Floristic Quality Assessment for Wisconsin Wetlands

User Guide

Fall 2024 - Version 1.0

Wisconsin Department of Natural Resources
Bureaus of Water Quality and Waterways
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Photo Credit: Vegetation survey of an herbaceous wetland, 2023 by Sally Jarosz

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1. Introduction

Wisconsin Department of Natural Resources (WDNR or "the Department")'s Floristic Quality Assessment (FQA) methodology was developed as a "Level 3" or "intensive" site assessment according to U.S. Environmental Protection Agency guidelines and serves as the most reliable and accurate method of measuring wetland condition available in the state. FQA has been the primary method of wetland condition assessment for over 20 years in Wisconsin and has been applied to a variety of assessment projects. A Level 2 or Rapid FQA assessment tool has also been developed to provide a faster but less accurate method of condition assessment (details of the Rapid FQA tool are provided on the DNR Website). The following guidance applies specifically to the Department's original FQA methodology for wetland condition assessment. Because this methodology requires a full inventory of vascular plant species in the area being assessed, it may be referred to as the "full-inventory FQA" or "Full FQA" to contrast it with the Rapid FQA which assesses condition using only dominant plant species. The purpose of this document is to put all elements required to complete a full-inventory FQA survey in one place: including background and guidance to implement the field protocol, disturbance factors checklist, FQA metrics calculator, and condition look-up tables.

2. FQA Methodology Background

[The following text is modified from (T. Bernthal 2003)]

The WDNR Floristic Quality Assessment Method is an adaptation of the floristic quality assessment method for use in Wisconsin, treating the entire state as a single region. Floyd Swink and Gerould Wilhelm (Swink 1979, 1994) developed the original methodology for the Chicago Region as a standardized, repeatable means of evaluating natural area quality. The method allows the comparison of floristic quality among many sites and for tracking changes at the same site over time, whether undergoing natural succession or being actively managed.

2.1. Coefficient of Conservatism Values

The FQA method is based on the concept of species conservatism. Each native plant species occurring in a regional flora is assigned a coefficient of conservatism (C-value) representing an estimated probability that a species is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition (Table 1). The most conservative species are limited to a narrow range of ecological conditions, are intolerant of disturbance, and are unlikely to be found outside undegraded remnant natural areas, while the least conservative species can be found in a wide variety of settings and thrive on disturbance. Coefficients range from 0 (highly tolerant of disturbance, little fidelity to any natural community) to 10 (highly intolerant of disturbance, restricted to pre-settlement remnants). Coefficients of conservatism (C-values) are subjective ratings based on the best professional judgement of a group of botanists rather than on experimental or observational data collected along a disturbance gradient. Conceptually this 10-point scale can be subdivided into several ranges. The following description of coefficient ranges combines the discussions presented by (Taft 1997) and (Francis 2000); describing concepts used in (Oldham 1995).

Table 1. Narrative description of coefficient of conservatism values (C-values) assigned to 2007 species of vascular plants in the Wisconsin flora.

C-Value	Narrative description
0 - 3	*Taxa found in a wide variety of plant communities; tolerant of disturbance.*
4 - 6	*Taxa typically associated with a specific plant community but tolerate moderate disturbance.*
7 - 8	*Taxa found in a narrow range of plant communities in advanced stages of succession but can tolerate minor disturbance.*
9 - 10	*Taxa restricted to a narrow range of ecological conditions, with low tolerance of disturbance.*

Conservatism and rarity, or special conservation concern status, are not always equated. Many species of conservation concern are both highly conservative and restricted to specific remnant natural communities. An example is *Chamaesyce polygonifolia*, seaside spurge, a "special concern" species, confined to sandy beaches and dunes along the Great Lakes. It is assigned a C-value of 10. In contrast, some rare species are found in highly disturbed areas and are not conservative. An example is *Carex pallescens*, pale sedge, another "special concern" species. It is assigned a C-value of 1, because it can be found locally in moist disturbed roadsides, fields, clearings, and borders of woods in the North. In other cases, rare species may now be found increasingly in disturbed habitats in addition to remnant undisturbed sites, as in the case of *Gentiana alba*, yellow gentian, a "threatened species" assigned a C-value of 7. It is native to deep soil, mesic to moist prairies, but is now also found on roadsides, embankments, old fields, and logging roads. Many conservative species are not at all rare in Wisconsin. An example is *Kalmia polifolia*, swamp laurel, a shrub restricted to bogs, which is assigned a 10, but it is not endangered because bog habitat is still common in northern Wisconsin.

Coefficients of conservatism were developed for Wisconsin's flora beginning in 2001 when DNR wetland assessment staff coordinated botanists across the state to assign C-values to plants they were familiar with via survey. Later a smaller, core group of botanists finalized the list by considering the range of opinions on each species. Each rating therefore may represent a compromise in terms of differing opinion and differing behavior of the species across the varied environments of the state.

2.2. Floristic Quality Metrics

To use the Full FQA method, the plant community is inventoried or sampled to compile a species list of vascular flora on a site as accurately and completely as possible. While the choice of a sampling methodology is not dictated in FQA methods generally, WDNR's FQA method uses the timed meander survey (TMS) protocol to create the plant inventory (see Sections 2.3 and 4.0 for details). Using the plant inventory and the list of coefficients of conservatism for the region, floristic quality metrics can be calculated. When abundance data is added to the assessment (e.g., areal cover), cover-weighted metrics can be calculated (Milburn, Bourdaghs and Husveth. 2007) . There are currently two primary floristic quality metrics used to classify wetlands by condition:

1. Mean coefficient of conservatism ($\overline{C}$): The average coefficient of conservatism value (C) across all plant species (N) observed in the assessment area.

$$\bar{C} = \sum_{i=1}^{N} C_i / N$$

2. Cover-weighted mean coefficient of conservatism ($w\overline{C}$): Calculated as the C-value of each species multiplied by its proportional abundance (p), (e.g.., relative cover) and summed across all species (N) observed in the assessment area.

$$w\overline{C} = \sum_{i=1}^{N} p_i \, C_i$$

Other metrics related to floristic quality included in calculations include the following:

1. Species richness (N): the total number of vascular plant species found in the assessment area, native and non-native.
2. Non-native species richness (N_{nn}): the total number of non-native or introduced species found in the assessment area.
3. Non-native cover (NN % Cover and Rel. NN Cover): the sum of cover values assigned to all non-native species expressed as absolute cover and as a proportion of total cover.
4. Floristic Quality Index (FQI): mean conservatism modified by species richness, calculated as $\overline{C}$ multiplied by the square root of N, the total number of species in the assessment area.

$$FQI = \bar{C}\sqrt{N}$$

5. Cover-weighted floristic quality index (wFQI): mean cover-weighted conservatism modified by species richness and calculated as $w\overline{C}$ multiplied by the square root of N, the total number of species in the assessment area.

$$wFQI = w\overline{C}\sqrt{N}$$

2.3. Field Methodology: The Timed Meander Survey Protocol

The timed meander survey (TMS) protocol is a plotless vegetation survey technique that was first described as a method for searching for threatened and endangered plant species (Goff 1982). The meandering method allows the surveyor to move freely in search of new species, seeking out diversity, rather than being confined to plots. The survey is quantified by keeping track of the number of new species discovered in each successive unit of search time and the survey only stopped after the yield begins to level off, approaching zero new species. This allows standardization of effort and the ability to assure that 90% to 95% of species have been captured even when used by surveyors of different abilities or in communities that differ in complexity.

