence of upland plant species
Water quality input and treatment systems
Surrounding land use

Type of water management systems

General Conclusions: The FWRAP method evaluates mitigation projects based on six variables. The scoring of the variables is easy to perform based on narrative descriptions. Additionally, the method is rapid to perform in the field. Because each variable is scored based on the presence of several indicators, it may be difficult to assign scores in some situations where indicators do not all fall in the same category. Some flexibility is provided by allowing the user to assign scores of 0.5 between primary scores of 0-3. The FWRAP method has a strong focus on habitat and provides a measure of the quality of wildlife habitat provided by a site more than the overall condition for a site.

MARYLAND DEPARTMENT OF THE ENVIRONMENT METHOD

Citation: Furgro East, Inc. 1995. A method for the assessment of wetland function. Prepared for Maryland Department of the Environment, Baltimore, MD. 240pp.

Scoring: The MDE Method assesses nontidal, palustrine vegetated wetlands using six functions. Each function can be assessed using a desktop method or a field method and is calculated by summing scores for a set of indicators (fewer indicators are used for the desktop method) and then dividing by the total possible points. Indicators are weighted differently based on the number of possible points that can be attained. A total functional capacity can be calculated for the site by adding together the scores of the six functions.

List of functions and indicators:
Ground water discharge
Hydrogeomorphic type
Nested piezometer data
Inlet/ outlet class
Relationship to regional potentiometer surface
Presence of springs and seeps
Wetland soil type
Surface water hydrologic connection
Water chemistry
Surficial geologic deposit under wetland
Water regime
Microrelief of wetland surface
Relationship to steep slopes
Hydrologic alteration (ditching, channelization)
Flood flow attenuation
Hydrogeomorphic type
Inlet/ outlet class
Degree of outlet restriction
Basin topographic gradient
Wetland water regime
Surface water fluctuations
Ratio of wetland area to watershed size
Stem density
Microrelief of wetland surface
Presence of dead plant material
Adjacency to a water body or water way
Occurrence of down cut stream channel
Occurrence of ditching
Modification of water quality
Frequency of overbank flooding
Microrelief of wetland surface
Wetland land use
Basin topographic gradient
Degree of outlet restriction
Topographic position in the watershed
Hydrogeomorphic type

Water regime
Inlet/ outlet class
Stream sinuosity
Dominant vegetation type
Occurrence of overbank flooding
Percent of wetland edge bordering a sediment source
Occurrence of ditching
Cover distribution
Occurrence of dead plant material
Hydric soil type
Sediment stabilization
Hydrogeomorphic type
Frequency of overbank flooding
Overland flow from uplands potential
Evidence of retained sediments
Microrelief
Stem density
Percent of wetland edge bordering a sediment source
Wetland area to watershed area ratio
Aquatic Diversity/ Abundance
Hydrogeomorphic type
Association with open water
Water regime
Water/ cover ratio
Stream sinuosity
Dominant vegetation
Wetland class richness
Vegetative density
Wetland juxtaposition
Known habitat for anadromous or catadromous fish, trout, or warm water fish
Habitat for aquatic invertebrates, reptiles or amphibians
Wetland land use
Adjacent to undisturbed upland habitat
Adjacent to known upland wildlife habitat
Buffer for water body
Occurrence of debris dams in wetland stream
Within or adjacent to Chesapeake Bay Critical Area
Wildlife Diversity/ Abundance
Wetland size
Wetland class richness
Wetland class rarity
Wetland class edge complexity
Surrounding upland habitat
Wetland juxtaposition
Water regime
Wetland land use
Microrelief of wetland surface
Presence of seeps and springs
Water chemistry

Vegetative interspersion
Interspersion of vegetation cover and open water
Presence of islands
Presence of rare, endangered or threatened species
Linked to a significant habitat
Connected to a known wildlife corridor
Number of vegetation layers and percent of cover
Fragmentation of once larger wetland
Watershed land use
Adjacency to designated wildlife habitat
Regional significance

General Conclusions: The MDE method evaluates wetlands based on six functions using models similar to an "HGM-Light" approach. This method requires a lot of data and is not in our opinion a rapid assessment. We estimated that to perform either the desktop or field version would require more than a day. Detailed and easy to read flow-charts are provided to score each function. An overall score can be calculated by summing the function scores but it is not specifically a measure of condition. Certain HGM subclasses are scored higher for some of the functions because of their potential to perform the function. A fairly comprehensive list of indicators is used for each function; however, few of them address stressors or landscape features.

MASSACHUSETTS COASTAL ZONE MANAGEMENT METHOD

Citation: Hicks, A.L. and B.K. Carlisle. 1998. Rapid habitat assessment of wetlands, macroinvertebrate survey version: brief description and methodology. Massachusetts Coastal Zone Management Wetland Assessment Program, Amherst, MA.

