Defining Wetland Condition Assessment Processes

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FOREWORD

The following document entitled *Defining Wetland Condition Assessment Processes* provides a framework to begin assessing the condition of Minnesota's depressional wetlands. The pathway leading towards wetland condition assessments was initiated over a decade ago with the publication of the U.S. Environmental Protection Agency (US EPA) document *National Guidance: Water Quality Standards for Wetlands*. In response to this guidance document, Minnesota codified (Minn. R. Ch. 7050) the 'basic requirements for applying State water quality standards to wetlands.' Hence, the basis for assessing the biological community of wetlands for impairment was established with the designation of beneficial uses and the adoption of narrative biological criteria for wetlands.

Since this time the Minnesota Pollution Control Agency has been working to establish an ambient wetland monitoring and assessment program. Through a series of projects, funded primarily by US EPA Wetland Program Development grants (Section 104[b]3 CWA), sampling protocols have been developed, regional reference conditions have been described, indicators have been selected and validated, and the statistical properties of those indicators have been characterized. Applying this knowledge and experience to assess wetland condition and develop a process for integrating this assessment information into surface water program reporting and decision making represents the next logical step in this progression. Moreover, the process outlined in this report parallels the determination of biological impairment in streams which has been used to satisfy 305(b) reporting and 303(d) listing requirements in Minnesota since 1998.

It is the responsibility of the Pollution Control Agency to monitor Minnesota's water bodies, to assess water quality, and to report the results to the public. This task extends to wetlands which prior to this document did not have a formalized assessment procedure and thus were not included in the reporting process. The Pollution Control Agency recognizes the importance of this vital resource and understands that in order to achieve significant improvements in the quality of the nation's surface waters, wetlands need to be integrated into a surface water monitoring program. The main objective of this project is to facilitate this process.

Sincerely,

Michael J. Sandusky
Division Director
Environmental Analysis and Outcomes Division

EXECUTIVE SUMMARY

The dramatic decrease in the quantity of wetlands in this country since pre-settlement has been well documented (Dahl 1990). Much less is known about trends in the quality of wetlands over this same period or, for that matter, the condition of wetlands that remain today. Minnesota still has extensive wetland resources, even though a large percentage of its historic wetlands has been lost (Anderson and Craig 1984). Given the significance of these remaining resources, the Minnesota Pollution Control Agency (MPCA) has developed a framework for assessing the condition of depressional wetlands throughout the state. It is anticipated that these procedures will ultimately become incorporated into a statewide monitoring and assessment program that will provide continual estimations of the status and trends of wetland quantity and quality in Minnesota.

We propose to assess the condition of depressional wetlands based on the determination of their Aquatic Life Use Support (ALUS) status, using both plant and macroinvertebrate indices of biological integrity (IBI). This approach is patterned after the process which has been used in Minnesota since 2002 to determine the ALUS status of streams, using fish and macroinvertebrate IBIs. Examining the biology of aquatic ecosystems allows detection of alterations to any of the five water resource features: habitat structure, hydrologic regime, water quality, energy source, and biotic interactions (Karr 1991). Regional reference conditions provide the measure for determining whether a wetland is supporting its Aquatic Life Use. This is accomplished independently for plants and macroinvertebrates by comparing a wetland IBI score to the range of scores exhibited by the designated reference sites; the lowest score among the reference sites represents the impairment threshold. Replicate sampling within a wetland provides an estimation of the level of precision for each IBI which can then be incorporated into the impairment decision process by creating an area of uncertainty around the impairment threshold. Wetlands with scores that fall within this area of uncertainty, expressed as 90% confidence intervals, are designated to receive further scrutiny by a professional judgment team before a final assessment is made.

In addition to the technical assessment procedure itself, a number of supporting processes needed to be developed for the general assessment framework. For instance, guidelines for delineating depressional wetland assessment units were created. A process for acquiring unique identifiers for wetland assessment units was developed with the assistance of the Minnesota Department of Natural Resources (MNDNR). Criteria for evaluating the suitability of data contributed by other monitoring programs for the purpose of assessing wetlands were adopted. And finally, the process of soliciting public input on wetland assessments was gleaned from the current process utilized for other water bodies.

INTRODUCTION

Prior to European settlement, it is estimated that Minnesota contained approximately 18.6 million acres of wetlands, roughly 1/3 of the state's total area (Anderson and Craig 1984). Since European settlement it is estimated that approximately 50% of Minnesota's wetlands have been converted to upland (MNDNR 2004). The condition of these remaining wetland resources is largely unknown, but it is becoming apparent that in some regions of the state (e.g., western and southern agricultural regions) most remaining wetlands are impacted to some extent by anthropogenic factors. For instance, in 2002 MPCA biologists sampled wetlands in the southern agricultural part of the state in an attempt to develop indicators of wetland condition. During the site selection process it was very difficult to locate wetlands that were not currently or had not been historically affected by human disturbance, sites that are required in order to characterize regional reference conditions. In other words, the vast majority of remaining wetlands in this region exist as isolated natural 'islands' embedded in a 'sea' of agriculture. To begin to quantify the current status of these remaining wetlands, this report presents a framework for determining whether wetlands are meeting their Aquatic Life designated use.

Inherent in this assessment process is the acknowledgement that wetlands are adversely affected by pollutants (e.g., nutrients, sediment, chloride) as well as the various other impacts that can be coarsely classified as pollution (e.g., hydrologic fluctuations, invasive species, habitat alteration). Following the period when wetlands in this nation were primarily thought of as wasteland (until mid-1970s), wetlands began to be recognized for the valuable functions they provide, prompting their protection through the implementation of laws, regulations, and management plans. Yet, when wetlands are expected to provide functions beyond the range of natural conditions, provision of these functions may be detrimental to the ecological integrity of the wetland. For instance, wetlands have often been referred to as the 'kidneys of the landscape' because of their ability to remove waterborne pollutants (e.g., N, P, sediments), thereby reducing the amount being received by downstream water bodies (Johnston 1991). However, when excessive amounts of a pollutant enter a wetland as a result of human activities, the ecological health of the wetland may begin to deteriorate and certain wetland functions such as wildlife habitat, recreation, and aesthetics may be affected (Johnston 1991). In such cases, the wetland is providing a beneficial function (improved downstream water quality) at the expense of its own degradation. Contributing to this problem is the fact that researchers have yet to resolve how much pollutants can be removed by wetlands without compromising biological integrity (Zedler 2003).

It is becoming increasingly apparent that wetlands are affected by a multitude of anthropogenic stressors, including pollutants such as nutrients, toxic chemicals, and sediments. Several researchers have documented the establishment and proliferation of invasive plant species (e.g., *Phalaris arundinacea* L., *Typha* spp.) resulting from the increase in nutrients entering a wetland (Kadlec and Bevis 1990, Richardson et al. 1999, Gustafson and Wang 2002). Wilcox (1986) noted the invasion of *T. angustifolia* L. in areas of a wetland contaminated by the intrusion of road salt. Elevated levels of selenium

at Kesterson Reservoir (Kesterson National Wildlife Refuge) was considered the most likely cause of the high incidences of embryonic and adult mortality as well as embryonic deformities in wetland-associated birds (Ohlendorf et al.1986, 1988). Increased sediment loads in wetlands can alter litter decomposition dynamics (Vargo et al. 1998), reduce germination rates of aquatic plants to the extent where fewer species are able to be recruited from the seed bank (Jurik et al. 1994, Wang et al. 1994), and decrease the abundance and diversity of aquatic insects (Martin and Neely 2001). In all of the above examples, wetlands are providing a function, protecting the water quality of downstream resources, and thus from this perspective they are perceived as 'valuable'. However, independent assessments that focus on wetland condition would indicate that the wetlands are being degraded in the process of providing this function. While characterization of the interaction between certain wetland functions and condition will be required for the proper management, protection, and restoration of wetlands, only a shift from a focus on wetland function toward a broader recognition of wetland stressors will provide a better understanding of the status and trends of wetlands in this country.

Assessing wetlands for the Aquatic Life Use is an approach that examines the condition of a wetland rather than the functions it is performing. As such, Aquatic Life Use assessments provide a direct measure of how well we, as a nation, are meeting the objective of the Clean Water Act (CWA) to 'maintain and restore the chemical, physical, and biological integrity of our Nation's waters.' This premise is based on the fact that biological communities of aquatic systems integrate, both spatially and temporally, the physical, chemical, and radiological conditions of their environment, and can thus serve as indicators of the overall integrity of a water body. When the Aquatic Life Use is not supported by a water body, companion data (e.g., water and sediment chemistry) and the autecologies of resident flora and fauna can be investigated as part of the stressor identification process (USEPA 2000) in order to pinpoint the pollutant for which a Total Maximum Daily Load (TMDL) will be developed as required by the Consolidated Assessment and Listing Methodology (CALM). Failure to identify a specific pollutant will likely result in the wetland impairment being characterized as caused by pollution; which will require the implementation of alternative regulatory programs (e.g., CWA Sec. 319) for remediation.

Regardless of whether impairment is caused by a pollutant or by pollution, the fact remains that wetlands are a valuable resource that should be protected from such disturbances. The remediation of wetlands determined to be impaired will likely require the utilization of many different strategies, one of which may be the development of a TMDL plan. The Aquatic Life Use assessments provide a method for identifying sites in need of such remediation. However, identifying the appropriate remediation strategy is not part of the assessment process and thus is not discussed in this report. Rather, this step will likely be accomplished in the stressor identification process (USEPA 2000) for wetlands that have been identified as impaired or non-supporting of the Aquatic Life Use designation.

SECTION I. Historical Background

US EPA published two guidance documents for States and Tribes to consider during triennial rule revisions of water quality standards; *Water Quality Standards for Wetlands* (USEPA 1990a) and *Biological Criteria, National Program Guidance for Surface Waters* (USEPA 1990b). Both of these guidance documents were intended to initiate significant wetland program development efforts with intended outcomes of more fully integrating wetlands and aquatic life criteria into various programmatic elements of the CWA including water quality permitting, compliance, and monitoring and assessment. Following these guidance documents the MPCA adopted wetland water quality standards and numeric aquatic life standards and began developing biological assessment criteria for streams and wetlands based on the multimetric index of biological integrity (IBI) approach first published by Karr (1981).

In 2002 the MPCA adopted more concise narrative water quality impairment language into State Water Quality Standards based on biological measures (see Appendix A). This standard explicitly includes wetlands in the definition of "water bodies". The basis of biological impairment is further identified by measures of the resident fish community, resident aquatic invertebrate community, resident aquatic plant community, or measures of habitat quality.