Tests of the method for use in wetland floristic quality surveys by researchers at the Lake Superior Research Institute (Paul S. Hlina 2011) found that in an alder thicket the TMS was four times faster and less energy intensive than a plot-based method and discovered more species. However, the opposite was true in a northern hardwood swamp in which the open understory made setting up plots easier and the extra attention given to a small plot led to the discovery of a greater number of small understory species missed in the meander. Minnesota Pollution Control Agency (MPCA) conducted their own tests comparing a plot-based method (releve) with a timed meander protocol. Their results showed that the meander data found more species than the plot-based method (M. Bourdaghs 2012).

Based on these results the TMS protocol was adopted due to the potential it afforded to survey more wetlands with limited staff resources, however, it was recommended that a search for low-lying forbs

hidden beneath the dominant herbaceous layer be included in each search period. A Standard Operating Procedure (SOP) was developed in 2016 (Trochlell, 2016).

Originally the timed-meander survey resulted only in a species inventory and did not include plant abundance measures. Calculating abundance weighted metrics follows Minnesota PCA's wetland floristic quality assessment methodology and began with the use of cover classes to estimate plant areal cover (Milburn, Bourdaghs and Husveth. 2007) (M. Bourdaghs 2012). The Wisconsin TMS protocol replaced cover classes with integer estimates of areal cover from 1% to 100% to improve accuracy. However, because cover estimates are known to be highly variable between observers, even with the use of cover classes, and even in small, 1 square meter plots (Kercher 2003), the results of cover estimates across whole communities should be assumed to be imprecise. Despite their imprecision they nevertheless provide useful information about the relative abundance of plant species within communities and allow the calculation of cover-weighted floristic quality metrics.

2.4. The FQA Calculator

WDNR's FQA Calculator is an Excel tool developed in 2016 to enter TMS results and calculate floristic quality metrics. The calculator relies on a plant taxonomy database, WIPLANTS, developed over several years from the original list of coefficient of conservatism values published in 2003 (T. Bernthal 2003). The WIPLANTS table contains all naturally occurring vascular plants in Wisconsin as determined by the Wisconsin State Herbarium. Each plant species is associated with attributes used by the calculator: coefficient of conservatism, native status, common names, growth form, wetland indicator status, NR40 status, NHI (endangered species) status, and accepted Integrated Taxonomic Information System (ITIS) name. From this attribute table a wetland community inventory and cover values can be translated into metrics for species richness, mean conservatism, and floristic quality index.

The WIPLANTS taxonomy table is intended to be updated every few years to keep up with taxonomic or attribute changes, such as wetland indicator status. Since 2016, it has been updated once, in 2023, based on taxonomic changes made in 2020 by NHC and the Wisconsin State Herbarium.

The FQA Calculator has had two updates since 2016. The latest changes (Version 3.2024) eliminated the need for 6-letter taxon codes to enter species and no longer calculates natives-only metrics. Added features include metrics calculated based on wetland indicator status, including percent hydrophytes, percent obligates, and numeric wetland indicator score.

Access to the FQA Calculator can be found on the DNR Wetland Monitoring and Assessment webpage here: https://dnr.wisconsin.gov/topic/wetlands/methods.html.

2.5. The Disturbance Factors Checklist

Bioassessments like the Full FQA method are based on the premise that the organisms in a wetland reflect the level of cumulative anthropogenic stress or disturbance the wetland has undergone (USEPA 2002). Therefore, measurements of anthropogenic disturbance are an important element in their development and are required for setting numeric condition criteria. The Disturbance Factors Checklist (DFC) was developed for this purpose as part of early FQA benchmark setting (Bernthal and J. Kline 2007) using Ohio's Rapid Assessment Method version 5.0 as a model. The DFC was intended as a field checklist to look for signs of anthropogenic disturbance in a wetland and use those observations to rate the wetland on a coarse scale of 1 to 5 (non-disturbed to severe) using best professional judgement. This rating, called Overall Disturbance (OD) was defined as a composite index based on observed on-site disturbance effects.

Early use of the DFC compared its performance with a more objective, GIS-based measurement - natural land cover in a 300 meter radius around the centroid of the wetland (Bernthal and J. Kline 2007) or around the meander track (Hlina and Hagedorn 2015). While both methods were found to be correlated with floristic quality metrics, the DFC rating system performed slightly better because it resulted in a larger disturbance range than natural land cover (Hlina and Hagedorn 2015).

Rating disturbance levels is known to be difficult to accomplish accurately since it is impossible to know the full history of all the anthropogenic stressors a wetland may have been subjected to in their nature or extent (USEPA 2002), and will tend to underestimate overall disturbance for that reason. At least two attempts to improve the checklist have occurred since it was first developed. In a 2017 revision, the ability to note historical impacts was added and recently revisions were made to simplify the checklist based on the knowledge gained over the past decade about the relative importance and frequency of the many possible stressors. In addition, rather than relying exclusively on in-field observations, users are encouraged to consult web-based imagery to improve accuracy.

In addition to the Overall Disturbance rating, the DFC also asks that users directly rate the wetland's plant community condition (PCC) based on structural and functional integrity on a scale from 1 to 6 (intact to highly altered). This rating allows those wetlands that have many disturbance factors but still appear intact or vice versa to be identified. The PCC rating requires that users have some experience with intact examples of the community type being assessed.

The Disturbance Factors Checklist and its user guide are attached as Appendix C and D, respectively.

2.6. Condition Benchmarks

Condition benchmarks, numeric criteria for five tiers of wetland condition (Excellent to Very Poor) based on floristic quality metrics have been in development for Wisconsin since 2014 when statewide data collection began. Beginning with the most common community types, the Department has been working towards the goal of developing condition benchmarks for all wetland types specific to all four major regions of the state. Funded by multiple EPA wetland program development grants (Hlina and Hagedorn 2015), (Marti and Bernthal 2019), (Gibson, O'Connor and Jarosz 2023), the Department has condition benchmarks available for 20 wetland communities in at least one ecoregion of Wisconsin (Table 2) and a total of 90 sets of criteria by community type and Omernik level III ecoregion (Figure 1) (as of December of 2024).

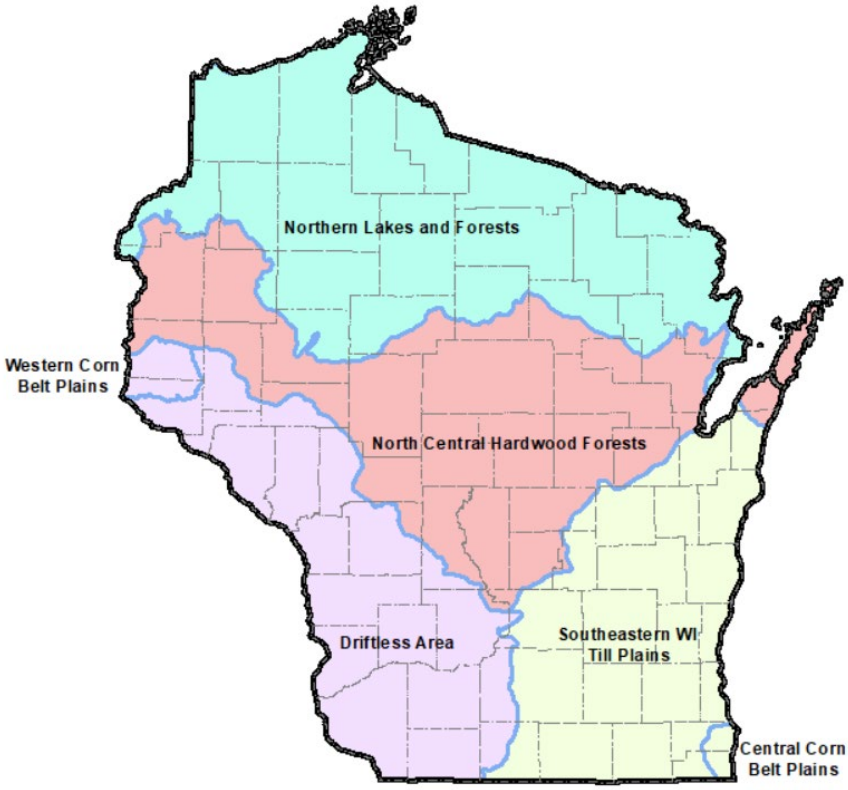


Figure 1. Map of the six Level III Omernik Ecoregions of Wisconsin

Methods used to determine condition tier cut-offs are based on guidance from EPA for evaluating wetland condition (USEPA 2002) and follows those used by the Minnesota Pollution Control Agency (M. Bourdaghs 2012). Condition tiers for Excellent, Good, Fair, Poor, and Very Poor are determined by the $\overline{C}$ or w$\overline{C}$ scores found in least- disturbed and most-disturbed examples of each community type. In Wisconsin, condition benchmarks have been developed separately for each of Wisconsin's four major Omernik level III ecoregions (Figure 1) to satisfy the original intent that floristic quality assessment be applied within a regional context (Swink 1979, 1994). This mitigates the effects of assigning a single coefficient of conservatism value to each species for the entire state, despite plants in some instances falling on a different part of the conservatism – tolerance spectrum depending on region.