Scoring: Wetland sites are scored based on five indicators of the quality of the surrounding landscape and eight indicators of the quality of the wetland. Different indicators are provided for freshwater and saltwater wetlands. Each indicator is scored 0 – 6. General criteria lead the observer to one of four blocks of scores for each indicator. Best professional judgment is then used to assign the score within each block. The total score for the site is calculated by summing the scores of all indicators and dividing by the highest possible score. All indicators receive the same weight.

List of Indicators:
Landscape Indicators
Dominant land use
% impervious surface
% natural vegetation
Ratio wetland/ drainage basin
Possible major sources of pollution
Wetland Indicators (tidal indicators in parentheses)
Water level fluctuation (tidal fluctuation)
Outlet restriction
Rate of sedimentation (rate of erosion)
Nature of sediments (nature of substrate at water/ substrate interface)
Vegetation diversity
% Presence of a vegetated buffer of 100ft. width
Food sources
Degree of human activities in wetland

General Conclusions: The MA Coastal Zone Management Method was developed to assess habitat integrity and quality for macroinvertebrates. Although some of the landscape indicators may require a fair amount of office time to calculate, the field portion is rapid and could be completed in less than half a day. The format is easy to follow and self-explanatory and we liked the ability of the observer to assign a score within a given range. Although the manual states that the method is for evaluating macroinvertebrate habitat, it is likely good for assessing overall condition, however, it may lack some sensitivity because it lumps most human-stressors into one indicator of human activities.

MINNESOTA ROUTINE ASSESSMENT METHOD (MNRAM)

Citation: Minnesota Board of Water and Soil Resources (MBWSR). 2003. Minnesota routine assessment method for evaluating wetland functions (MNRAM). Version 3.0. Minnesota Board of Water and Soil Resources, St. Paul, MN 53pp.

Scoring: The Minnesota routine assessment method evaluates 12 functions based on a set of questions for each function. Each question is designed to evaluate a particular aspect of the function and is given a score of high/medium/low or a yes/no answer. Narrative descriptions are given for each category and which include quantitative measures and guidance is provided for how to score each question. Decision trees and formulas are then provided on how to combine the answers to the questions to calculate a function score. Scores range from 0.1 – 2.0 which are categorized into low, medium, high and exceptional functional ratings. Additional evaluation information is rated for wetland restoration potential, wetland sensitivity to stormwater and urban development, and additional stormwater treatment needs. No overall score is calculated for the wetland.

List of function/value characteristics and indicators:

Special features

Vegetative diversity/ integrity
- Community rating
- Presence of invasive species

Maintenance of characteristic hydrologic regime
- Outlet
- Dominant upland land use
- Soil condition/ wetland
- Stormwater runoff/ pretreatment

Flood and stormwater storage/ attenuation
- Outlet – flood attenuation
- Dominant upland land use
- Upland soils
- Soil condition
- Sediment delivery
- Stormwater pretreatment and detention
- Subwatershed wetland density
- Emergent vegetation percent cover (flow through wetlands)
- Emergent vegetation roughness (flow through wetlands)
- Channels/ sheet flow

Downstream water quality protection
- Dominant upland land use
- Stormwater runoff pretreatment and detention
- Sediment delivery
- Upland buffer width
- Upland area management
- Upland area slope
- Emergent vegetation percent cover (flow through wetlands)
- Emergent vegetation roughness (flow through wetlands)
- Downstream sensitivity
- Outlet for flood

Maintenance of wetland water quality
- Vegetative diversity/ integrity
- Dominant upland land use
- Stormwater runoff pretreatment and detention
- Upland buffer width
- Upland area management
- Upland area slope
- Sediment delivery
- Nutrient loading

Shoreline protection
- Shoreline
- Rooted shoreline vegetation
- Wetland width
- Emergent vegetation erosion resistance
- Shoreline erosion potential
- Bank protection ability

Management of characteristic wildlife habitat structure
- Wildlife barriers
- Vegetative ranking
- Wetland detritus
- Upland buffer width
- Upland area management
- Upland area diversity
- Outlet natural hydrologic regime
- Stormwater runoff pretreatment and detention
- Vegetation interspersion
- Community interspersion
- Wetland interspersion
- Amphibian breeding/ hydroperiod
- Amphibian breeding/ fish
- Amphibian overwintering habitat

Maintenance of characteristic fishery habitat
- Fishery quality
- Final wetland water quality ranking

Maintenance of characteristic amphibian habitat
- Amphibian breeding potential/ hydroperiod
- Amphibian breeding potential/ fish
- Amphibian overwintering habitat
- Upland buffer width
- Wildlife barriers
- Dominant upland land use
- Stormwater runoff pretreatment and detention

Aesthetics/ recreation/ education/ cultural/ science
- Rare educational opportunity
- Wetland visibility
- Proximity to population
- Public ownership
- Public access
- Human influences/ wetland