Beginning in 1994 Minnesota assessed stream condition using a fish-based IBI and these condition assessments were included in Minnesota's 305(b) report on the status and trends of the state's waters. In 1998 the MPCA listed a few stream reaches, based on biological data, on the 1998 303(d) list. Following this listing cycle a series of significant refinements were made to the listing criteria and process. These new criteria and processes have focused on lakes and streams and have become part of the agency's CALM process. Use of the newer assessment process began in 2002 and included the listing of biologically impaired stream reaches on the 303(d) list using fish-based IBIs. In the most recent 2004 CALM cycle, the MPCA continued to assess stream reaches based on fish data and also began using stream invertebrate data based on the IBI approach for stream assessments.

SECTION II. Monitoring the Status and Trends of Wetlands in Minnesota

The MPCA is currently focused on the monitoring and assessment of only one wetland type, depressional wetlands, with the anticipation of expanding to other hydrogeomorphic (HGM; Brinson 1993) wetland types once assessment tools are developed on a statewide basis for depressional wetlands. In addition to a wetland classification system, ecoregions are currently being utilized as a geographic framework for deriving regional expectations of reference (= least-impaired) conditions. Once reference conditions are characterized for a particular class of wetland (e.g., depressional wetlands in the North Central Hardwood Forest ecoregion), the magnitude of the deviation from these conditions is used to determine impairment. Currently, the MPCA is proposing to assess

the Aquatic Life use designation of depressional wetlands using plant and macroinvertebrate IBIs which is the main subject of this report.

To meet the objective of statewide coverage of depressional wetlands, the MPCA is collecting plant and macroinvertebrate data using standardized protocols on an annual basis, expanding to new ecoregions (Level III; Omernik 1987) each year. Previous projects in Minnesota (Gernes and Helgen 1999, 2002) focused on the development and validation of IBIs for depressional wetlands located in the North Central Hardwood Forest (NCHF) ecoregion. In 2002, wetlands were sampled in both the Northern Glaciated Plains (NGP) and Western Cornbelt Plains (WCBP) and IBIs are currently being developed to assess wetlands in these ecoregions (Federal Assistance #CD-975768-01). In 2004, wetlands in the Northern Lakes and Forests (NLF) ecoregion were sampled and IBIs are anticipated to be completed in the next year or two. The only remaining ecoregion with significant depressional wetlands is the Red River Valley (RRV), which is expected to be sampled in either 2005 or 2006. The sampling approach for obtaining this statewide data set has been, and will continue to be, based on the targeted selection of study sites. This approach was necessary as this phase of the overall monitoring strategy is solely for the purpose of developing assessment tools. In order to accomplish this task, a sample of sites that span the continuum of wetland condition, from unimpaired to severely degraded, is required. Once the assessment tools have been developed, probabilistic survey designs can be employed which will be able to yield estimates of the current status of depressional wetlands on a watershed, ecoregion, or statewide basis. These results can then become a routine contribution to 305(b) reports. The MPCA explored the utility of a probabilistic survey design on a watershed basis in 2003 (Federal Assistance #CD-975768-01), and discovered that this was a feasible option for assessing the status of wetlands that could be vastly improved upon as updated digital wetland coverages (e.g., NWI) become available.

Given the vastness of wetland resources in Minnesota, assessing these resources exclusively with intensive Level III field assessments such as the IBI is not a feasible approach. Therefore, efforts are currently underway to develop landscape level indicators (Level I) and rapid assessment protocols (Level II) to supplement the IBI assessment of wetlands. All three levels of assessment will be integrated into an overall probabilistic survey design for monitoring both the quantity and quality of wetlands on a statewide basis and thus will satisfy 305(b) reporting requirements. However, only data resulting from Level III assessments will be specific enough to determine individual site impairments for the 303(d) list. The design specifications of this integrated assessment strategy will not be further discussed in this report as this ongoing effort represents the objective of another currently funded EPA Wetland Program Development Grant, the development of a Comprehensive Wetland Assessment, Monitoring and Mapping Strategy (CWAMMS) for Minnesota (Federal Assistance #CD-965084-01).

Currently, monitoring of trends in wetland condition by the MPCA has been limited to repeated sampling at a subset of study sites. By including both unimpaired (natural) and impaired (agricultural and urban) wetlands in this design, it is possible to begin to characterize the natural temporal variability of wetland plant and macroinvertebrate

assemblages and compare this variability to that of impacted wetlands. Understanding this variability helps to refine the assessment process by incorporating this variability as bounds around an impairment threshold, represented by 90% confidence limits (see SECTION III: *Impairment Threshold Determination/Reference Criteria*). This approach also allows broad generalization about how wetland conditions are changing in response to dominant landscape setting: natural, agricultural, urban. However, this design does not allow the detection of trends in wetland condition on any geographic scale (e.g., watershed, ecoregion, state, etc.). Therefore, the MPCA plans to utilize a more structured approach to monitoring trends in wetland condition. It is anticipated that this approach will be defined in the statewide CWAMMS, and will likely involve both repeated sampling at a subset of the study sites as well as probabilistic sampling during each time interval, so that extrapolations to the population (e.g., all the target wetlands in a pre-defined geographic area) will be possible.

SECTION III. Technical Guidance for Determining Aquatic Life Use Support (ALUS) in Depressional Wetlands

This section describes the technical aspects of the assessment process for determining whether Minnesota depressional wetlands are meeting their Aquatic Life use using indices of biological integrity. The assessment process involves several steps, beginning with data collection and culminating with the final assessment (Figure 1). A thorough discussion of each of these steps is presented in this section, with the exception of the data collection and index development phases which have been extensively documented in earlier reports and publications (e.g., Gernes and Helgen 1999, 2002, USEPA 2002). Some of the components necessary for building a framework for the assessment process (e.g., defining assessment units, assigning unique identifiers, etc.) had not been accomplished in Minnesota prior to this report, and thus are included here. In 2004, language regarding the determination of biological impairment in wetlands was included in the guidance manual (MPCA 2004) and was based on an earlier version of the procedures outlined in this section of the report. An abbreviated version of this section will also be included as part of the *2006 Guidance Manual for Assessing the Quality of Minnesota's Surface Waters for the Determination of Impairment*, a document that will be made publicly available as a companion to the 2006 305(b) report and 303(d) list.

The process outlined in the following sections represents the development of biological criteria in the NCHF ecoregion, an area of the state where the MPCA had obtained the most extensive data set for assessing wetland condition. A similar process will be repeated as data are collected from other regions of the state and as other wetland types begin to be assessed.

Wetland ALUS Determination

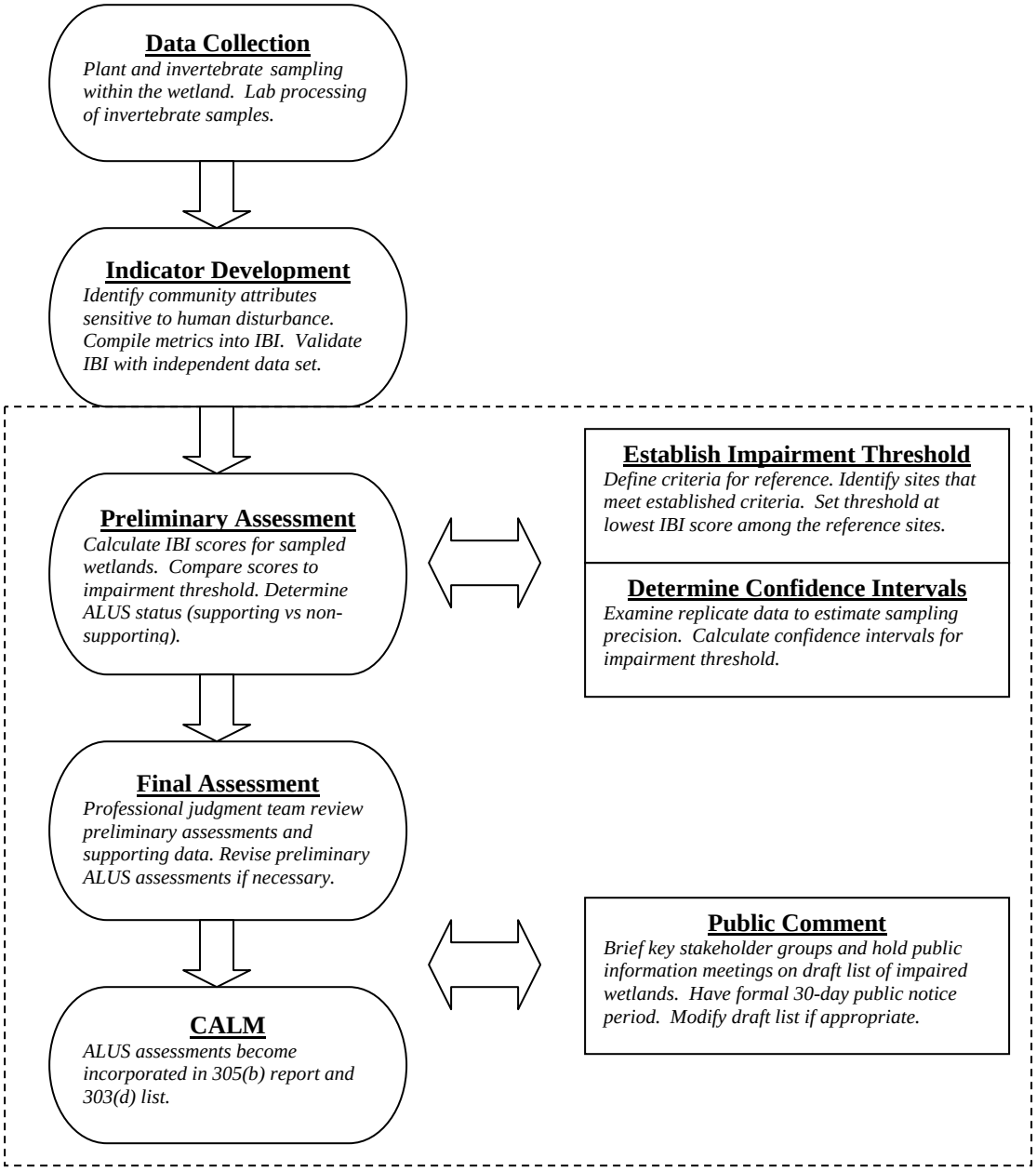

Figure 1. Diagrammatic overview of the process for assessing the Aquatic Life designated use of depressional wetlands in Minnesota. Dashed box indicates the steps in the process addressed in this report.