For each of the communities listed in Table 2, condition benchmarks have been developed for one or both of the two floristic quality metrics: $\overline{C}$ and w$\overline{C}$. These have proven to have a stronger correlation with anthropogenic disturbance than another commonly used metric, FQI (Bernthal and J. Kline 2007) (Hlina and Hagedorn 2015). It has been observed that FQI, because it relies on species richness, rather than conservatism alone, is sensitive to assessment area size, with more species being found in larger areas (Bernthal and J. Kline 2007). This is problematic when wetlands of different sizes are being compared. In addition, there is the tendency for a moderate amount of disturbance to increase diversity, (i.e., the intermediate disturbance hypothesis) which diminishes its utility as an indicator of disturbance.

Comparisons between $\overline{C}$ and w$\overline{C}$ have found that w$\overline{C}$ is more tightly correlated with disturbance measures than $\overline{C}$ (M. Bourdaghs 2012) (Marti and Bernthal 2019), and therefore is suggested as the default metric to use to assign condition tiers when cover data is present.

Table 2. The wetland communities with condition benchmarks for wetland floristic quality ($w\bar{C}$ and $\bar{C}$) in at least one Omernik level III ecoregion. See a current version of the FQA Calculator for an updated list by ecoregion. Communities are defined using the DNR's Natural Heritage Bureau's Natural Community Classification.

Wetland Community	
Emergent	Emergent Marsh
	Northern Sedge Meadow
	Southern Sedge Meadow
	Wet-Mesic Prairie
	Wet Prairie
	Calcareous Fen
	Interdunal Wetland
Scrub-Shrub	Alder Thicket
	Shrub-carr
	Bog Relict
	Open Bog
	Muskeg
Forested	Black Spruce / Tamarack Swamp
	Cedar Swamp (Northern Wet-mesic Forest)
	Floodplain Forest
	Northern Hardwood Swamp
	Southern Tamarack Swamp
	Forested Seep
	Southern Hardwood Swamp
	White Pine- Red Maple Swamp

2.7. Wetland Community Classifications

Conducting a timed meander survey requires that users delineate a single homogeneous plant community for each assessment area (AA) and include the wetland's natural community type in the form. Once floristic quality metrics have been calculated for a site, condition can be looked up from condition benchmark tables based on community and ecoregion.

The Department's Natural Heritage Conservation Bureau has created a Key to Wetland Natural Communities (O'Connor 2023) to aid wetland assessment staff in determining community type. The Key to Wetland Natural Communities can be found on the DNR's website.

The key to Wetland Natural Communities recognizes 37 natural communities and 4 "ruderal" communities, or plant assemblages that do not correspond to any natural community type due to severe alteration. Ruderal communities should be matched with a corresponding natural community to be assigned benchmarks. For instance, Ruderal Wet Meadows were included in the most-disturbed group for benchmark setting for Northern and Southern Sedge Meadows, Wet Prairie, and Wet-mesic Prairie, depending on their composition and overall wetness. Table 3 (Section 4.4) provides a crosswalk to match a ruderal community with a natural community.

Not all 37 natural communities have condition benchmarks established for all ecoregions; some are missing criteria for some ecoregions, and others have not yet been established. Consult a current

version of the condition benchmark look-up tables which can be found in the latest version of the FQA calculator (see WDNR website for FQA Calculator).

2.8. FQA Survey Uses and Limitations

The full FQA survey can be utilized in almost all wetland communities of Wisconsin with a few exceptions and considerations.

2.8.1. When an FQA Survey is Recommended

This level 3 wetland assessment tool can be used on most wetland communities in the state to assess biological condition, wetland health, floristic quality, or to monitor a plant community. It is preferred over the Rapid FQA when the user is interested in species richness, identification of threatened, endangered, or special concern plant species, condition category relative to a specific community type and ecoregion, or when results need to be held to a high standard in terms of data quality and detail. There are circumstances when this protocol is required by regulators for permitting or to assess environmental impact.

2.8.2. When NOT to Use the FQA

The full FQA can be used in any wetland to document the plant community and calculate floristic quality metrics, however, not all wetland types have established criteria for condition (Table 2 provides a list of communities with condition benchmarks). Aquatic communities (Submergent Marsh, Floating-Leaved Marsh), peat fens (Central Poor Fen, Boreal Rich Fen, And Poor Fen) and several rare community types (Coastal Plain Marsh, Inland Beach, and Great Lakes Shore Fen) currently have no condition benchmarks. In addition to lacking condition benchmarks, any aquatic communities with a component of submersed vegetation require a slightly different survey protocol, including the use of a rake, to adequately survey the plant community.

Sites that have experienced recent disturbance that reset the plant community within the last five years or are subject to ongoing disturbance (such as mudflats, active farm fields, developed areas, or active stormwater features) should also be assessed with caution. They do not have appropriate condition benchmarks for reference and because they are in the early stages of succession are likely undergoing rapid change from year to year.

2.8.3. Regulatory Context

At any point, the Department or any other regulatory agency can dictate which survey method shall be used for wetland permit or exemption applications. This tool may be used for regulatory purposes, but it may not be needed in all regulatory situations; the Department may suggest that a Rapid FQA survey (or other suitable survey methodology) is sufficient in some situations.

If a wetland is being evaluated for regulatory purposes (in the planning phases of a proposed wetland impact permit), the AA survey location should include the entirety of the proposed impact zone and adjoining wetland areas around the impact zone, if access is available. Multiple AA units may be necessary if the impact zone includes multiple natural wetland community types.

2.8.4 Assessor Experience Requirements

Assessors are expected to have the experience and resources to be able to recognize wetland communities and identify all wetland plants to species to complete an FQA survey.

At least one of the Assessors should have the following professional requirements:

1. Has completed advanced wetland delineation training or its equivalent.
2. Has expert level familiarity with Midwest wetland plant species.

Across the range of wetland communities, over 1,375 plant species have been identified in a DNR wetland survey with typically 25 to 110 species identified per survey. Surveyors should have the ability to recognize wetland plants throughout the growing season, at times in a vegetative state, have the appropriate reference materials and knowledge to key out unknown plant species or have access to a regional expert who can serve in this capacity. Utilization of the FQA tool is not recommended without this level of experience. Use of the FQA for regulatory purposes may only be permitted when the wetland assessor(s) can show that these requirements have been met and may require confirmation by the Department.

2.8.5 Size Limitations

An FQA survey should not be conducted on small wetlands less than 0.25 acres in size or on larger wetlands generally over 10 acres (Trochlell 2015) unless homogeneity of the vegetation across the entire area can be verified. Larger wetlands can be divided into small AAs as needed. Exceptions to these size limitations can be made in some circumstances or based on best-professional judgement or consultation with Department wetland assessment experts.