- Human influences/ viewshed
- Spatial buffer
- Recreational activities

Commercial uses
- Commercial crop/ hydrologic impact

Groundwater interaction
- Soil properties
- Subwatershed landuse and runoff characteristics
- Wetland size and upland soils
- Wetland hydrologic regime
- Inlet/ outlet configuration
- Upland topographic relief

Wetland restoration potential
- Wetland restoration potential
- Number of landowners affected
- Subwatershed wetland density
- Wetland restoration size
- Proportion of wetland drained
- Potential buffer width
- Likelihood of restoration success

Wetland sensitivity to stormwater input and urban development
- Vegetation type

Additional stormwater treatment needs
- Maintenance of wetland water quality index

General Conclusions: The Minnesota method evaluates wetland sites based on 12 functions. A list of 72 questions are used to calculate the functions. Some of the questions would be difficult to answer in the field and it is noted that these can be evaluated using GIS. The formulas and decision trees are complicated for many of the functions, however, an electronic version of the method is available which automates the process. Function scores do not necessarily depict condition because measures of value and opportunity are included. No overall score is calculated for the site.

MONTANA WETLAND ASSESSMENT METHOD

Citation: Berglund, J. 1999. Montana wetland assessment method. Montana Department of Transportation and Morrison-Maierle, Inc., Helena, MT.

Scoring: The Montana Wetland Assessment Method evaluates 12 functions. Functions are scored 0.1 – 1.0 and rated as high, medium, or low based on a set of indicators that are also scored 0.1 to 1.0. Sites are then placed into Category I, II, III and IV based on criteria that are outlined in the methods. These categories are not equivalent to condition but rather their uniqueness or high value for certain functions.

List of functions and indicators:
Listed/ proposed threatened and endangered species habitat
Primary, secondary, or incidental habitat
Habitat for rare plants or animals
Primary, secondary, or incidental habitat
General wildlife habitat rating
Observations and sign
Structural diversity
Class cover distribution
Duration of surface water
Disturbance
Fish/aquatic habitat
Duration of surface water
Cover
Shading
Species present
Flood attenuation
Area subject to flooding
% Flooded that is forested, scrub/shrub
Outlet present
Short and long term surface water storage
Area subject to flooding or ponding
Duration of surface water
Frequency of flooding
Sediment/nutrient/ toxicant retention and removal
% cover of wetland vegetation
Evidence of flooding
Outlet present
Sediment/ shoreline stabilization
% cover by species with deep root masses
Production export/food chain support
Area of vegetated cover
Structural diversity
Outlet present
Duration of surface water
Groundwater discharge/ recharge
Check all indicators that apply, springs, vegetation growing during dormant season, toe of slope, seep, outlet no inlet, no confining layer, inlet no outlet

Uniqueness
Presence of rare communities
Disturbance
Recreation/ education potential
Known recreation or education location
Public vs. private ownership

General Conclusions: The Montana method was developed for use in a regulatory context to evaluate sites where proposed impacts may occur. This method is focused on identifying areas with high value or uniqueness and does not specifically evaluate condition, although it does group wetlands of like-condition into broad categories. The method is easy to use and the tables simplify the calculation of the function scores. Some of the field indicators are not rapid and may be difficult to accurately assess.

NEW HAMPSHIRE COASTAL METHOD

Citation: Cook, R.A., A.J. Lindley Stone, and A.P. Ammann. 1993. Method for the evaluation and inventory of vegetated tidal marshes in New Hampshire. The Audubon Society of New Hampshire, Concord, NH. 77pp.

Scoring: This method evaluates nine functions for tidal marshes, each of which is scored based on several indicators. Each indicator is given a value of 0.1, 0.5, or 1.0 and are all weighted equally. Indicators are then averaged to get a numerical score between 0.1 and 1.0 for each function. No overall score is calculated for each wetland, rather a series of graphs are produced for each function.

List of functions and indicators:
Ecological Integrity
Invasive species presence
Tidal restrictions
Type of tidal restriction
Ditching
Dominant land use in 500ft. buffer
Ratio of the number of occupied buildings to the to area of assessment unit
% of assessment area that has a natural buffer at least 500ft.
Square feet of impervious surface within 150ft. of assessment area
Shoreline anchoring
Type of marsh
Morphology
Storm Surge Protection
Size of assessment area
Type of marsh system
Wildlife, Finfish, and Shellfish Habitat
Size of assessment area
Score of Ecological Integrity
Type of tidal restriction
Diversity of habitat types
Presence of SAV
% of assessment area that has a natural buffer at least 500ft.
Proximity to freshwater wetlands
Water Quality Maintenance
Size of assessment area
Number of tidal restrictions
Type of tidal restriction
Recreational potential
Presence of shellfish beds
Waterfowl hunting
Opportunities for wildlife observation
Canoe and boat passage
Canoe and boat access
Public parking
Handicap accessibility
Visitor center, tails or boardwalks