Depressional Wetland Assessment Units

For management and remediation purposes the extent of area that is assessed by the indicator(s) needs to be clearly demarcated using consistent criteria. These assessment units will then act as the entities for which management decisions will be based. Wetland basins were chosen as the assessment unit, as opposed to individual wetland types (e.g., wet meadow, emergent vegetation, etc.) of which a single basin may contain one to several. For depressional wetlands, the MPCA used heads-up digitizing with digital ortho quads (DOQs) in conjunction with digital National Wetland Inventory (NWI) quads to delineate assessment unit boundaries of study sites in ArcMap™ 8.3 (ESRI® 2002). Hydrologic connectedness was the major criterion applied in the decision making process for delineating assessment unit boundaries. For example, a large number of wetlands have road beds that bisect their historic basin boundary. In such cases, the historic basin boundaries would represent the assessment unit if surface water connections (e.g., culverts) were present and obviously functioning. If no such hydrologic connections were present then two separate assessment units would be delineated. A similar situation arises with adjacent wetland basins that are separated by saturated soils or temporarily flooded wetland types. In these situations best professional judgment is used, taking into consideration the periodicity of surface water connections, to determine whether wetlands adjacent to the area sampled should be included as part of the assessment unit. For instance, using Cowardin et al. (1979) as guidance, adjacent wetland basins with an F or H water regime modifier (semipermanently or permanently flooded) connected by a wetland area with an A or B water regime modifier (temporarily flooded or saturated) would be considered two separate assessment units. However, if the two basins were connected by a wetland area with a C or G water regime modifier (seasonally flooded or intermittently exposed), they would be considered part of a single assessment unit. Data such as the NWI would be augmented by field observations and best professional judgment (BPJ) before any assessment unit delineations are finalized in order to insure that the NWI accurately reflects the current conditions at a site.

Once a digital representation of the assessment units has been created in a geographic information system (GIS), a unique identifier needs to be assigned to individual unit wetlands. The Minnesota Department of Natural Resources (MNDNR) developed and currently maintains a statewide identification system for lakes and certain wetlands (Public Waters Inventory). This system seemed to be appropriate for identifying MPCA wetland assessment units as well and thus an agreement was established with the MNDNR Lake Hydrology Program to assign assessment unit identifiers (AUIDs) on an annual basis (see Appendix B). The completed GIS coverage of assessment units then becomes indexed to the National Hydrography Dataset (NHD) as required by the 305(b) report and 303(d) list.

An additional consideration in the determination of potential assessment units is whether a water body should be assessed as a lake or a depressional wetland. The MPCA has protocols for assessing both types of water bodies and in shallow open water systems with well-developed emergent fringes deciding which protocol is appropriate can be

problematic. A document was jointly produced by wetland and lake researchers to provide guidance for making such determinations (Appendix C). Another consideration when deciding if a wetland should be assessed is whether the wetland is man-made (e.g., wastewater treatment wetlands, stormwater retention ponds, farm ponds) or if it is an altered natural wetland for which mitigation has occurred. Wetlands in either of these two categories will not be assessed by the MPCA, though see Appendix D for further clarification of the criteria for making such decisions.

Index of Biological Integrity

A major shift in understanding the protection of water resources has been the acknowledgement that water quality is degraded by more than pollutants. Human activities can degrade water resources through alterations in habitat structure, hydrologic regime, water quality, energy source, and biotic interactions (Karr 1991). An indicator that integrates all of these factors is the biological response to these alterations ('stressors'). The index of biological integrity (IBI) was developed as a tool to directly measure biological response and typically includes 8-10 attributes of the community that are sensitive to human disturbance. The IBI was originally developed for wadeable streams using fish assemblages (Karr 1981). Since that time, IBIs have been created for a variety of water resources using additional biological communities such as plants, macroinvertebrates, zooplankton, amphibians, and birds. Through a series of studies the MPCA has developed two separate IBIs, one based on plants and one based on macroinvertebrates, for assessing the quality of depressional wetlands in Minnesota. Specifically, wetlands are assessed to determine whether or not they are supporting the Aquatic Life beneficial use (Minn. R. Ch. 7050.0222, subp. 6), commonly referred to as Aquatic Life Use Support (ALUS). Individual wetland IBI scores are compared to regional reference (= least-impaired) wetland IBI scores and the magnitude of the deviation from reference conditions determines whether a site is supporting the Aquatic Life designated use. Details of this process are outlined in the following sections.

Wetland IBI scores are generated using a continuous scoring method which is based on dividing each metric value by the range of the data set and normalizing to 10. Since both plant and macroinvertebrate IBIs are comprised of 10 metrics, each index ranges 0-100. Before IBI scores can be calculated in this manner, data must be collected from an adequate number of sites (30-40 +) representing the range of human disturbance across multiple years for the area of interest (e.g., ecoregion) in order to establish the scoring set (max, min, 95^{th} & 5^{th} percentile metric values of the entire data set) from which scores will be derived (Figure 2).

Metrics that Decrease with Increasing Disturbance:

$$\text{Score} = \left(\frac{\text{metric value - minimum value}}{\text{95th percentile value- minimum value}} \right) \times 10$$

Metrics that Increase with Increasing Disturbance:

$$\text{Score} = 10 - \left(\left(\frac{\text{metric value - 5th percentile value}}{\text{maximum value- 5th percentile value}} \right) \times 10 \right)$$

Figure 2. Formulas for determining continuous metric scores.

Impairment Threshold Determination/Reference Criteria

The first step in determining the criteria for assessing wetlands was the selection of a threshold value. Thresholds were set at the **lowest IBI score among the reference sites** for each IBI separately. Previously, reference wetlands had been designated based solely on the best professional judgment (BPJ) of local wetland scientists and resource managers. In an effort to move from a Level 3 to a Level 4 (*sensu* USEPA *in prep*) for the 'Criteria for Reference Sites' program component, the semi-quantitative data used to determine the Human Disturbance Score (HDS) for each site were used to validate the BPJ reference sites. To accomplish this, the HDS score that roughly approximated the previously used narrative criteria for reference wetlands was determined. The narrative criteria for reference wetlands are as follows:

- No history of drainage, filling, or excavation activities within the natural extent of the wetland
- Well buffered by natural vegetation around the perimeter of the wetland
- No direct discharges from municipalities or industries
- No indication of recent silvicultural activities within the drainage area
- No agricultural runoff, and no direct runoff from deicing compounds from streets or highways
- No history of aquaculture, including fish rearing or stocking
- No known history of or ongoing active pesticide (e.g., mosquitoes), herbicide, or algacide treatments within the wetland or drainage area

On the HDS scale of 0-100, the equivalent to these narrative criteria was determined to be a score of 30 or less. An additional stipulation for a site to be designated as a reference site was that it could not have any single score for any of the five HDS factors greater than the 'Moderate' score (= 6 or 7, depending on the factor). The HDS criterion of 30 was decided upon because it required a 'Moderate' score (6 or 7) in four of the five

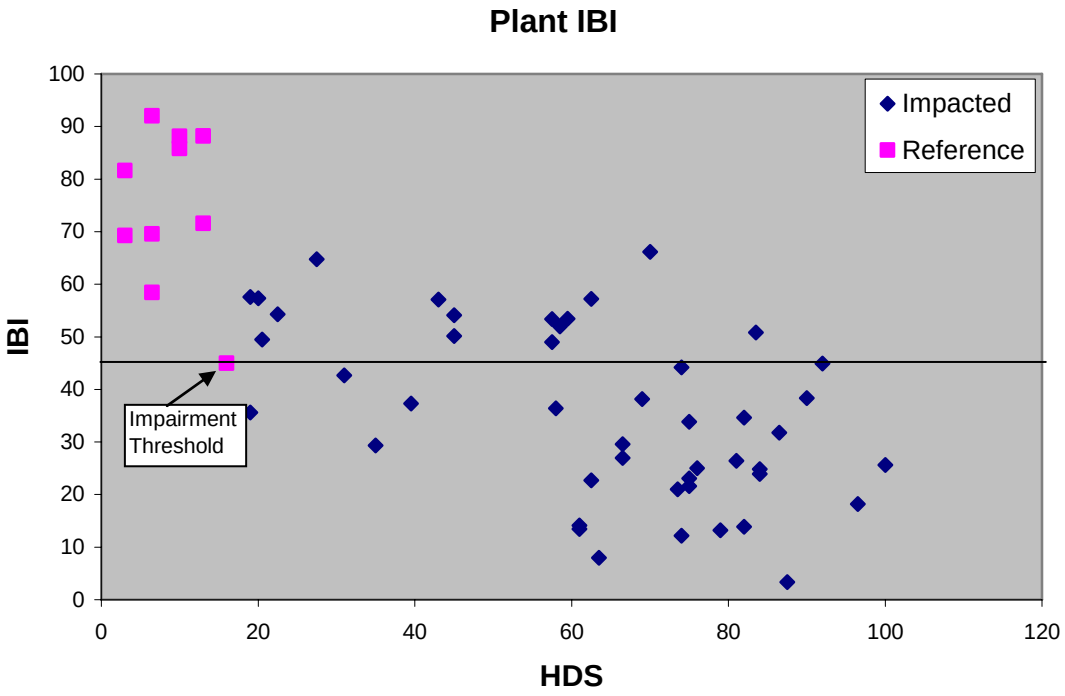

Figure 3. Plot of plant IBI scores vs Human Disturbance Score (HDS) used to determine impairment threshold for the plant IBI.

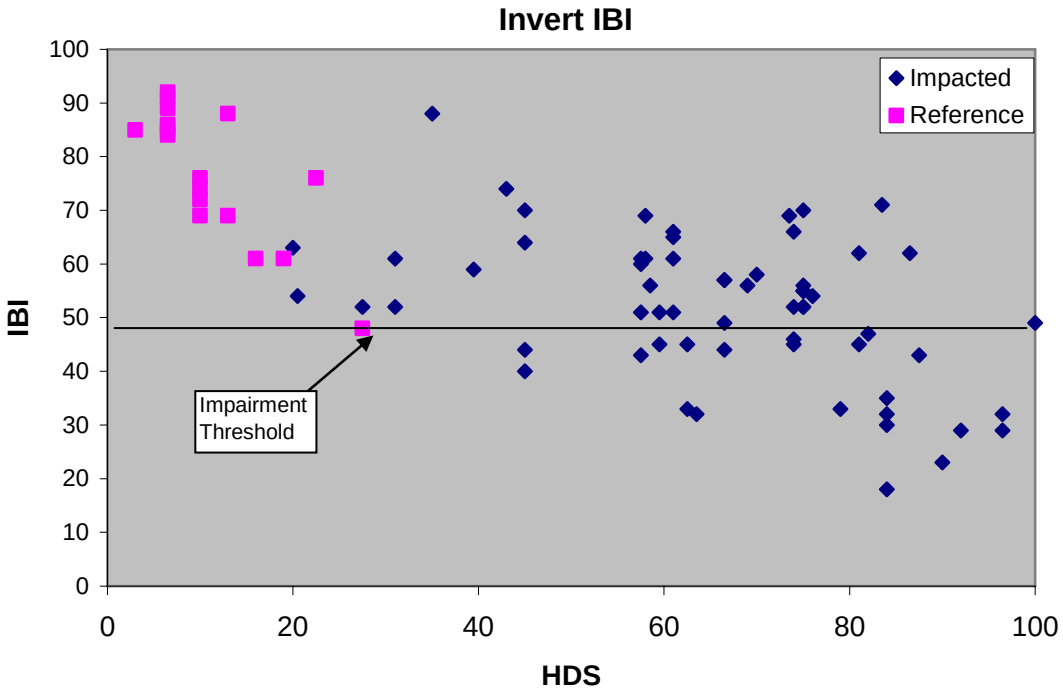

Figure 4. Plot of invertebrate IBI scores vs Human Disturbance Score (HDS) used to determine impairment threshold for the invertebrate IBI.

factors and a 'Best' or 'Best-Moderate' in the remaining fifth factor. This scoring scenario still allowed a reference site to have a score of one in the 'Additional factors and concerns' section. For a detailed description of the factors considered in the HDS scoring process see Appendix 3 in Gernes and Helgen (2002). As a result of the translation of narrative criteria into quantitative criteria, reference wetlands generally refer to sites that have an HDS score <30 with no single factor score exceeding the score associated with the 'Moderate' category. However, even if a site has met HDS criteria to be designated as reference, it may still be excluded from the list reference sites on the basis of violating one of the original narrative criteria.