2.8.6 Seasonality Limitations

The ideal date range for botanical surveys in Wisconsin is from June 15th to September 1st when a single visit is likely to capture the most species (T. Bernthal 2003, E. Judziewicz 2002). Surveys outside of these dates (late May to Oct 1st) are allowable but may be missing species that are only visible or identifiable for a portion of the growing season. Repeated sampling over the course of a growing season will allow the closest approximation of the "true" species composition, $\overline{C}$, and $w\overline{C}$.

3. Timed Meander Survey Field Preparation

Data collection for an FQA survey is accomplished by conducting a Timed Meander Survey (TMS) of each wetland community of interest. Normally two people are required to complete a survey, at least one of whom has a high level of botanical knowledge. Two people are recommended both for safety and to improve cover estimates. The following section details the planning stage while Section 4 will go over the field portion of a survey. Prior to conducting a timed meander survey (TMS) in the field, Assessors should prepare by reviewing aerial imagery of the wetland area of interest and gather the tools needed to complete the survey.

3.1. Assessment Area Planning

Homogeneity requirement

The unit of assessment for TMS surveys is an area of homogenous vegetation corresponding to a single wetland community type usually following the DNR's NHC classification system (O'Connor 2023) . Wetland assessment areas (AAs) can be estimated using recent aerial imagery, drone photography (if available), and wetland mapping (either Wisconsin Wetland Inventory or National Wetland Inventory layers) available on the Department's Surface Water Data Viewer. This desktop analysis can provide an initial idea of how many AAs may need to be created on a given site, but this should be confirmed in the field (see Section 3.1.1 below).

Splitting or lumping guidelines

Small inclusions of other wetland community types are commonly encountered within the context of a larger wetland type. In these cases, use a 0.25 acres (900 m^2) size cut-off as a rule of thumb to help guide the decision to include the smaller wetland in the survey or to delineate a separate AA and start a new survey (see Example 1, Figure 2). If the wetland of a different structural type is larger than 900m^2, that wetland pocket should be excluded from the original FQA survey; the Assessor should establish a second AA for the pocket wetland and conduct a second TMS survey (see Example 2, Figure 3).

***Example 1**: There is a contiguous, southern sedge meadow wetland with a small, shrub-carr wetland pocket. The whole wetland complex totals 20 acres and the shrub-carr pocket only makes up 0.2 acres. In this example, a single FQA AA is required since the shrub-dominated pocket makes up less than 0.25 acres in total. See Figure 2.*

***Example 2**: There is a contiguous, southern sedge meadow wetland with a shrub-carr wetland pocket. The whole wetland complex totals 20 acres and the shrub-carr pocket makes up 2.0 acres. In this example, two separate FQA surveys should be completed since the shrub-dominated wetland pocket makes up greater than 0.25 acres in total. FQA AA #1 would be the southern sedge meadow wetland and0 FQA AA #2 would be the shrub-carr wetland pocket. See Figure 3.*

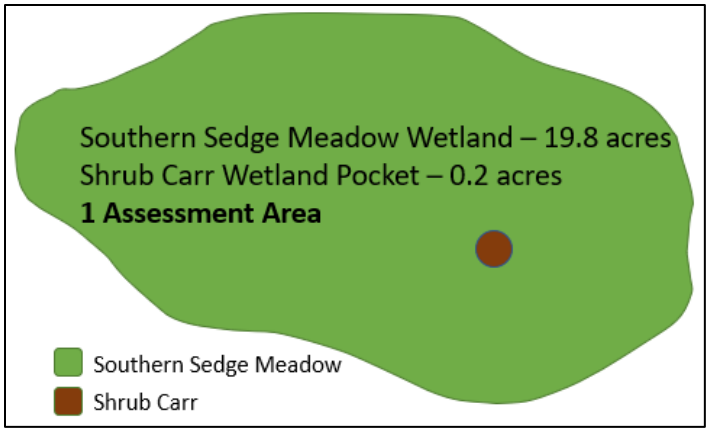


Figure 2. AA Homogeneity Example 1

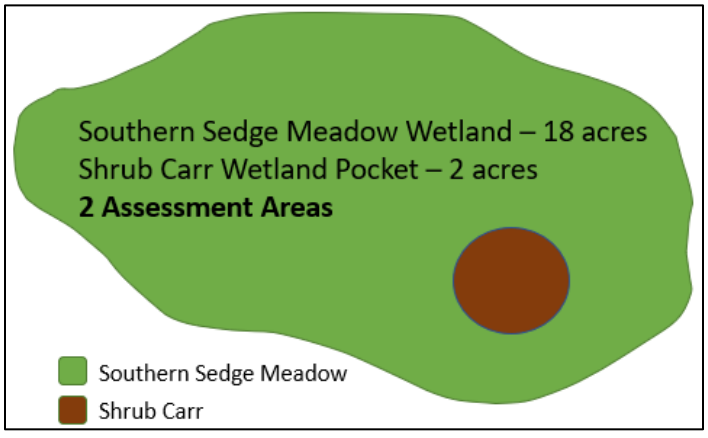


Figure 3. AA Homogeneity Example 2

3.1.1. Identifying Wetland Types

Each AA should be limited to one of the natural wetland community types as defined in DNR's NHC Wetland Community Classification Key (O'Connor 2023).While it is not necessary to identify a natural wetland community before field work, Assessors should have some familiarity with Wisconsin's wetland natural communities and how to distinguish them before going out into the field to allow AAs to be delineated in the field.

3.1.2. Assessment Area Size Guidelines

We recommend a minimum AA of 0.25 acres and a maximum of 10 acres. If the wetland area to be surveyed is greater than 10 acres, it can be divided into several AAs. As described above, wetlands less than 0.25 acres can be included within a larger AA of a different community type.

3.1.3. Identifying Wetland Disturbance

While reviewing imagery for field preparation make note of the presence of wetland alterations or stressors in the vicinity of the AA. Examples to look for include ditches, roads, impoundments, and agricultural activities. See the Disturbance Factors Checklist for a complete list. The Disturbance Factors Checklist and its user guide are attached as Appendix C and D or found in the FQA Calculator.

3.2. Equipment Needed

The following are the essential tools to complete a timed meander survey:

- Timed Meander Survey field form on weatherproof paper (or WDNRs FQA Calculator)
- The Disturbance Factors Checklist (DFC) on weatherproof paper (or WDNRs FQA Calculator.)
- Stopwatch or phone/tablet with timer app
- Hand lens (10X objective)
- Writing utensils
- Plant identification guide(s).
- Key to Wisconsin Natural Communities in paper or digital form.
- A tool to calculate location (e.g., a smart phone or tablet is suitable to provide start coordinates)
- Plant collection bags (XL and quart-sized)
- Other field gear for outdoor conditions (i.e., muck boots, sun protection, rain gear, etc.).

Optional:

- Soil probe, shovel, or garden knife (Hori Hori) for describing the soil and water level if below the surface.
- Optional: pH meter or kit for taking soil or water pH measurements.
- Optional: Small clippers or pocketknife for collecting woody specimen.

3.2.1. Forms for data entry

The TMS field form for entering plant data and accompanying disturbance factors checklist (DFC) exist as both a printed hard-copy (Appendix B) or electronically as the FQA Calculator (see WDNR Website for current version of FQA Calculator). Each FQA calculator contains three tabs for three separate AAs but blank forms can be copied if more are needed.

3.2.2. Plant ID guides/tools

Many plant identification guides appropriate for Wisconsin wetland plants are available, including floras intended for the Midwestern region or for neighboring states with similar floras - Michigan and Minnesota. At least one guide should be included that covers the entire flora instead of just the wetland

plants however, because many upland plants do occasionally find themselves in a wetland. In addition, the Online Virtual Flora of Wisconsin aligns closely with the plant names used in the FQA Calculator and is recommended for its Wisconsin range maps.