Aesthetic Quality
Ecological integrity
Wildlife observation
Visible land use
General appearance
Noise level
Odors
Educational Potential
Wildlife observation
Visitor center, trails or boardwalks
Proximity to other habitats
Parking
Student safety
Handicap accessibility
Noteworthiness
Rare or endangered species
Other significant species present or listed as exemplary community
Historical or archaeological site
Located in urban setting
Used as long-term research site

General Conclusions: The Coastal Method assesses each tidal marsh evaluation unit based on nine functions. The estimated time to perform this method is greater than one day so this method would not be considered a rapid assessment method. The numerous indicators that are used in this method provide good ideas for rapid indicators especially for services and values. Additionally, this method provides a good example for how to adapt a nontidal method to tidal systems. The directions for scoring each function are easy to follow; however, the equations used to generate scores will be difficult to defend or validate. The functions are not intended to specifically evaluate condition at each site but rather assess how individual functions are performing. The final output is a score for each function and a collection of graphs; no overall score is produced for each site.

NEW HAMPSHIRE METHOD

Citation: Ammann, A.P., and A.L. Stone. 1991. Method for the comparative evaluation of nontidal wetlands in New Hampshire. NHDES-WRD-1991-3. New Hampshire Department of Environmental Services, Concord, NH.

Scoring: This method evaluates 14 functions, each of which is scored based on several indicators. Each indicator is given a value of 0.1, 0.5, or 1.0. To calculate the score for each function, all the indicators are averaged with each indicator receiving the same weight. No overall score is calculated for the wetland.

List of Functions and Indicators:
Ecological Integrity
% Area having poorly drained soils or open water
Zoning of wetland ** not clear
Water quality of water associated with wetland
Occupied buildings within 500 ft to area of wetland
Percent of wetland filled
% Of wetland with 500ft. buffer
Human activity in wetland
Human activity in upland
% Of plant community being altered include invasives
% Of wetland being drained
Number of road crossing per 500ft. of wetland
Wetland wildlife habitat
Ecological integrity score
Area of shallow open water
Water quality of water associated with wetland
Wetland diversity
Dominant wetland class
Interspersion of vegetation
Wetland juxtaposition
Number of islands
Wildlife access to other wetlands
Percent of wetland edge bordered by upland wildlife habitat
Finfish habitat
Land use in watershed above wetland
Water quality of the water associated with wetland
Barriers/ dams
Stream width
Shade
Character of stream channel
Abundance of cover
Spawning areas
Education potential
Ecological integrity score
Wetland wildlife habitat score
Proximity to school
Presence of nature preserve or wildlife management area

Proximity to other plant communities
Off-road parking
# of wetland classes assessable to site
Access to perennial stream
Access to pond
Safety
Public access
Visual/ aesthetic quality
Handicap accessibility
Visual/ aesthetic quality
wetland classes visible from primary viewing location
Dominant wetland class
Noise level
Odors
Extent of open water visible
General appearance
Landform contrast
Surrounding land use
% area dominated by flowing shrubs/ trees or bright in fall
Wetland wildlife habitat score
Water-based recreation in watercourse associated with the wetland
Fishing permitted
Hunting permitted
Wildlife observation
Water quality of watercourse associated with wetland
Canoe and boat passage
Off-road public parking
Access to water, launch site
Visual/ aesthetic quality score
Flood Control Potential
Area of wetland
Area of watershed above the outlet
Wetland control length
Ground water use potential
Existing wells
Potential water supply
Ground water quality of aquifer
Water quality of water associated with wetland
Sediment trapping
Slope of watershed above wetland
Sources of excess sediment
Opportunity for sediment trapping
Effective floodwater storage
Distance to perennial stream or lake
Dominant wetland class
Areas of impounded open water
Nutrient attenuation
Opportunity of sediment trapping
Potential sources of excess nutrients

Opportunity for nutrient attenuation
Potential for sediment trapping
Dominant wetland class
Wetland hydroperiod
Shoreline anchoring and dissipation of erosive forces
Wetland morphology
Width of wetland bordering watercourse
Vegetation density
Urban Quality of Life
Dominant land use within 0.5miles
Rate of development within 0.5miles
Area of shallow permanent open water
Wetland diversity
Dominant wetland class
Interspersion of vegetation and/or open water
Stream corridor vegetation
Proximity to schools
Off road parking
Safety
Access to stream or lake
Number of wetland classes visible
Dominant wetland class visible
Area open water visible
Area dominated by flowering shrubs/ trees
General appearance
Water quality of water associated with wetland
Opportunities for wildlife observation
Hazards
Historical site potential
Proximity to perennial water course
Visible stone or earthen foundation, berms, dams, standing structures
Existence of mill pond at site
Presence of historical buildings
Noteworthiness
Critical habitat for T&E species
Study site for research
National natural landmark
Local significance
Archaeological site
Connected to state or federally designated river

General Conclusions: The New Hampshire Method was a precursor to the Coastal Method described above and uses similar methods to evaluate functions based on a set of indicators. The estimated time to perform this method is greater than one day so this method would not be considered a rapid assessment method. However, we feel that some of the indicators used to calculate each function could be used as potential indicators in a rapid assessment method. This method does not evaluate condition at each site; rather how each individual function is performing. No overall score is produced for each site.