Data from 1999 and 2001 were used to select the lowest scoring reference site as this data set represents the scoring criteria for the ecoregion. Thus, the impairment threshold for the plant IBI was determined to be 45 (Figure 3) and the threshold for the invert IBI was set at 48 (Figure 4). These scores were derived from the IBI continuous scoring method which ranges 0-100.

With a threshold established, within site variability which incorporates year-to-year differences, spatial variability within the wetland, and crew error was quantified and applied to the threshold as 90% confidence intervals (e.g., Figure 5). Analysis of Variance (ANOVA) was used to estimate the within site variance for both invertebrate and plant protocols. These variance estimates were then used to calculate the 90% confidence intervals. The number of samples collected from a wetland determines the size of the 90% confidence intervals; as the number of replicates increase, the size of the interval decreases (see Figure 6). With multiple samples from a wetland, the assessment is made by comparing the average IBI score to the confidence interval specific to that sample size. This methodology is based on the general premise that as the number of samples increase, the accuracy of the measurement increases. Averaging IBI scores was only performed when replicate samples were collected from a site during the same visit.

ALUS Assessments

ALUS assessments are made for wetlands by comparing individual site IBI scores (or average scores within a single visit) to the established impairment threshold and its surrounding confidence interval. A site with an IBI score above the upper 90% confidence limit is considered to be **fully supporting** of Aquatic Life (Figure 7). A site with an IBI score below the lower 90% confidence limit is considered to be **non-supporting** of Aquatic Life. When IBI scores fall within the 90% confidence interval or if a site has discrepant scores (one year supporting, the next year non-supporting IBI scores), the wetland gets a preliminary assessment and gets identified as a site that requires further scrutiny by the professional judgment team (PJT). For example, if the IBI score is above the threshold and within the upper confidence limit then the preliminary assessment would be **fully supporting** though this would need to be confirmed by the PJT (Figure 7). Similarly, in cases where the IBI score is below the threshold and within the lower confidence limit the preliminary assessment would be **non-supporting** of aquatic life, but would also require further review by the PJT.

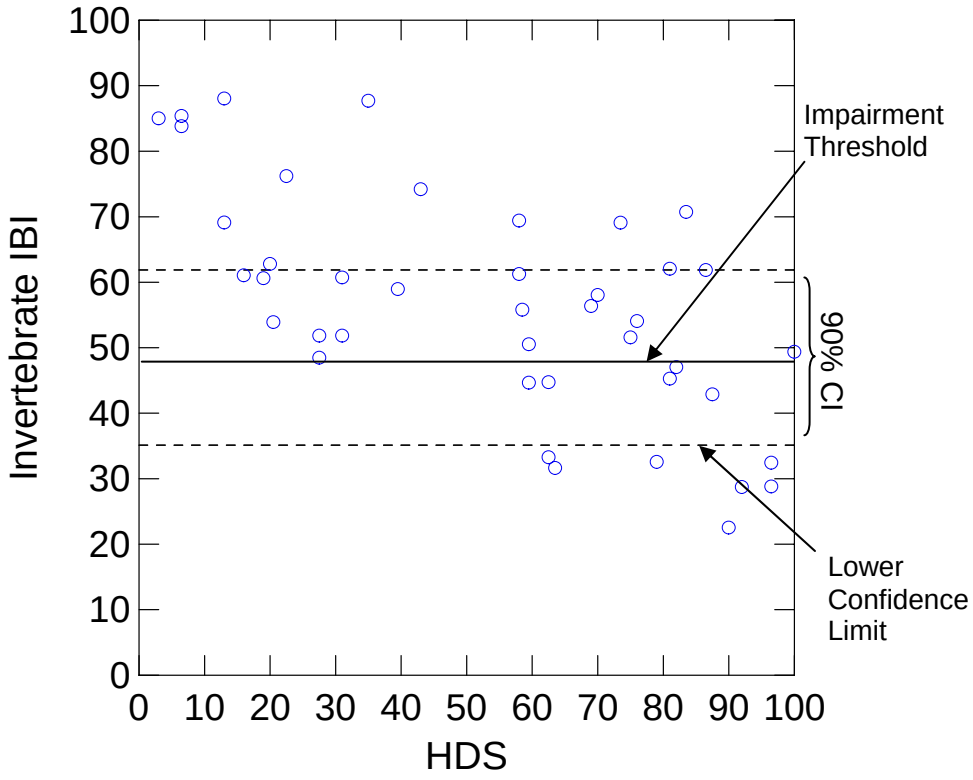

Figure 5. Impairment threshold for wetland Aquatic Life Use Support determinations based on the macroinvertebrate IBI.

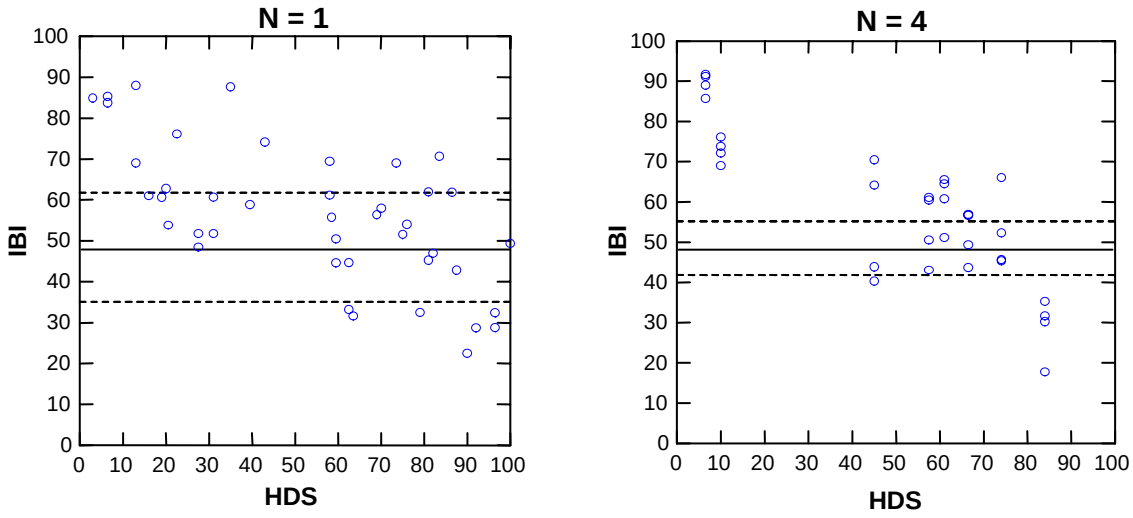

Figure 6. Comparison of 90% confidence intervals for two sample sizes; when only 1 sample has been collected from a wetland (N=1) and when four samples have been collected (N=4).

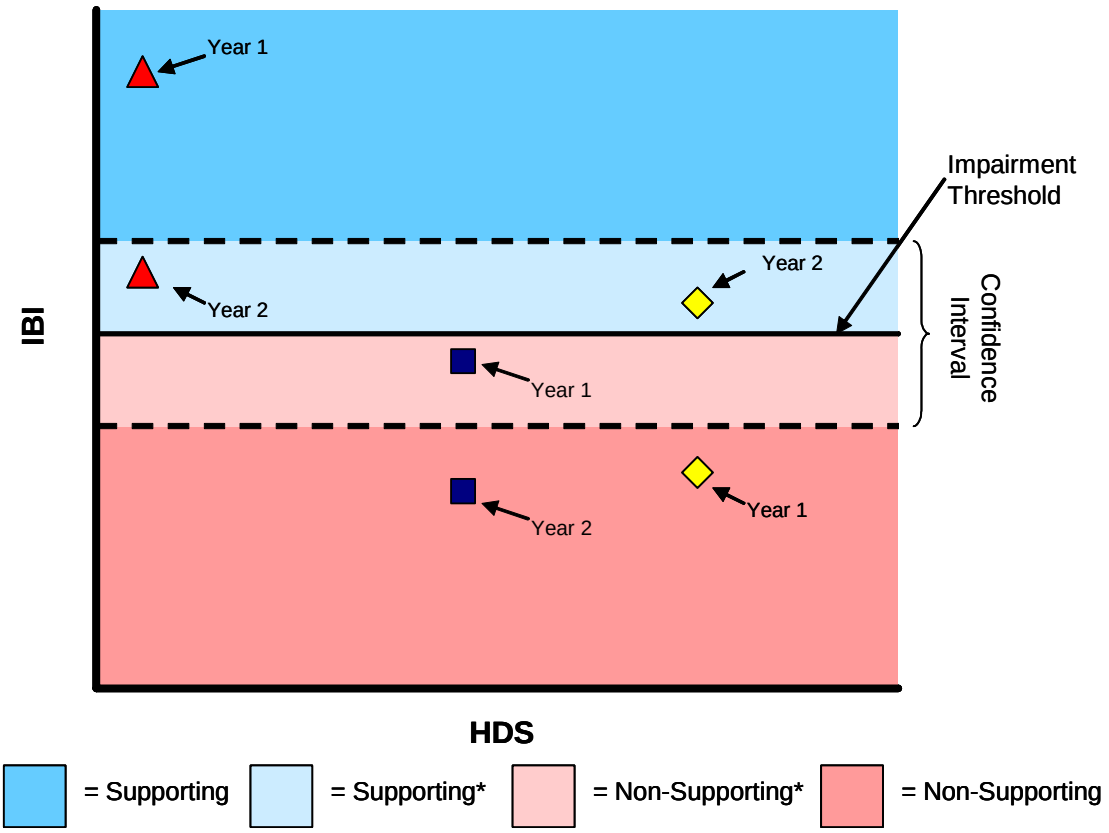

Figure 7. Visual representation of preliminary assessment categories. Color scheme represents assessment categories for sites with IBI scores falling in that area of the graph (single visits). For sites with data from multiple years and scores in different regions of the graph, the following examples illustrate how such situations would be assessed: ▲ = **Supporting*** because both scores are above the impairment threshold, but one score is within the confidence interval. ■ = **Non-Supporting*** because both scores are below the impairment threshold, but one score is within the confidence interval. ◆ = **Partial Support*** because one score is above the impairment threshold and one score is below and at least one score is within the confidence interval. ***** **indicates sites identified for PJT evaluation**.