3.2.3. GPS

The Assessor should have a way to establish starting meander coordinates in latitude and longitude, decimal degrees preferred. This can be accomplished with a GPS or a smart phone that can provide coordinates. Starting coordinates should be recorded at the top of each AA form. Collecting the starting latitude and longitude is required. In addition to the start point creating a track of the meander path is highly recommended.

3.2.4. Other digital field tools

Recent aerial imagery can be helpful while in the field, preferably on a smart phone or tablet that has the capability of showing the Assessor's current location such as ArcGIS Field Maps, Google Earth or Avenza Maps. These apps can indicate where in the AA you are currently standing, and the extent of the community if the aerial imagery is of high quality. Another useful aid is to be able to measure AA sizes while in the field to determine if an inclusionary wetland is above or below the maximum threshold of 0.25 acres or to determine the estimated size of the AA. Printed hard copy maps using current aerial imagery may also prove helpful. In addition to estimating locations and areas, aerial imagery can be used before, during, or after an FQA assessment to aid in completing a Disturbance Factors Checklist at the end of the timed meander survey.

4. Timed-Meander Survey Field Procedure

The following directions for completing a timed meander survey in the field are adapted from the Timed Meander Sampling Protocol for Wetland FQA Standard Operating Procedure (SOP) (Trochlell 2015). The protocol is attached as Appendix A and can be referenced at any time.

4.1. Prepare to Survey

Define the Assessment Area (AA)

Once on-site, the Assessors should define the homogenous community type that will form the unit of assessment, the AA, reviewing community definitions (O'Connor 2023) if necessary. Assessment Areas should be homogeneous and at least 0.25 acres. When multiple community types are interspersed decide whether to lump or split them based on relative sizes and the needs of the project. Once the AA(s) is(are) confirmed, the Assessor should complete one FQA survey per AA. There may be multiple surveys completed within a single wetland complex or area of interest.

Designate Roles

At least two people should conduct the Timed Meander Survey. Designate a lead observer (usually the stronger botanist) and a data recorder for each survey. The lead observer will conduct the taxonomic identification. The data recorder will complete the Data Sheet and operate the timer. Both observers should take note of the relative abundances of species and participate in cover estimates at the end of the survey when possible.

Select a start point and begin filling out the form.

Choose a point well-within the boundary of the AA and fill out the site and survey information at the top of the Timed-Meander Data Sheet ("Data Sheet") or the FQA Calculator on a tablet. If using the FQA Calculator in Excel, see the tab labeled "Guide" detailed instructions.

- **Site names**: Write- in the Site Name (e.g., Crex Meadows Wildlife Area); an AA name – an informal name for the AA; and a Survey ID – a unique combination of numbers and letters.
- **Access route** - Provide details about the access route used to reach the wetland AA and any permissions needed for future visits.
- **Natural Community type**- Write in a natural community type using the DNR's Key to Wetland Natural Communities of Wisconsin.
- **Field surveyor or observer names-** all persons participating in the timed meander survey should be listed.
- **Start Point Coordinates--** Collect the latitude and longitude coordinates in decimal degrees of the start point using a GPS unit, smart phone, or tablet and enter them into the form.

4.2. Start the Timed Meander Survey

Start the survey by setting a countdown timer for 5 minutes and starting a track using a GPS or mobile device.
The timer will keep track of active search time as a measure of survey effort. Alternatives to recording a track include creating a polygon of the estimated boundary of the AA on a paper map or mobile mapping device.

Begin identifying and recording all species at the start point.
Record plants using the full species scientific name. Collect any unknown plants and record them using a temporary designation.

Once all species have been identified at the start point begin walking through the AA
Meander through the AA with the goal of a complete species inventory; intentionally seeking out diversity and recording each new species on the data sheet. Pause the timer temporarily whenever active searching has stopped (e.g., to consult field guides, or other interruptions). Stop to record with a waypoint and a photo any rare, threatened, or endangered species are found.

When the timer beeps, indicate on the data sheet the time interval that has passed ("0 -5"; "5 -10", "10 - 15") in the "time interval" column next to the last species entered.
Be sure to make clear on the data sheet the time interval in which each new species was recorded. Draw line under the last species found in the interval can help.

Restart the timer and continue the survey.
Continue to meander through the AA seeking out new species. This will continue for each of the consecutive 5-minute blocks of time ("10-15", "15-20", etc) until the survey has ended. Be sure to investigate all vegetation layers, making a point of periodically searching for small hidden plants in the understory.

Collecting unknowns
Unknown plants should be designated as such on the data form ("Unk sedge 1"), and sample collected for future identification, in a labeled collection bag. See DNR guidance on collecting plant samples. If possible, representative photos can also be taken of the plant, especially if it is too large to collect the whole specimen, or there are too few to collect without harming the population. In addition to complete unknowns, it is advisable to collect plants with an uncertain identification for later verification, especially if they have high cover in the community.

4.3. End the Survey

Stop the search when one of the following is true:

1. A pre-defined area has been completely searched;
   - *OR* -
2. 30 minutes of search time has elapsed AND one or zero new species were found during the most recent interval;
   - *OR* -
3. 30 minutes of search time as elapsed AND the number of species observed in the most recent 5 minute interval is less than 5% of the running total of recorded species (including unknowns).

The justification for ending the survey even if the entire area has not been explored, or a few species may be left undiscovered, is that if the community is homogeneous, at this point the survey has reached the point of diminishing returns, has likely captured 90 – 95% of the species richness, and 100% of the dominant and common species.

Once the species list is complete assign each species a percent cover based on an ocular estimate of the percent of the AA covered by the canopy of that species.
Estimate to the nearest whole number. For species that cover 1% or less, use 1. (Note in some protocols it may be preferable use 0.01% for species that are singular and occupy a "trace" amount of space.) Use visual guides of areal cover (Figure 3) to aid in estimation and confer between observers to avoid extreme values.

Record any additional site observations:
Users can make additional notes about the site. Examples of observations include:

- Water level (above or below ground)
- Soil texture and pH
- % areal cover of Sphagnum moss
- % areal cover of non-Sphagnum mosses
- Wildlife or other observation

Assess Disturbance with the Disturbance Factors Checklist (DFC)
Fill out the DFC with observations made during the survey in addition to any desktop reviews completed earlier. Alternatively, the Assessor can denote any disturbance (e.g., ditches, agricultural activities, roads, logging, in the AA or its surroundings) in the notes section of the timed meander data sheet.

4.4. Post-Survey Data Processing

Transcribing Data
If field data was entered using hard-copy field forms, it should be transcribed into the FQA Calculator in Excel. See the "Guide" tab on the calculator for instructions (Figure 4). Each FQA Calculator contains data entry forms for 3 AAs. However, these forms (Calc1, Calc2, etc..) can be copied to make more if necessary. Note that both the TMS data and the DFC for each AA should be transcribed to the FQA Calculator.

Department staff should send completed forms to the wetland monitoring and assessment team for inclusion in a centralized database. External partners can also submit completed FQA Calculator forms to the Department.