OHIO RAPID ASSESSMENT METHOD (ORAM)

Citation: Mack, J.J. 2001. Ohio Rapid Assessment Method for Wetlands v. 5.0: User's Manual and Forms. Ohio EPA Technical Report WET/2001-1. Ohio Environmental Protection Agency Division of Surface Water, 401/Wetland Ecology Unit, Columbus, OH. The document can be downloaded from http://www.epa.state.oh.us/dsw/401/.

Scoring: The Ohio Method evaluates the quality of wetlands using six metrics. Each metric is scored by evaluating several indicators. An overall score is calculated by summing the scores from all metrics. Some metrics are weighted more than others by having the potential to score more points. The score is then used to place wetlands into three categories that have different regulatory implications.

List of metrics and indicators:
Wetland area (size)
Upland buffers and surrounding land use
Average buffer width
Intensity of predominant surrounding land use
Hydrology
Sources of water
Connectivity
Maximum water depth
Duration of standing water/ saturation
Modifications to natural hydrologic regime
Habitat alteration and development
Substrate/ soil disturbance
Habitat development
Habitat alteration
Special wetland communities
Vegetation, interspersion, microtopography
Wetland plant communities
Horizontal community interspersion
Microtopography

General Conclusions: ORAM is used to evaluate the quality of wetlands for both regulatory and ambient condition assessment purposes. The method is easy to use because the questions are clearly written and the presence or absence of the indicators that the user is asked to evaluate can be assessed rapidly in the field. The method includes indicators of ecological condition and indicators of disturbance which provides a good characterization of the site. Because the method was developed for regulatory purposes, it includes some "value-added" metrics such as the presence of rare species that may not necessarily be metrics that indicate condition. Several of these value-added metrics may also score particular types of wetlands higher than others, which again may not be indicative of condition.

OREGON FRESHWATER WETLANDS METHOD

Citation: Roth, E., R. Olsen, P. Snow and R. Sumner. 1996. Oregon freshwater wetland assessment methodology. Oregon Division of State Lands, Salem, OR.

Scoring: This method evaluates nine functions for each site. Functions are scored by answering a set of questions after performing a characterization of the site. The characterization is primarily an office exercise to gather extensive information about the site and the surrounding landscape. Each function is then assigned a category of how it is performing using narrative criteria based on the answers to each question. No overall score is calculated.

List of functions and indicators:
Wildlife habitat
Number of Cowardin wetland classes present
Dominant wetland class
Wetland class and upland inclusion interspersion
Area of open water
Hydrological connectivity
Hydroperiod
Percent of edge that is upland wildlife habitat or the width of vegetated buffer
Fish habitat
Portion of stream associated with wetland that is shaded by vegetation
Physical character of the stream channel
Percent of stream that contains cover objects
Water quality of water bodies in upstream watershed
Surrounding land use
Species of fish present
Variability of water depth
Percent of lake containing cover items
Percent of the shoreline that is vegetated
Primary water source
Percent of wetland that is vegetated
Size
Located in the 100year floodplain
Water flow out of the wetland restricted
Percent of wetland that is forested or scrub-shrub
Land use downstream or down slope of wetland
Comprehensive plan land-use designation upstream
Sensitivity to impact
Hydrology upstream modified
Zoned land use within 500ft.
Dominant vegetation class
Enhancement potential
Assessment results for wildlife, fish, water quality and hydrology functions
Degree of tillage or compaction of soil
Water source
Open to the public
Visible hazards to the public

Potential for fish and wildlife habitat study
Physical access to other habitats
Public access to point within 250ft. of wetland
Access for people with limited mobility
Public boat launch or water access
Trails, viewing areas
Opportunity for fishing
Opportunity for hunting
Aesthetic quality
General appearance of wetland
Visual characteristic of the surrounding area
Odors present
Noises

General Conclusions: The Oregon method evaluates functions for use in local planning on the landscape level. Nine functions are assessed and assigned to broad categories of functional performance. Gathering the information in the characterization part of the method to answer these questions is time consuming. This method provides a comprehensive list of value-added indicators. Many of the questions are based on assessing wetland value or the opportunity for a site to perform a function rather than assessing condition. Additionally, some of the questions also score wetter and bigger wetlands higher. Functions are assigned to broad categories, which may tend to score most wetlands in the middle and few at the top and bottom; this may limit the ability of the method to differentiate sites.