In cases where sites have been sampled multiple years, resulting in discrepant IBI scores, some general guidelines have been developed to provide preliminary assessments of these sites. For instance, if any of the scores fall within the confidence interval, but are both on the same side of the impairment threshold, then the site gets assessed as either **fully supporting** or **non-supporting** (depending on which side of the threshold) and identified as a site for further review by the PJT (Figure 7). If multiple scores fall on opposite sides of the impairment threshold, the preliminary assessment would be **partial support**. All sites identified as **partial support** would require further review by the PJT. In the PJT evaluation, sites that have IBI scores from multiple years can be examined in order to detect any apparent trends or spatial patterns in the data. These trends or patterns as well as any additional data (e.g., water chemistry, upland land use patterns) would be considered in the final ALUS determination. Following the PJT process, a final assessment is made for each wetland that is either **fully supporting** or **non-supporting**

of Aquatic Life; the **partial support** status is not utilized in the final ALUS determination. Sites identified as **non-supporting** are candidates for the 303(d) list.

Assessing the Aquatic Life Use of a wetland is a separate process for the plant and macroinvertebrate assemblages. Independent applicability is utilized in the final assessment process so that a wetland may be listed as supporting for one assemblage and listed as non-supporting for the other assemblage. This approach acknowledges the differing sensitivities of the assemblages to human disturbance. For instance, plants are typically more sensitive to perturbations in the sediment than are macroinvertebrates and respond at a different rate to certain types of anthropogenic impacts (Galatowitsch et al. 1999, Gernes and Helgen 2002).

Professional Judgment Team

The MPCA has the responsibility under its delegated authority for the CWA to collect water resource data, assess that data, determine the impairment status by comparing to the narrative and numeric water quality standards (WQS), and develop TMDLs for those waters determined to be impaired. The MPCA must assess wetlands using all available data for which assessment tools exist (e.g., MPCA data, Minnesota Routine Assessment Method, Citizen IBIs, local government unit data, etc.).

One important assessment approach is the use of professional judgment teams (PJT). They consist of an Agency lead and a number of other Agency staff and resource managers from other state, federal or local organizations, agencies or entities who are familiar with the data, assessment techniques, and wetland resources being considered for listing as impaired waters. It is likely that professionals representing the MNDNR, the U.S. Fish and Wildlife Service, and/or local watershed management officials would be invited to participate in the wetlands PJT meetings. Their role is to review the data and the preliminary assessment. This process will likely involve comparisons of the primary data to WQS, consideration of the contribution of any supporting data to assessment decisions, and discussion of mitigating issues specific to the assessment when the primary data are within confidence intervals as described in the guidance. The PJT would assure that minimum data requirements are met and determine whether the data quality meets appropriate QA/QC requirements. This is an advisory group and, as such, the final decision-making authority rests with the Agency. Following the assessment process, a decision document will be created that explains the rationale for all assessment determinations.

SECTION IV. Data Requirements for Assessing ALUS in Minnesota Wetlands

Currently, the primary source of data for assessing ALUS for wetlands in Minnesota is the MPCA. However, it is anticipated that data from other agencies, citizen monitoring programs, environmental consulting firms, or local government units could eventually be utilized for this purpose in the future. This section describes the criteria that would need

to be demonstrated by any outside source before such data would be incorporated into the CALM process.

US EPA (*in prep*) has developed a set of guidelines for evaluating the technical elements of a bioassessment program. These guidelines consider 12 key technical elements that are each evaluated on a scale of one to four, with level four representing the most rigorous bioassessment program. Using this evaluation framework, the MPCA would expect outside entities to exhibit the level of rigor consistent with a Level three or higher bioassessment program before their data would be considered for using in the CALM. To determine whether the quality of data submitted by an external group is adequate enough for utilizing in the CALM, the monitoring program of that outside entity would be evaluated using the US EPA 12 technical elements. Each element would be assigned a value of 1-4, depending on the level of rigor exhibited by the program being evaluated. If the average score of all 12 technical elements is greater than three, then the data set is deemed suitable for inclusion in the assessment and reporting process. For instance, an adequate program would have documented conditions from a clearly defined set of reference wetlands, a classification framework that minimizes natural variability between unimpaired wetlands, well-documented seasonal index period(s) and sampling protocols, and a moderately high level of precision.

In addition to the technical guidelines outlined by US EPA, monitoring programs would need to demonstrate the level of taxonomic expertise required by the biological indicator in question. For instance, if the indicator only requires the identification of organisms to the family level, then proficiency in differentiating taxa at this level must be demonstrated either through the education of the taxonomists or by independent verification of identifications by an individual with known taxonomic competency.

SECTION V. Administrative Process for Integrating Wetland Condition Assessment into the CALM

The 2006 List of Impaired Waters for Minnesota is due to US EPA by April 1, 2006. Planning for that list began before the 2004 List had been sent to EPA for their review; their approval was received on May 13, 2004. Calls for data have already occurred, both internally, by letter, and by notice in the *State Register*.

We anticipate that the wetland PJT will meet in early summer and a draft list of impaired waters will be available within a few weeks after that. The draft list of wetlands will be added to the list of other new impairments for streams and lakes.

Once the draft List of Impaired Waters is fully developed, it undergoes a significant regimen of public participation. First, key stakeholders are briefed and feedback reviewed. Then there are six public information meetings held throughout the state to brief the public on the purpose and contents of the list to prepare them for the formal 30-day public notice, which occurs next. All comments received, and Agency responses, are forwarded to EPA along with the List. The comments the Agency receives are taken very

seriously; during every listing cycle, at least one and usually several items on the list are modified based on comments received.

ACKNOWLEDGEMENTS

Funding for this project was provided by a Wetland Program Development grant, Section 104(b)3 Clean Water Act (Federal Assistance #CD-975938-01). We are very appreciative of the assistance and continued support with assigning assessment unit identifiers provided by Bob Potocnik and Glenn Radde, Minnesota Department of Natural Resources. Steve Heiskary helped with the development of criteria for distinguishing shallow lakes and wetlands. We appreciate the support and technical assistance provided by our EPA Project Officer, Alicia Hernandez and project technical contact, Sue Elston. Dan Helwig and Michael Bourdaghs reviewed the report and provided numerous suggestions that improved the quality of this document. Carrie Bartz and Jennifer Crea indexed wetland assessment units into the National Hydrography Dataset. This project benefited tremendously from the earlier work that was accomplished by Scott Niemela, Joel Chirhart, and Michael Feist in establishing the process for determining biological impairment in rivers and streams. Lastly we wish to thank Leska Fore for her instrumental assistance in helping us to understand the statistical aspects of the assessment process.

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APPENDIX A

Minnesota Rule 7050.0150

Minnesota Rules, Table of Chapters

Table of contents for Chapter 7050

Subpart 1. Policy and scope. The intent of the state is to protect and maintain surface waters in a condition which allows for the maintenance of all existing beneficial uses. The condition of a surface water body is determined by its physical, chemical, and biological qualities. The narrative water quality standards in subpart 3 prescribe the qualities or properties of surface waters that are necessary for the protection of designated public uses and benefits. If the narrative standards in this part are exceeded, it is considered indicative of a polluted condition which is actually or potentially deleterious, harmful, detrimental, or injurious with respect to the designated uses of the waters of the state.

Subparts 5 to 7 list factors the commissioner will use to determine if surface waters are in compliance with applicable narrative standards in subpart 3. Determination of compliance with the narrative standards will be made for individual water bodies on a case by case basis.

Subp. 2. Other standards preserved. The requirements of this part are in addition to the application of other narrative or numerical water quality standards in this chapter. If the requirements of this part conflict with any other narrative or numerical standard in this chapter, the more stringent standard applies.

Subp. 3. Narrative standards. For all Class 2 waters, the aquatic habitat, which includes the waters of the state and stream bed, shall not be degraded in any material manner, there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters, sediments, and aquatic flora and fauna; the normal fishery and lower aquatic biota upon which it is dependent and the use thereof shall not be seriously impaired or endangered, the species composition shall not be altered materially, and the propagation or migration of the fish and other biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste, or other wastes to the waters.

Subp. 4. Definitions. For the purposes of this part, the following terms have the meanings given them.

A. "Chlorophyll-a" means a pigment in green plants including algae. The concentration of chlorophyll-a, expressed

in weight per unit volume of water, is a measurement of the abundance of algae.

B. "Ecoregion" means an area of relative homogeneity in ecological systems based on similar soils, land use, land surface form, and potential natural vegetation.

C. "Hydraulic residence time" means the time water resides in a basin or, alternately, the time it would take to fill the basin if it were empty.

D. "Impaired water" or "impaired condition" means a water body that does not meet applicable water quality standards or fully support applicable beneficial uses, due in whole or in part to water pollution from point or nonpoint sources, or any combination thereof.

E. "Index of biological integrity" or "IBI" means an index developed by measuring attributes of an aquatic community that change in quantifiable and predictable ways in response to human disturbance, representing the health of that community.

F. "Lake morphometry" means the physical characteristics of the lake basin that are reasonably necessary to determine the shape of a lake, such as maximum length and width, maximum and mean depth, area, volume, and shoreline configuration.

G. "Mixing status" means the frequency of complete mixing of the lake water from surface to bottom, which is determined by whether temperature gradients are established and maintained in the water column during the summer season.

H. "Nuisance algae bloom" means an excessive population of algae that is characterized by obvious green or blue-green pigmentation in the water, floating mats of algae, reduced light transparency, aesthetic degradation, loss of recreational use, possible harm to the aquatic community, or possible toxicity to animals and humans. Algae blooms are measured through tests for chlorophyll-a, observations using a Secchi disk, and observations of impaired recreational and aesthetic conditions by the users of the water body, or any other reliable data that identifies the population of algae in an aquatic community.