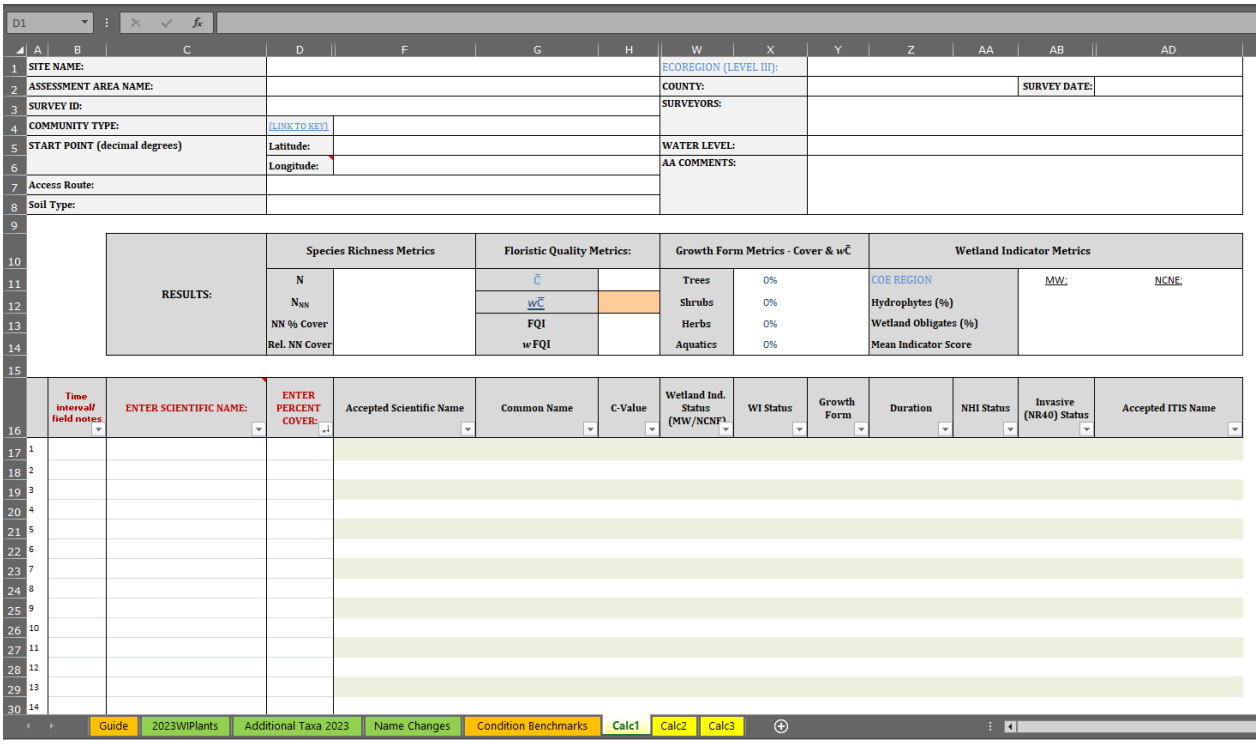


Figure 4. Screen grab from the FQA Calculator

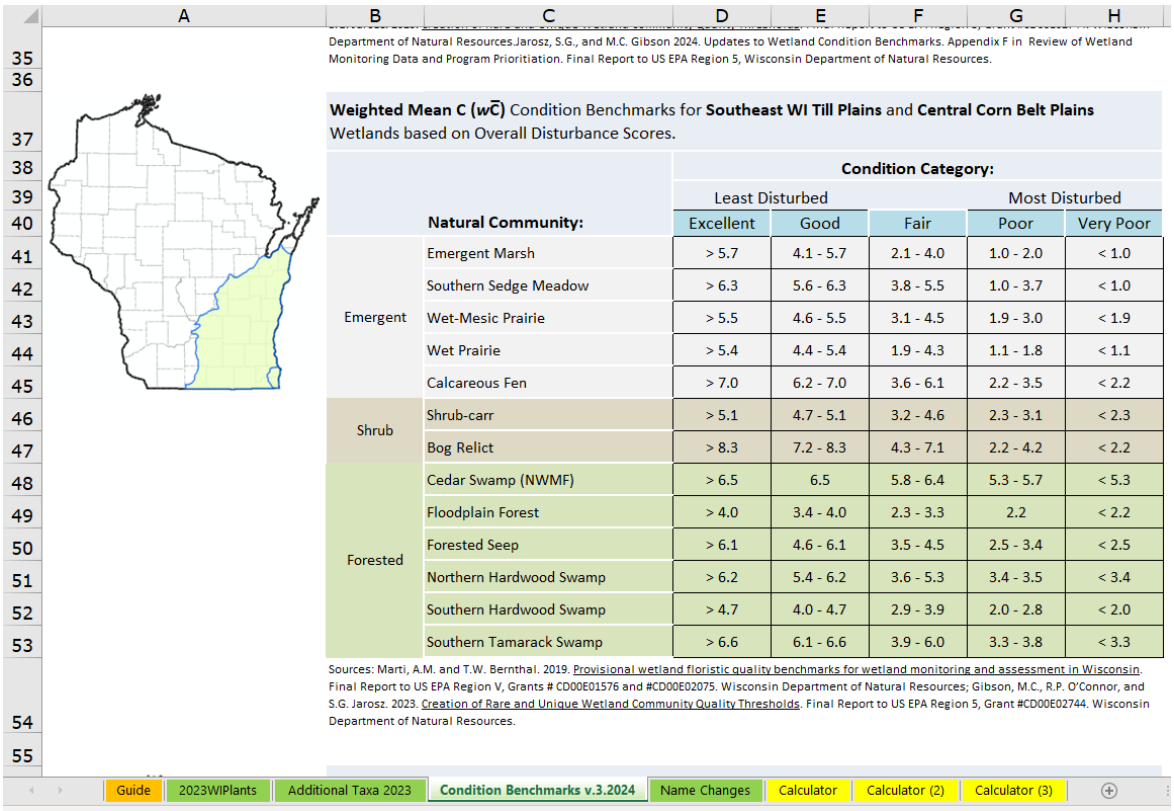
Results: Determining Condition: Excellent, Good, Fair, Poor, or Very Poor

The primary result of an FQA survey is the calculated mean conservatism metric ($w\bar{C}$), (highlighted in orange on the results section of the FQA Calculator) and the condition rating associated with this metric. Condition should be looked up by referring to the "Condition Benchmarks" tab on the FQA Calculator (Figure 5). In the Condition Benchmarks tab, look-up the condition tier using the following information: 1) Ecoregion (Level III), 2) NHC Natural Community type, and 3) $w\bar{C}$ or $\bar{C}$ score.

1. Determine Level III Ecoregion using the map on the "Guide" page on the calculator If a more detailed map is required, see EPA's website for more information and to download boundaries. Note that if the AA is in one of the smaller ecoregions (Western or Central Corn Belt Plains) numeric criteria have been combined with the larger adjacent ecoregion.

2. NHC Natural Community type is determined by referring to the Key to Wetland Natural Communities. A link is provided on the calculator.

3. Mean conservatism ($\bar{C}$) and weighted mean conservatism $w\bar{C}$ are automatically calculated once all data have been entered. Use the $w\bar{C}$ result for condition determination when possible. C benchmarks ($\bar{C}$) can be used when $w\bar{C}$ benchmarks for a particular community are not provided or for plant data lacking cover estimates for each species. Note that the Condition Benchmarks page lists wC condition benchmarks on the top. Scroll down to the bottom for $\bar{C}$ tables.



Department of Natural Resources.Jarosz, S.G., and M.C. Gibson 2024. Updates to Wetland Condition Benchmarks. Appendix F in Review of Wetland Monitoring Data and Program Prioritiation. Final Report to US EPA Region 5, Wisconsin Department of Natural Resources.

Weighted Mean C ($\overline{wC}$) Condition Benchmarks for **Southeast WI Till Plains** and **Central Corn Belt Plains** Wetlands based on Overall Disturbance Scores.