PENN STATE STRESSOR CHECKLIST

Citation: Brooks, R.P., D.H. Wardrop, and J.A. Bishop. 2002. Watershed-Based Protection for Wetlands in Pennsylvania: Levels 1 & 2 - Synoptic Maps and Rapid Field Assessments, Final Report. Report No. 2002-1 of the Penn State Cooperative Wetlands Center, University Park, PA
16802. 64 pp.

Scoring: The current version of the Penn State method evaluates wetland condition by using a stressor checklist to modify a previously completed landscape level assessment which categorizes land use within a 1-km radius of the site. The checklist tabulates the number of stressors present at a site and accounts for the ameliorating effects of the surrounding buffer. A buffer score is calculated based on the width of the buffer and the vegetation type. A stressor score is calculated by adding the number of stressors that are found at the site; all stressors receive equal weighting. If the surrounding land use affects wetland condition by 'penetrating' the buffer (for example the presence of culverts that allow the effects of the surrounding land to impact the wetland despite the presence of the buffer) the value of the buffer is decreased in calculating the score. An overall score is then calculated using the formula below. Penn State is developing versions of the Stressor Checklist that do not require the completion of a landscape assessment to use the stressor checklist.

$$\text{CONDITION} = \text{CF} \left[\%FLC \left(\frac{10 - \#STRESSORS}{10} \right) + \left[BUFFERSCORE - BUFFERHITS \right] \right]$$

Where:
CF = calibration factor (100/114) needed to standardize the scores to a scale of 0 to 100
%FLC = percent forested land cover, i.e., the results of the landscape assessment
#STRESSORS = the number of the ten categories of stressors present on site (Table 1)
BUFFERSCORE = a value from 0 to 14 assigned to the buffer given its type and width
BUFFERHITS = number of the eight stressor indicators present that were likely to "puncture" the buffer; can not exceed the value of BUFFERSCORE

List of indicators:
Buffer
Width
Vegetation type
Stressors
Hydrologic modification
Ditch
Tile drain
Dike
Weir/dam
Stormwater inputs
Point source (non stormwater)
Filling, grading, dredging
Road/ railroad
Dead/dying trees

Sedimentation
Sediment deposits/ plumes
Eroding banks/ slopes
Active/ recently active adjacent construction, plowing, heavy grazing, or forest harvesting
Siltiness on ground or vegetation
Urban/ road stormwater input/ culvert
Dominant presence of sediment tolerant plants
Dissolved Oxygen
Excessive density of aquatic plants or algal mats in water column
Excessive deposition or dumping of organic waste
Direct discharges of organic wastewater or material
Contaminant Toxicity
Severe vegetation stress
Obvious spills, discharges, plumes, odors
Wildlife impacts
Adjacent industrial sits, proximity of railroad
Vegetation Alteration
Mowing
Grazing
Tree cutting
Brush cutting
Removal of woody debris
Aquatic weed control
Excessive herbivory
Dominant presence of exotic or aggressive plant species
Evidence of chemical defoliation
Eutrophication
Direct discharges from agriculture feedlots, manure pits
Direct discharges from septic or sewage treatment systems
Heavy or moderately heavy formation of algal mats
Dominant presence of nutrient tolerant species
Acidification
Acid mine drainage discharges
Adjacent mined lands/ spoil piles
Excessively clear water
Absence of expected biota
Turbidity
High concentration of suspended solids in water column
Moderate concentration of suspended solids in water column
Thermal alteration
Significant increase water temperature
Moderate increase in water temperature
Salinity
Obvious increase in concentration of dissolved salts

General Conclusions: The Penn State method combines a landscape level assessment with a rapid field assessment. The field part of the method assesses the condition of wetlands by making the assumption that a site is in good condition unless there is evidence of disturbance present. The field portion of the method is easy to use consisting primarily of a checklist of stressors and is very rapid. Some of the stressors are specific to Pennsylvania and may require some adaptation for use in other areas where different stressors are present. The landscape analysis portion of the method excludes it from being a rapid assessment, however Penn State is developing versions of the stressor checklist that do not require the landscape analysis to score a wetland.

VIRGINIA INSTITUTE OF MARIN SCIENCE METHOD

Citation: Bradshaw, J. 1991. A technique for the functional assessment of nontidal wetlands in the coastal plain of Virginia. Special Report No. 315 in Applied Marine Science and Ocean Engineering. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA.