I. "Readily available and reliable data and information" means chemical, biological, and physical data and information determined by the commissioner to meet the quality assurance and quality control requirements in subpart 8, that are not more than ten years old from the time they are used for the assessment. A subset of data in the ten-year period, or data more than ten years old can be used if credible scientific evidence shows that these data are representative of current conditions.

J. "Reference water body" means a water body least impacted by point or nonpoint sources of pollution that is

representative of water bodies in the same ecoregion or watershed. Reference water bodies are used as a base for comparing the quality of similar water bodies in the same ecoregion or watershed.

K. "Secchi disk transparency" means the average water depth of the point where a weighted white or black and white disk disappears when viewed from the shaded side of a boat, and the point where it reappears upon raising it after it has been lowered beyond visibility. The Secchi disk measures water clarity and is usually used in lakes.

L. "Summer-average" means a representative average of concentrations or measurements of nutrient enrichment factors, taken over one summer growing season from June 1 through September 30.

M. "Transparency tube" means a graduated clear plastic tube, 24 inches or more in length by 1-1/2 inches in diameter, with a stopper at the bottom end, the inside surface of which is painted black and white. The tube is filled with water from a surface water; the water is released through a valve at the bottom end until the painted surface of the stopper is just visible through the water column when viewed from the top of the tube. The depth of water at the point of initial visibility is the transparency. The transparency tube measures water clarity and is usually used in rivers and streams.

N. "Trophic status or condition" means the productivity of a lake as measured by the phosphorus content, algae abundance, and depth of light penetration.

O. "Water body" means a lake, reservoir, wetland, or a geographically defined portion of a river or stream.

Subp. 5. Impairment of waters due to excess algae or plant growth. In evaluating whether the narrative standards in subpart 3, which prohibit any material increase in undesirable slime growths or aquatic plants including algae, are being met, the commissioner will use all readily available and reliable data and information for the following factors of use impairment:

A. representative summer-average concentrations of total phosphorus and total nitrogen measured in the water body throughout the summer growing season;

B. representative summer-average concentrations of chlorophyll-a measured in the water body throughout the summer growing season;

C. representative measurements of light transparency in the water body, as measured with a Secchi disk in lakes or a transparency tube in rivers and streams, throughout the growing season; and

D. any other scientifically objective, credible, and supportable factor.

A finding of an impaired condition must be supported by data showing elevated levels of nutrients in item A, and at least one factor showing impaired conditions resulting from nutrient over-enrichment in items B and C. The trophic status data described in items A to D must be assessed in light of the magnitude, duration, and frequency of nuisance algae blooms in the water body; and documented impaired recreational and aesthetic conditions observed by the users of the water body due to excess algae or plant growth, reduced transparency, or other deleterious conditions caused by nutrient over-enrichment.

Assessment of trophic status and the response of a given water body to nutrient enrichment will take into account the trophic status of reference water bodies; and all relevant factors that affect the trophic status of the given water body appropriate for its geographic region, such as the morphometry, hydraulic residence time, mixing status, watershed size, and location. The factors in this subpart apply to lakes and, where scientifically justified, to rivers, streams, and wetlands.

Subp. 6. Impairment of biological community and aquatic habitat. In evaluating whether the narrative standards in subpart 3, which prohibit serious impairment of the normal fisheries and lower aquatic biota upon which they are dependent and the use thereof, material alteration of the species composition, material degradation of stream beds, and the prevention or hindrance of the propagation and migration of fish and other biota normally present, are being met, the commissioner will consider all readily available and reliable data and information for the following factors of use impairment:

A. an index of biological integrity calculated from measurements of attributes of the resident fish community, including measurements of:

(1) species diversity and composition;

(2) feeding and reproduction characteristics; and

(3) fish abundance and condition;

B. an index of biological integrity calculated from measurements of attributes of the resident aquatic invertebrate community, including measurements of:

(1) species diversity and composition;

(2) feeding characteristics; and

(3) species abundance and condition;

C. an index of biological integrity calculated from measurements of attributes of the resident aquatic plant community, including measurements of:

(1) species diversity and composition, including

algae; and

(2) species abundance and condition;

D. a quantitative or qualitative assessment of habitat quality, determined by an assessment of:

(1) stream morphological features that provide spawning, nursery, and refuge areas for fish and invertebrates;

(2) bottom substrate size and variety;

(3) variations in water depth;

(4) sinuosity of the stream course;

(5) physical or hydrological alterations of the stream bed including excessive sedimentation;

(6) types of land use in the watershed; and

(7) other scientifically accepted and valid factors of habitat quality; and

E. any other scientifically objective, credible, and supportable factors.

A finding of an impaired condition must be supported by data for the factors listed in at least one of items A to C. The biological quality of any given surface water body will be assessed by comparison to the biological conditions determined for a set of reference water bodies which best represents the most natural condition for that surface water body type within a geographic region.

Subp. 7. Impairment of waters relating to fish for human consumption. In evaluating whether the narrative standards in subpart 3, which prevent harmful pesticide or other residues in aquatic flora or fauna, are being met, the commissioner will use the residue levels in fish muscle tissue established by the Minnesota Department of Health to identify surface waters supporting fish for which the Minnesota Department of Health recommends a reduced frequency of fish consumption for the protection of public health. A water body will be considered impaired when the recommended consumption frequency is less than one meal per week, such as one meal per month, for any member of the population. That is, a water body will not be considered impaired if the recommended consumption frequency is one meal per week, or any less restrictive recommendation such as two meals per week, for all members of the population. The impaired condition must be supported with measured data on the contaminant levels in the indigenous fish.

Subp. 8. Determination of compliance. In making tests or analyses of the waters of the state, sewage, industrial wastes, or other wastes to determine compliance with the standards and water quality condition, samples shall be collected in a manner

and place, and of such type, number, and frequency as may be considered necessary by the agency from the viewpoint of adequately reflecting the condition of the waters, the composition of the effluents, and the effects of the pollutants upon the specified uses. The samples shall be collected, preserved, and analyzed following accepted quality control and quality assurance methods, and according to the procedures in Code of Federal Regulations, title 40, part 136. The agency may accept or may develop other methods, procedures, guidelines, or criteria for collecting and analyzing samples and measuring water quality characteristics. The commissioner will retain a record of all impairment decisions using the factors in this part, including all supporting data, for a minimum of eight years.

STAT AUTH: MS s 115.03; 115.44

HIST: 9 SR 913; 15 SR 1057; 18 SR 2195; 27 SR 1217
Current as of 10/27/03

APPENDIX B

Procedure for Assigning Assessment Unit Identifications (AUIDs) to Depressional Wetlands in Minnesota

Purpose: To document the annual procedure between the Minnesota Pollution Control Agency (MPCA) Biological Monitoring Unit and Minnesota Department of Natural Resources (MNDNR), Lake Hydrology Program for assigning assessment unit identifiers (AUIDs) to depressional wetlands in Minnesota. Each year MPCA biologists assess the quality of roughly 50-60 wetlands throughout Minnesota and before these assessments can be used for Clean Water Act requirements (e.g., 305b, 303d) a unique identifier must be assigned to each. The MNDNR Lake Hydrology Program has agreed to provide unique identifiers for these wetlands, using their preexisting statewide numbering system for lakes and wetlands.

Procedure:

1. The MPCA Biological Monitoring Unit will maintain a shapefile delineating their depressional wetland study sites with a corresponding attribute table that contains the following information: site identifier (MPCA internal database number), site name, area, perimeter, and AUID.
2. When new wetlands are assessed they will be added to the shapefile by MPCA biologists and attribute information will be added. MPCA staff will have access the MDNR Lakes Database and thus will be able to determine if any of the new wetlands already have an AUID (DOWLK#).
3. For wetlands that do not already have a DOWLK# or where the MNDNR delineation does not closely match the MPCA delineation of a wetland (requiring a sub-basin identifier for an existing DOWLK#), the shapefile of MPCA wetlands will be sent to Bob Potocnik, Program Leader, Lake Hydrology Program.
4. New DOWLK#s will be generated by Lake Hydrology Program personnel for any wetland in the shapefile that is missing an AUID in the attribute table. Also sub-basin identifiers will be generated for specified sites.
5. The updated shapefile will be returned to MPCA biologists and will subsequently be used in Step #1 when additional wetlands need to be added.

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APPENDIX C

Procedure for defining wetlands versus lakes with regard to monitoring and assessing non-flowing waterbodies

Background and Purpose: Minnesota is fortunate to be rich in water resources; however there are frequently questions about when something is a lake versus a wetland. Unfortunately the terms "wetland" and "lake" occur across a continuum and there are no clear distinctions. The wetland biological assessment program has focused on depressional wetlands which can often overlap with what are often considered to be lakes. Proposed nutrient standards being developed for Minn Rules ch. 7050 are intended to be applied to lakes and the Minnesota Pollution Control Agency (MPCA) biological assessment indices are being developed primarily for wetlands and thus the MPCA needs to have a way to differentiate lakes and wetlands.