		Condition Category:				
		Least Disturbed				Most Disturbed
	Natural Community:	Excellent	Good	Fair	Poor	Very Poor
Emergent	Emergent Marsh	> 5.7	4.1 - 5.7	2.1 - 4.0	1.0 - 2.0	< 1.0
	Southern Sedge Meadow	> 6.3	5.6 - 6.3	3.8 - 5.5	1.0 - 3.7	< 1.0
	Wet-Mesic Prairie	> 5.5	4.6 - 5.5	3.1 - 4.5	1.9 - 3.0	< 1.9
	Wet Prairie	> 5.4	4.4 - 5.4	1.9 - 4.3	1.1 - 1.8	< 1.1
	Calcareous Fen	> 7.0	6.2 - 7.0	3.6 - 6.1	2.2 - 3.5	< 2.2
Shrub	Shrub-carr	> 5.1	4.7 - 5.1	3.2 - 4.6	2.3 - 3.1	< 2.3
	Bog Relict	> 8.3	7.2 - 8.3	4.3 - 7.1	2.2 - 4.2	< 2.2
Forested	Cedar Swamp (NWMF)	> 6.5	6.5	5.8 - 6.4	5.3 - 5.7	< 5.3
	Floodplain Forest	> 4.0	3.4 - 4.0	2.3 - 3.3	2.2	< 2.2
	Forested Seep	> 6.1	4.6 - 6.1	3.5 - 4.5	2.5 - 3.4	< 2.5
	Northern Hardwood Swamp	> 6.2	5.4 - 6.2	3.6 - 5.3	3.4 - 3.5	< 3.4
	Southern Hardwood Swamp	> 4.7	4.0 - 4.7	2.9 - 3.9	2.0 - 2.8	< 2.0
	Southern Tamarack Swamp	> 6.6	6.1 - 6.6	3.9 - 6.0	3.3 - 3.8	< 3.3

Sources: Marti, A.M. and T.W. Bernthal. 2019. Provisional wetland floristic quality benchmarks for wetland monitoring and assessment in Wisconsin. Final Report to US EPA Region V, Grants # CD00E01576 and #CD00E02075. Wisconsin Department of Natural Resources; Gibson, M.C., R.P. O'Connor, and S.G. Jarosz. 2023. Creation of Rare and Unique Wetland Community Quality Thresholds. Final Report to US EPA Region 5, Grant #CD00E02744. Wisconsin Department of Natural Resources.

Guide | 2023WIPlants | Additional Taxa 2023 | Condition Benchmarks v.3.2024 | Name Changes | Calculator | Calculator (2) | Calculator (3)

Figure 5. Screen grab of Condition Benchmarks tab from the FQA Calculator showing condition criteria for the Southeast WI Till Plains and Central Corn Belt Plains ecoregions.

Determining condition for ruderal wetland communities

Wetlands that key to one of the four ruderal wetland communities should be matched to an appropriate natural community for the purposes of determining a condition tier. Use Table 3 for suggested communities. When more than one natural community is possible, use ecoregion, soil, hydrology, or any remnant native indicator species to select the most appropriate match. Note that the natural community used to determine a condition category may not in fact be the community of the wetland before degradation, which normally is unknown. Rather, these are the communities that provide the best match in the present-day.

Table 3. Crosswalk between ruderal wetland communities and recommended natural community to use for condition benchmarks.

Community Classification	Condition Benchmark Community
Ruderal Wet Meadow	Northern Sedge Meadow
	Southern Sedge Meadow
	Wet Prairie
	Wet-mesic Prairie
Ruderal Marsh	Emergent Marsh
Ruderal Shrub Swamp	Shrub-carr
	Alder Thicket
Ruderal Flooded and Swamp Forest	Floodplain Forest
	Southern Hardwood Swamp
	Northern Hardwood Swamp

Missing numeric criteria for ecoregion or community

In cases where w$\overline{C}$ criteria are not provided for the community in the ecoregion of the wetland, users can first look to see if $\overline{C}$ criteria exist. Next, users can check to see if criteria exist in an adjacent ecoregion. It is acceptable to use the benchmarks in an adjacent ecoregion, but the discrepancy should be highlighted. In the absence of numeric criteria for a community type across the state, the result is the mean conservatism metric w$\overline{C}$.

5. References

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6. Appendices

Appendix A: Timed-Meander Sampling Protocol for Wetland Floristic Quality Assessment SOP (2016)

Appendix B: Timed-Meander Sampling Field-Form (hard copy version; 2024)

Appendix C: Wisconsin DNR Wetland Disturbance Factors Checklist Version 3/2024

Appendix D: Wisconsin DNR Wetland Disturbance Factors Checklist User Guide (2024)

Appendix A. Timed-Meander Sampling Protocol for Wetland Floristic Quality Assessment SOP (2016)

Timed-Meander Sampling Protocol for Wetland Floristic Quality Assessment

Wisconsin Department of Natural Resources

INTRODUCTION

This standard operating procedure (SOP) describes the methods used by the Wisconsin Department of Natural Resources to conduct timed-meander surveys of wetland plant communities to determine wetland plant community condition. This SOP should be used in conjunction with the Floristic Quality Assessment Methodology for Wisconsin (Bernthal 2003). This SOP is based on and modified from procedures first developed and employed by the Lake Superior Research Institute (LSRI) (LSRI 2013). Possible uses for this protocol include Natural Heritage Inventory (NHI) surveys of State Natural Area wetland plant communities, FQA Benchmark Project surveys, water quality standards compliance surveys, wetland restoration site monitoring and wetland assessments for regulatory purposes.

DESCRIPTION

In this method, wetland types are first identified using aerial photographs and/or site investigations of the potential wetland(s) to be sampled. Assessment Areas (AAs) composed of relatively homogenous vegetation, are defined prior to sampling but can be modified after the survey based upon the conditions and features encountered during the survey. Natural communities, as defined by the NHI natural community classification, serve as the foundational unit of sampling (Table 1). When multiple types are present at a site, multiple AAs must be defined. Assign a wetland AA to the natural plant community type that it most closely resembles. If the AA's plant assemblage does not match any Natural Heritage Inventory community, record the National Vegetation Classification (NVC) type, which includes ruderal/weed communities or describe the dominant vegetation type (e.g., herbaceous, shrub, forested).

Timed-meander start locations should begin far enough from the edge of a community type or from an anthropogenic disturbance (i.e., roadway, residential development, etc.) to avoid including transition zones from other plant communities in the survey. However, if the assessment area is surrounded by roadways, residential development, or other anthropogenic disturbance the timed-meander start location may be located at the edge of the disturbance. The survey consists of a search for all plant species present within a pre- or post- defined AA and an estimate of abundance and percent areal cover for each species at the end of the search period. The search takes place during timed intervals documented by the time keeper. The timer is paused when surveyors need to divert their attention from the search for any reason, such as conferring on an identification, documenting a rare species, or investigating an area with a plant composition different from the target community. The total time spent searching is an indication of search effort. All plant species are recorded when first observed and search intervals are documented on the Data Sheet. After all search intervals are complete, abundance and percent areal cover over the entire AA is estimated for each plant species, and notes on disturbance and other observations are documented.

The AAs must have homogeneous representation of wetland plants associated with each wetland community type. We recommend a minimum AA of 0.25 acres and a maximum 10 acres. If the wetland area to be surveyed is greater than 10 acres, it can be divided into several AAs. If a different wetland community type is encountered during a timed-meander

survey of a given targeted community type, the timer is paused and the size of the new plant community is evaluated. If the new type is greater than 900 m^2 (30m x 30m) (9688 ft^2, 98ft x 98ft or approximately 0.09 hectare (0.25 acre), then the area is excluded from the AA and the search remains paused until the surveyors return to the targeted plant community. If necessary, the new community would need to be evaluated by a separate survey. If the new type is less than 900 m^2 in size, the search is resumed and the small pocket can be treated as an inclusion within the primary wetland type.