Scoring: The VIMS method assesses nontidal wetlands on the coastal plain of Virginia for their opportunity and effectiveness to perform seven functions. Each function is evaluated by a set of factors that can be determined by desktop analysis of maps and existing data. Each factor is given a rating of high, medium or low. Narrative guidance is then provided to assign a rating of high, medium, or low for the function based on the factor ratings. No overall score is calculated for the site**.**

List of functions and indicators:
Flood storage and storm flow modification
Proportion of 2-year, 24-hour storm volume stored in wetland
Watershed slope
Retention/ detention of storm water within wetland
Nutrient retention and transformation
Potential source of excess nutrients
Proportion of land with nutrient runoff that is not treated prior to entering wetland
Average runoff in 2-year 24-hour storm
Average slope of watershed (same as in function 1)
Proportion of 2-year 24-hour storm volume stored in wetland (same as in function 1)
Retention/ detention ranking (same as in Function 1)
Sediment and toxicant trapping
Potential sources of sediments
Potential sources of nutrients
Proportion of land with sediment source that is not treated prior to entering wetland
Proportion of land with toxicant source that is not treated prior to entering wetland
Average runoff (same as above)
Watershed slope (same as above)
Proportion of 2-year 24-hour storm volume stored in wetland (same as above)
Retention/ detention ranking (same as above)
Sediment stabilization
Erodibility of soils within the wetland
Erosive conditions present (includes some stressors)
Flooding
Wetland roughness
Wildlife Habitat (this function is based on disturbance that would degrade the habitat and that all types of wetlands provide habitat)
Surrounding land use
Wildlife access to other wetlands over land
Disturbance within wetland
Potential sources of toxic inputs to wetlands
Regional biodiversity (rarity)
Special habitat features (not rated or used in the functional score)

Aquatic Habitat (most factors not dependent on condition)
Permanent water
Accessibility of wetland to fish
Water quality
Channel as habitat
Cover
Public use of the wetland
Public access to wetland
Other factors (These factors are not used to evaluate specific functions but are independent variables to analyze and describe data)
Disturbance in surrounding landscape
Disturbance within wetland (generic qualitative rating low, mod, high)
Landscape position
Stream order

General Conclusions: The VIMS method is primarily a desktop evaluation of the potential for a wetland to perform seven functions. Each function is assessed by answering several questions that require rather detailed information. There is no quantitative formula for translating the answers from the questions into an evaluation of function only narrative guidance. This method evaluates the opportunity the wetland has to perform a function based on landscape attributes and does not necessarily assess the actual condition of the wetland. Additionally, there is no overall rating of the site. Because of the complexity of information needed to complete this method we would not consider this a rapid assessment.

WASHINGTON STATE WETLANDS RATING SYSTEM (Eastern)

Citation: Washington State Department of Ecology. Draft revision. Washington State Wetlands Rating System: Eastern Washington. Second Edition. Publication #02-06-019. Washington State Department of Ecology, Olympia, WA. (http://www.ecy.wa.gov/biblio/0206019a.html).

Scoring: The Eastern Washington Method evaluates wetlands based on two criteria: the functions the wetland provides and special characteristics of the wetland. The categorization based on function uses a series of questions with categorical answers that are specific to the hydrogeomorphic type of wetland that is being evaluated. A final score is produced based on a water quality improvement, hydrologic, and habitat functions that determines if the sites is Category I, II, III, or IV. The categorization based on special characteristics is a series of yes/no questions that determines if the site is Category I, II, or III. Each series of questions places the wetland into a regulatory category.

List of indicators in the Eastern Washington Version:

- Categorization based on functions provided
  - Water Quality
    - Opportunity to improve water quality
    - Surface water flow
    - Soil properties
    - Emergent/ persistent vegetation
    - Seasonal ponding/ inundation
    - Surface depressions trapping water
    - Vegetation width and type along lakeshore
    - Slope
  - Hydrologic
    - Opportunity to reduce flooding and erosion
    - Surface water flow
    - Water storage
    - Vegetation type
    - Vegetation width and type along lakeside
  - Habitat
    - Vegetation structure
    - Presence of aquatic bed
    - Vegetation species richness
    - Interspersion
    - Special habitat features
    - Buffer width and land use
    - Inclusion in wetland corridor
    - Proximity to priority habitats
    - Surrounding land use
    - Presence of carp
- Categorization based on special characteristics
  - Vernal pools

Alkali wetlands
Natural heritage wetlands
Bogs
Forested wetlands

General Conclusions: The Eastern Washington Method was designed with the same purpose as the Western Washington Method to evaluate sites based on their sensitivity to disturbance, significance, rarity, irreplaceability, and the functions they provide. However, the two methods are very different. The Eastern Washington Method requires the user to identify the hydrogeomorphic type of wetland being evaluated. This avoids rating certain functions higher for wetlands based on their type but rather evaluates wetlands only in reference to those of the same hydrogeomorphic type. Secondly, the Eastern Washington Method doubles the function score for wetlands that have the opportunity to perform that function based on their landscape position, inputs to the wetland etc. Because of this measure, this method may not evaluate condition; however, the method could be easily modified to eliminate the opportunity factor. The questions are clearly stated and generally easy to assess in the field. Additionally, the method is concise and rapid to perform and an overall score is produced for the characterization of functions.