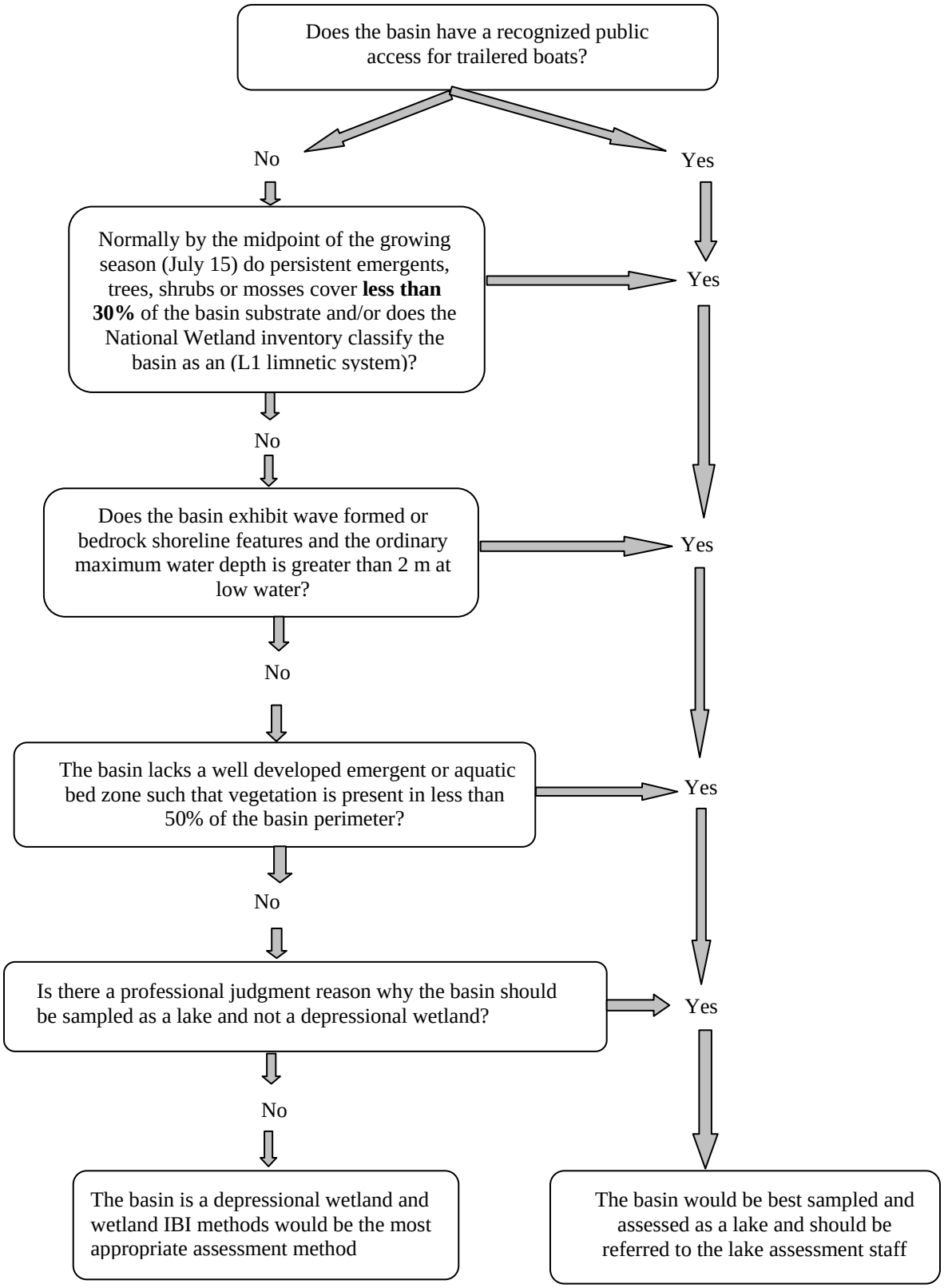
Three primary references or systems attempt to classify or provide a basis for water protection programs within the state of Minnesota. These include; Bulletin 25[1], the Protected Water Program as set forth within MN Statutes 103G[2] and Cowardin et al.[3] that is the wetland and deepwater classification system used by the U.S. Fish and Wildlife Service in the National Wetland Inventory program. Applicable parts of these three approaches are summarized in the appendix.

Beginning in 2004 the MPCA biological assessment program will use the following decision tree when evaluating the appropriateness of given basins to be treated as depressional wetland and therefore appropriateness of using the wetland IBIs.

This decision tree is intended to be helpful in differentiating lakes and depressional wetlands, though it should be pointed out that there may be situations where it will be appropriate to sample lakes, or at least lake littoral habitats using the depressional wetland criteria. In these situations it may also be appropriate and necessary to sample the basin using lake assessment methods. Therefore when the MPCA feels it necessary and justifiable, the two assessment results will be treated with independent applicability, where the lake assessment results will be considered independent of the wetland assessment result. In most of these situations the assessment unit (polygon) for both assessment approaches will encompass the entire basin and will most likely be similar to the Minnesota Department of Natural Resources boundary delineation. Rarely, it is anticipated that it may be appropriate to delineate an independent assessment polygon for the wetland vs. the lake and in these rare cases the separate polygons will be established separately in the National Hydrography Dataset (NHD). The most common case would be where a definable wetland area is fringing to a lake. The justification for, and identification of the independent polygon would be made by the field sampling crew(s).

[1]Waters Staff. 1968. An Inventory of Minnesota Lakes. Division of Soils, and Minerals, Minnesota Conservation Department, St. Paul, MN.
[2] Statutes. 2002. State of Minnesota Statutes. Legislative Revisers Office, Department of Administration, St. Paul, MN
[3] Cowardin, L.M., V. Carter, F. Golet, E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Dept. of Interior, Fish and Wildlife Service, FWS/OBS-79/31.

Depressional Wetland vs. Lake Assessment



Appendix:

Wetland/Lake Classification References

Cowardin et al. (1979) differentiates lacustrine (relating to, or formed by lakes) waters from palustrine (inland waters not subject to intensive wave or current effects) waters based on the following characteristics.

Lacustrine

- Waters covered by less than 30% persistent emergents, trees, shrubs or emergent mosses or nonpersistent emergents may be widespread may be present during some seasons of the year;
- Situated in a basin, catchment or depression or on level to sloping ground and water not usually flowing or
- Area 20 acres (8 ha) or greater, or if less than 20 acres, then wave formed or bedrock shoreline features prominent or water depth normally greater than 2 m (6.6 ft).

Palustrine:

- Waters covered by at least 30% persistent emergents, trees, shrubs, or emergent mosses,
- Situated in a basin, catchment or depression or on level to sloping ground and water not usually flowing, or
- Area, often less than 20 acres (8 ha), though they can be larger
- No wave formed or bedrock shoreline features prominent and water typically less than 2 m deep.

Bulletin 25

Historically the Minnesota Pollution Control Agency has relied on Bulletin 25 as a primary list of Minnesota Lakes. The Department of Natural Resources (DNR) Published Bulletin 25 in 1968. The intent of Bulletin 25 was to inventory and define lakes as, “including all natural enclosed depressions, 10 acres or more in area, which have substantial banks capable of containing water and which are discernible on aerial photographs. The inventory also includes all bodies of water, except streams, which are shown within the meander lines on plats of the General Land Office surveys.” Where discernable Bulletin 25 includes drained lake beds as part of the inventory. There are numerous instances in Bulletin 25 where waterbodies were not ascribed a name such as the 14 acre waterbody ID number 56-20 in Ottertail County or as the name connotes a wetland such as the 16 acre “Degreef Slough” or the 98 acre Klinkers Marsh both in Murray County.

Minn Statutes Subp. 103G.005 Public Waters is defined in Minnesota statutes to include:

Subd. 15. **Public waters.** (a) "Public waters" means:

(1) waterbasins assigned a shoreland management classification by the commissioner under sections 103F.201 to 103F.221;

(2) waters of the state that have been finally determined to be public waters or navigable waters by a court of competent jurisdiction;

(3) meandered lakes, excluding lakes that have been legally drained;

(4) waterbasins previously designated by the commissioner for management for a specific purpose such as trout lakes and game lakes pursuant to applicable laws;

(5) waterbasins designated as scientific and natural areas under section 84.033;

(6) waterbasins located within and totally surrounded by publicly owned lands;

(7) waterbasins where the state of Minnesota or the federal government holds title to any of the beds or shores, unless the owner declares that the water is not necessary for the purposes of the public ownership;

(8) waterbasins where there is a publicly owned and controlled access that is intended to provide for public access to the waterbasin;

(9) natural and altered watercourses with a total drainage area greater than two square miles;

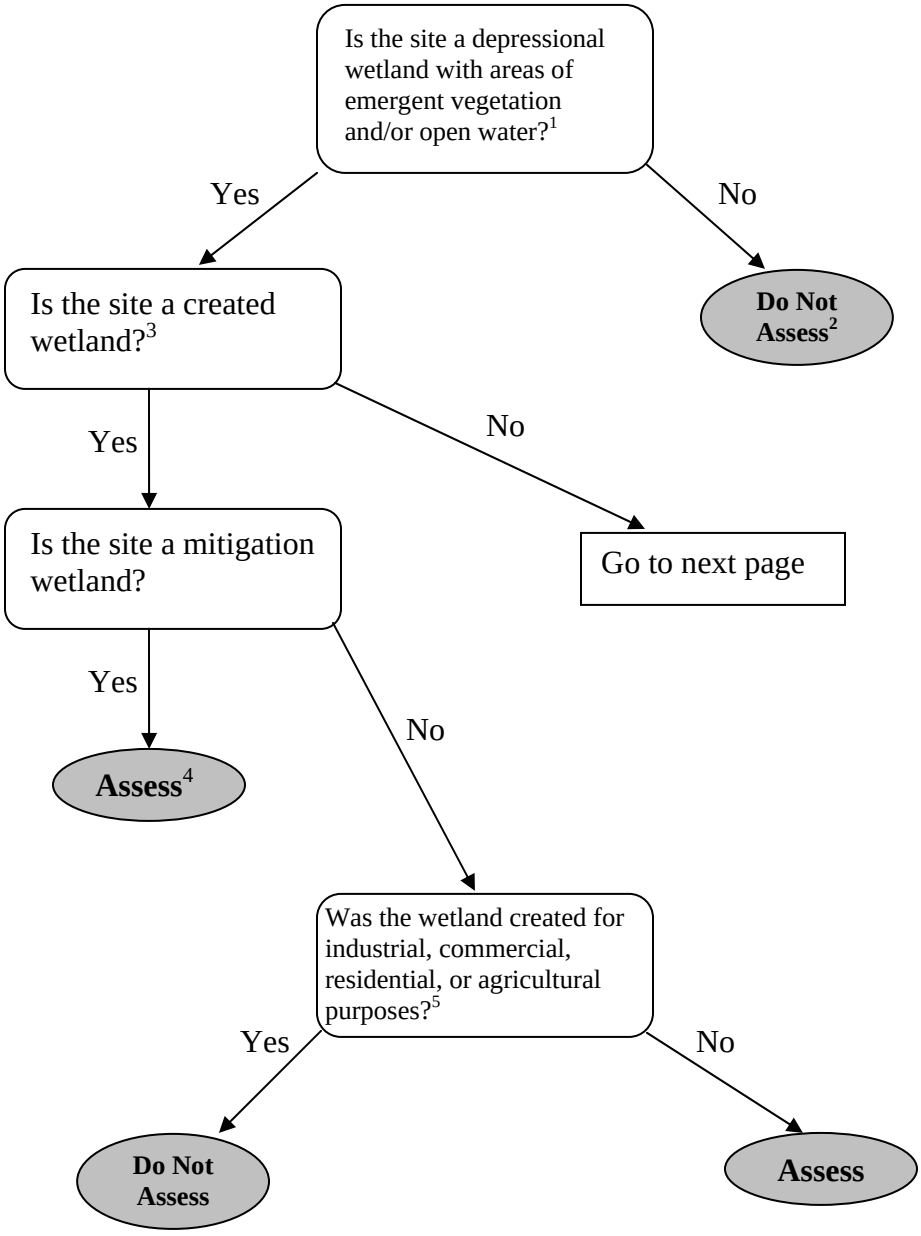
(10) natural and altered watercourses designated by the commissioner as trout streams; and