WASHINGTON STATE WETLANDS RATING SYSTEM (Western)

Citation: Washington State Department of Ecology. 1993. Washington State Wetlands Rating System: Western Washington. Second Edition. Publication #93-74. Washington State Department of Ecology, Olympia, WA. (http://www.ecy.wa.gov/biblio/93074.html).

Scoring: The Western Washington Method evaluates wetlands based on a series of questions. The questions are a combination of yes/ no and categorical answers which place a site into four regulatory categories. If the site is identified as a category I or IV site then no score is produced, rather the questions lead you to the appropriate category. If the site is a Category II or III site, scores are calculated to determine which is the appropriate category.

List of indicators in the Western Washington Version:

- High Quality Natural Wetland
  - Human caused disturbances
    - Impervious surface in the watershed
    - Hydrological modification
    - Grading, filling, or logging
    - Grazing
  - Non-native plants
  - Water quality degradation
- Irreplaceable Ecological Functions
  - Bogs and Fens
    - % cover of sphagnum
    - % cover of invasive species
    - Rare species
    - Vegetation classes
  - Mature forested wetland
    - Age of trees
    - Type of trees (deciduous, evergreen)
    - Structural diversity
    - Invasive species
  - Estuarine wetlands
    - Listed as a protected or special area
    - Size
    - Human disturbance
    - Hydrology
    - Buffer
    - Community diversity
  - Eelgrass and Kelp Beds
    - Presence of eelgrass
    - Presence of kelp beds
- Category IV wetlands
  - Size
  - Hydrology
  - Species composition
- Significant habitat value

Wetland area
Wetland type
Plant species diversity
Structural diversity
Interspersion
Habitat features
Connection to streams
Buffer
Connection to other habitat areas

General Conclusions: The Washington Method was designed to evaluate sites based on their sensitivity to disturbance, rarity, irreplaceability, and the functions they provide. This method evaluates condition but also includes some value measurements that could potentially score a site higher based on a variable that is not related to condition (e.g., the type of wetland). The questions are clearly stated and generally easy to assess in the field. Additionally, the method is concise and rapid to perform. Several versions of the Washington method were created to account for the variability in wetland types across the state. Determining the regulatory category (I-IV) from the questions is straightforward; however, an actual numerical score is only calculated for category II and III wetlands.

WISCONSIN RAPID ASSESSMENT METHOD

Citation: Wisconsin Department of Natural Resources. 1992. Rapid assessment methodology for evaluating wetland functional values. Wisconsin Department of Natural Resources, Madison, WI. 9pp**.**

Scoring: The Wisconsin Method evaluates eight functions. A list of yes/ no questions for each function determines if each indicator is present on site. After completion of these questions and a site description, best professional judgment is used to assign the site to a category of low, medium, high, exceptional or N/A for each function. A section is also provided to identify special features or "red flags" for a site. No overall score is calculated for the site.

List of indicators:
Site Description
Hydrologic Setting
Vegetation
Soils
Surrounding land uses
Special Features
Functions
Floral diversity
Diversity of native plants
Rare plant community
Wildlife and Fishery Habitat
Species observed
Vegetation diversity and interspersion
Ratio of open water to cover
Surrounding upland habitat value
Wildlife corridor
Part of a large tract of habitat
Distance to other wetlands
Adjaceny to permanent water body
Food base
In priority watershed
Unique habitat
Flood and stormwater storage/ attenuation
Presence of steep slopes, large impervious area, moderate slopes with row cropping or overgrazing
Reduction of run-off velocity
Flashy water level response to storms
Drainage impediment
Wetland storage capacity
Flood water storage
Water Quality Protection
Stormwater inputs
Nutrient and sediment sources
Flood/ stormwater attenuation

Trapping of suspended sediments
Water detention
Indicators of excess nutrients
Shoreline Protection
Wetland type
Wave action
Submerged and emergent vegetation
Stream bank erosion
Stream bank vegetation
Groundwater Recharge and Discharge
Indicators of groundwater springs
Contribution to base flow
Located on or near groundwater divide
Aesthetics/ Recreation/ Education and Science
Visability of wetland
Location to population centers
Ownership
Access
Presence of human influences
Viewshed
Diversity of wetland
Diversity of landscape
Encouragement of exploration
Recreational activities
Use for education or research

General Conclusions: The Wisconsin method evaluates eight functions for whether a "functional value is present and to assess the significance of the wetland to perform those functions." Although some of the indicators address condition, the overall method is an evaluation of the value and opportunity of the wetland for performing various functions. The questions are clear and easily guide the user through the method while looking at the site; however, there is not a quantitative method for using the answers to the questions to score the functions. The final assessment is a list of scores (high, medium, low) for eight functions and there is no overall score for the site.