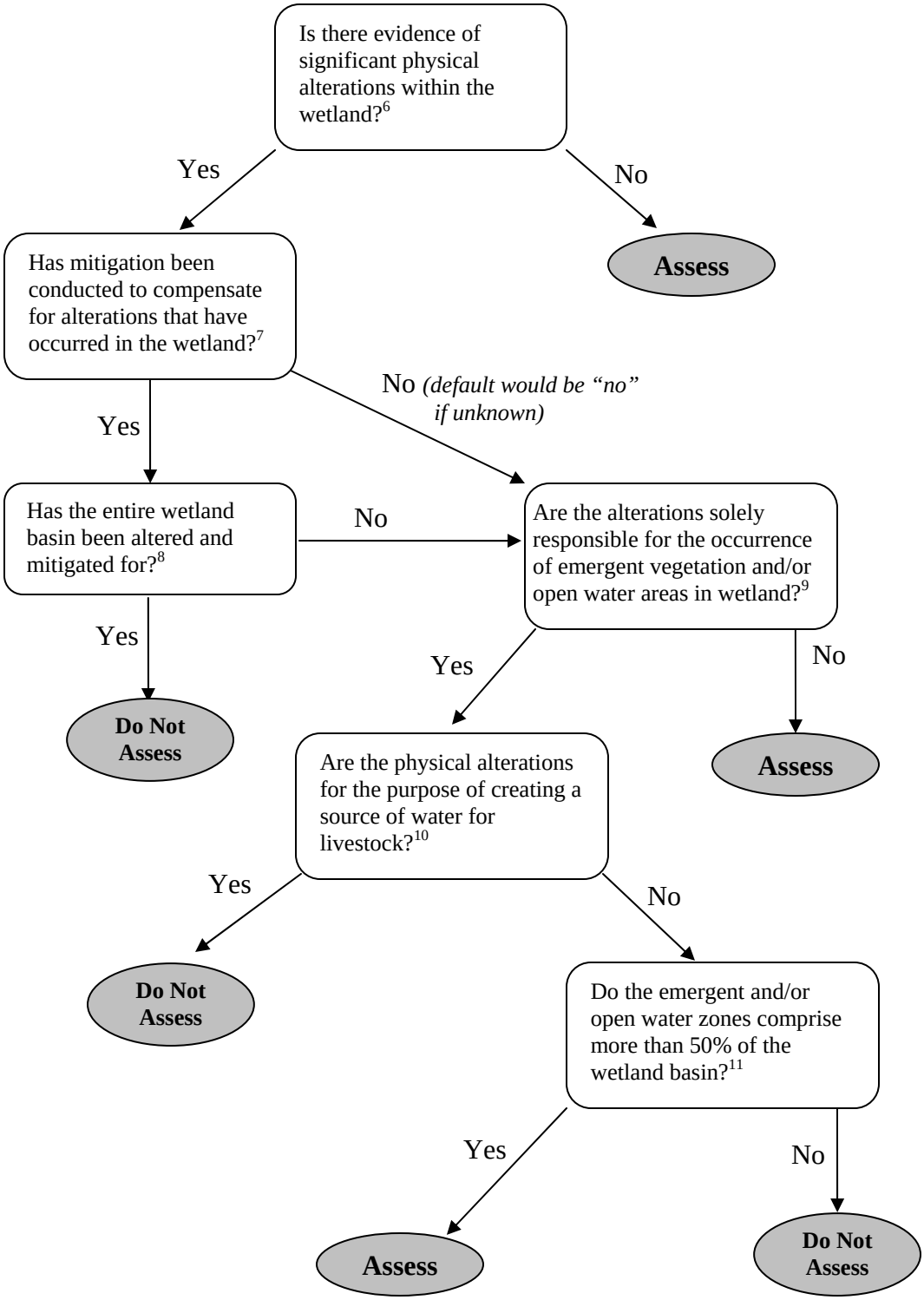
(11) public waters wetlands, unless the statute expressly states otherwise. (b) Public waters are not determined exclusively by the proprietorship of the underlying, overlying, or surrounding land or by whether it is a body or stream of water that was navigable in fact or susceptible of being used as a highway for commerce at the time this state was admitted to the union.

Subd. 15a. **Public waters wetlands.** "Public waters wetlands" means all types 3, 4, and 5 wetlands, as defined in United States Fish and Wildlife Service Circular No. 39 (1971 edition), not included within the definition of public waters, that are ten or more acres in size in unincorporated areas or 2-1/2 or more acres in incorporated areas.

APPENDIX D

Purpose: The following decision tree was designed to assist with determining 1) the applicability of the process outlined in the current report for assessing various wetland types and 2) the appropriateness of the process outlined in the current report for assessing wetlands in various regulatory contexts. Each branch of the tree ends with the decision of 'Assess' or 'Do Not Assess'. If included, guidance for a decision is indicated with a superscript number and can be found in the section following the decision tree. In cases where it is unclear whether the site is a shallow lake or wetland, this decision tree should only be used when the criteria in Appendix C has determined that it is more appropriate to assess the site as a wetland.




Is there evidence of significant physical alterations within the wetland?[6]
Yes
No
Assess
Has mitigation been conducted to compensate for alterations that have occurred in the wetland?[7]
Yes
No *(default would be "no" if unknown)*
Has the entire wetland basin been altered and mitigated for?[8]
No
Are the alterations solely responsible for the occurrence of emergent vegetation and/or open water areas in wetland?[9]
Yes
Yes
No
Do Not Assess
Assess
Are the physical alterations for the purpose of creating a source of water for livestock?[10]
Yes
No
Do Not Assess
Do the emergent and/or open water zones comprise more than 50% of the wetland basin?[11]
Yes
No
Assess
Do Not Assess

Guidance:

1) Determination of wetland type could preliminarily be made in the office using existing data sources (e.g., NWI) but the final decision should be based on a field visit to the site. Usage of the hydrogeomorphic wetland class 'depressional' here includes all of its various subcategories including: isolated, flow-through, and tributary. Emergent wetlands typically corresponds to Types 3, 4, and 5 in the Circular 39 wetlands classification system.

2) Current assessment techniques (e.g., IBIs) have not been tested and validated for wetland types in Minnesota other than depressional and therefore are not able to be assessed at this time.

3) Was the wetland created as a result of human activity in an area that was previously upland? Use National Wetland Inventory (NWI) maps, USGS quadrangle maps, historic aerial photos and soil surveys (e.g. absence of hydric soils) to document whether the site was previously upland. On-site indicators include: a geometric shape to the wetland; presence of berms, spoil piles, or islands; a poorly developed organic layer, steep-sided banks and littoral zone; and evidence of plantings.

4) While this kind of wetland could be assessed with the process described in this report, the resulting ALUS determination would need to be interpreted with caution given that the MPCA has not yet developed performance standards for compensatory mitigation wetlands. For example, the condition of these sites will be highly dependent on their age and creation methods.

5) Examples here would include wetlands constructed for the sole purpose of wastewater treatment, stormwater retention, and livestock watering.

6) Significant physical alterations to a wetland include dredging or excavation, fill, increased inundation, and drainage. Evidence of excavation would include: a geometric shape to the open water area; presence of berms, spoil piles, or islands; a poorly developed organic layer in the sediments of the open water area, and often a steep transition to the open water area of the wetland. Evidence of increased inundation or past drainage may not be obvious at a site. The first step in resolving this issue would be to examine existing data sources (e.g., NWI, aerial photos) to determine the type of wetland it was historically. If the water levels appear to have changed significantly from its historic condition, the next step is attempting to determine whether this change was due to natural climatic or anthropogenic factors. Field indicators of inundation include numerous standing dead trees with trunk bases submerged, emergent vegetation litter arising from deeper water zone with sparse emergent plants occurring toward shore, submerged microtopographic features such as hummocks, a sharp transition from obligate upland plant species to ponded waters, narrow bands of poorly developed emergent plants and in some cases floating mat communities, particularly dominated by *Typha* sp. Further evidence that an inundation increase was the result of human activities includes: the presence of culverts, ditches, or drain tile outlets entering the wetland; an

increase in the amount of impervious surface in the wetland's catchment basin; an unnatural connection to another waterbody; intentional conveyance of water into the wetland for treatment purposes (e.g., municipal water treatment); and the presence of impediments to subsurface and sheet flow (e.g., road and railroad beds) down-gradient of the wetland. Evidence that a drop in water level was the result of human activities includes: the presence of ditches, subsurface tiling, or water control structures; dewatering in or near the wetland; and the presence of impediments to subsurface and sheet flow (e.g., road and railroad beds) up-gradient of the wetland. Evidence of fill activities would include the presence of berms, levees, or dams. However, this question may be more readily resolved by examining existing data sources (e.g., NWI, soil surveys, USGS quadrangle maps, etc.) to delineate the historic wetland boundary and compare this to its current delineation.

7) Has the physical alteration been compensated for through wetland mitigation, restoration, or enhancement under the regulations of the Wetlands Conservation Act, Section 404 of the Clean Water Act, Public Waters Inventory, or Minnesota Rule 7050.0186.

8) Have the alteration(s) occurred in the entire wetland or only a portion of the wetland. If mitigation was required to compensate for only a portion of the wetland (e.g., a partial fill) then the unaltered (unmitigated) areas are subject to condition monitoring. However, if the alteration of the entire wetland has been compensated for through mitigation, the wetland would not be assessed. Wetlands which have been physically altered as part of municipal or industrial treatment systems and which have been fully mitigated are not considered to be Waters of the State in accordance with MN Rules ch 7050.0130 (F) and it is not appropriate to assess these treatment waters.

9) Have human activities created an emergent or open water zone in a wetland that previously did not contain such areas (e.g., wet meadow). Examples here would include the excavation of a saturated soil wetland to create areas of open water or increased inundation of a saturated soil, etc. Determination of the type of wetland it was prior to human alteration will require the examination of data sources such as the NWI, old USGS quadrangle maps, and historic aerial photos (when available).

10) The presence of livestock, evidence of recent usage by livestock within or immediately adjacent to the wetland, and the wetland being located within a fenced pasture are all indicators that the wetland is currently being used as a source of water for livestock.

11) This question represents a determination of whether it is more appropriate to assess the wetland basin as an emergent depressional wetland or the type of wetland it was previous to the physical alterations. If the historic wetland type still comprises the majority of the wetland basin, then it should not be assessed at this time because the MPCA currently does not have indicators of condition for these types of wetlands. If the majority of the wetland has been converted to an emergent/open water wetland, then it should be assessed using the protocols and assessment procedure outlined in this

document. An example here might be the excavation of small wildlife ponds within a larger high water table wetland with a saturated water regime such as a scrub-shrub carr, a fen, or a fresh wet meadow.