Invasive plant species and anthropogenic disturbances should be observed during the walk to and from the AA, and noted in comments on the Timed-Meander Survey Data Sheet. Additional condition assessment tools may also be used to evaluate the wetland's health. For regulatory decisions, the Condition Assessment in Section 3 of the Wisconsin Rapid Wetland Assessment Methodology version 2 (Trochlell 2014) should be used. A Disturbance Factor Checklist is used for rating disturbance levels for the FQA Benchmark Project surveys. For future wetland condition surveys the Disturbance Factors Checklist or a modification of it will be used to assess stressors that may be causing an impairment to the wetland.

DEFINITIONS

Assessment Area (AA): Discrete, homogenous area of a target plant community that is to be thoroughly sampled during the timed meander survey. Large wetlands/wetland complexes may contain multiple wetland assessment areas.

EO - Element Occurrence: In the Natural Heritage Inventory, a population of a species or an example of a natural community or natural feature naturally occurring at a specific, ecologically appropriate location.

Search: Locating, identifying and documenting plant species presence, while mentally noting percent cover. Previously un-documented plant species are continuously added until the search interval is paused or ends.

Search Interval: A pre-defined time interval, maintained by the time keeper. The search time may be paused whenever the active search for additional species stops for various reasons, including taking time to work out difficult identifications, documenting rare species, adjusting the Assessment Area or other reasons.

PROCEDURE

1. Upon arrival at the site, the survey team of two or more people must completely fill out the top portion of the WDNR Timed-Meander Survey Data Sheet (Data Sheet) in Attachment 1 or other form for the Assessment Area (AA) to be surveyed. Use the Natural Heritage Inventory (NHI) Natural Community Descriptions to determine the appropriate plant community classification for the AA to be surveyed. If the survey involves an existing NHI Element Occurrence note the EO code. If the plant assemblage does not appear to match a natural community, note the dominant vegetation type from Table 1.

2. Start locations on the AA must begin at a point clearly within the target community type, away from transitional areas or anthropogenic disturbance (i.e., roadway, residential development, logging, ditching, etc.). The exception to this is that if an AA is immediately adjacent to an anthropogenic disturbance, then the start location may be located near the edge of this disturbance.

3. Travel to the AA start location and record any disturbance (e.g., invasive plants, logging, ditches) encountered while traveling to the survey start-up point in the notes section of the Data Sheet. This can also be completed at the end of the survey after the entire AA has been surveyed.

4. Take a waypoint at the survey start point using a handheld GPS unit. Record the starting point on the Data Sheet in decimal degrees. Indicate whether the GPS is set to a tracking function. This will create a record of survey locations over the course of the search. It is strongly recommended that either a GPS track be taken or an observed survey area be mapped out shortly after the survey in ArcGIS and saved as a shapefile or Geodatabase to create a location record.

5. Designate a lead observer and a data recorder for each survey; the observer will conduct the taxonomic identification and the recorder will complete the survey Data Sheet and operate the timer.

6. Record the start time (24 hour clock) on the Data Sheet and set the countdown timer on the watch for 5 minutes. Start the stop watch and begin timing the first, 5-minute interval of the timed-meander survey. Standing at the start point, record all plants (ideally to species) that can be seen from the four cardinal directions before moving forward in search of new species. Upon reaching the end of a 5 minute interval, the timekeeper should instruct other observer(s) to stop searching until the next time interval begins.

7. Record plants using the full species name or the Wisconsin State Herbarium taxon code. Because there are numerous and often conflicting resources for accepted plant names (USDA Plants, Flora of North America, various state herbaria lists etc.), it is important to limit confusion caused by using multiple names for the same species. Therefore, this protocol follows the Wisconsin State Herbarium's list of vascular flora, which has recently been updated to reflect the most recent taxonomic information and is available online. The State Herbarium nomenclature should be used for conducting plant surveys in Wisconsin.

8. Record on the Data Sheet and collect all unknown, uncertain, and/or difficult-to-identify plant species, which will later be keyed or identified by experts (or eliminated from the analysis if identification is not possible).

9. Advance the search from the start point once the initial plants from the area surrounding the start point are recorded. Proceed walking through the site, taking care to identify all species encountered and making sure to investigate all vegetation layers. The search must always stay within the targeted plant community type for the duration of the survey, with one exception:

    a. If a different plant community type is encountered during the search, stop the watch to pause the elapsed time and evaluate the size of the community. If the new community type is less than 900 m^2 (30m x 30m or 0.09 hectares, 9688 ft^2 (98 ft x 98 ft) or 0.25 acres) the timed meander survey can continue through that community type.

    b. If the new community type is greater than 900 m^2, pause the survey until the surveyors have returned to the target plant community.

10. After each 5 minute time interval, the recorder should note on the Data Sheet the time interval in which those plant species were observed (i.e. 0-5 minutes, 5-10 minutes, 10-15 minutes, etc.). At the end of each time interval the observers may wish to briefly confer over any unknown species before resuming the next time interval. This reduces the number of unknown species for later office determination.

11. If an interruption of the process is necessary (e.g., intensive consulting with field guides and conferring with other surveyors over a difficult identification, bathroom breaks, difficult terrain, or vegetation encountered), stop the timer to pause the interval, eliminating these interruptions from the elapsed search time.

12. Pause the search if a rare, threatened, and/or endangered species is observed. Record the plant species on the Data Sheet, the location of the plant using the handheld GPS, take a digital photo of the species, and note associated species and other relevant information needed for the NHI Rare Plant Form. Collect a specimen if authorized and warranted. Resume the stop watch after all field recording is noted. Detailed notes about species may be added to the Notes section of the Data Sheet. Refer to the species number in the note. Notes on hydrology, animals, structure, invasive species, and anthropogenic disturbances may be added during this time.

13. Typically a minimum of 30 minutes of total search time is needed to thoroughly search an AA. Stop the search when:
    a. A pre-defined area has been completely searched. For some uses of this SOP a search of an entire pre-defined area may be required, regardless of the time it takes, even if no new species are observed in a search interval, OR
    b. After 30 minutes of search time, one or no new species is found during the most recent 5 minute interval, OR
    c. After 30 minutes of search time, the number of species observed in the most recent 5 minute interval is less than 5% of the running total of recorded species (including unknowns). For example, if, after the 10^{th} five-minute interval (50

minutes of elapsed search time), 100 species have been observed, and 4 or fewer species were observed in the 10th 5-minute interval, the survey should be ended. The justification for ending is that the survey has reached the point of diminishing returns and has likely captured 90-95% of the species richness, and has likely captured 100% of the dominant and common species.

d. The search may end earlier than 30 minutes only if the entire AA has been thoroughly searched and no new species were found in the final interval.
e. Record the total search time in minutes on the Data Sheet.

14. After the last search interval is completed take an end point using a handheld GPS unit. Record the end point on the Data Sheet in decimal degrees.

15. Once the species list is complete assign each species a percent cover based on an ocular estimate of the percent of the AA covered by the canopy of that species (see Figures 1 and 2). Estimate to the nearest whole number. For species that cover 1% or less, use 1.

16. For each species, it is optional to assign an abundance code based upon the class categories listed in Table 2 below. Abundance estimates give a qualitative estimate of relative frequency and distribution and can be used to make comparisons with historically gathered site data. They also provide valuable data to compare species with small areal percent cover.

17. Record other data on the Data Sheet, including soil texture and pH on side 1, if taken. Additional animal species and other observations may be recorded in the Notes section at the bottom of the Data Sheet.

EQUIPMENT LIST

♦ Clipboard
♦ Compass
♦ Digital Camera
♦ Field Guides
♦ GPS Unit
♦ Digital watch with countdown timer
♦ Hand Lens (10X objective)
♦ Maps
♦ Markers
♦ Pencils (and sharpener/extra lead)
♦ Plant Collection Bags (i.e., Ziploc® Big Bags)
♦ Weather-Proof Datasheets

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Figure 1: Comparison chart for visual percentage estimation. NPS US Dept. of the Interior, Damage Assessment Handbook, 2002.

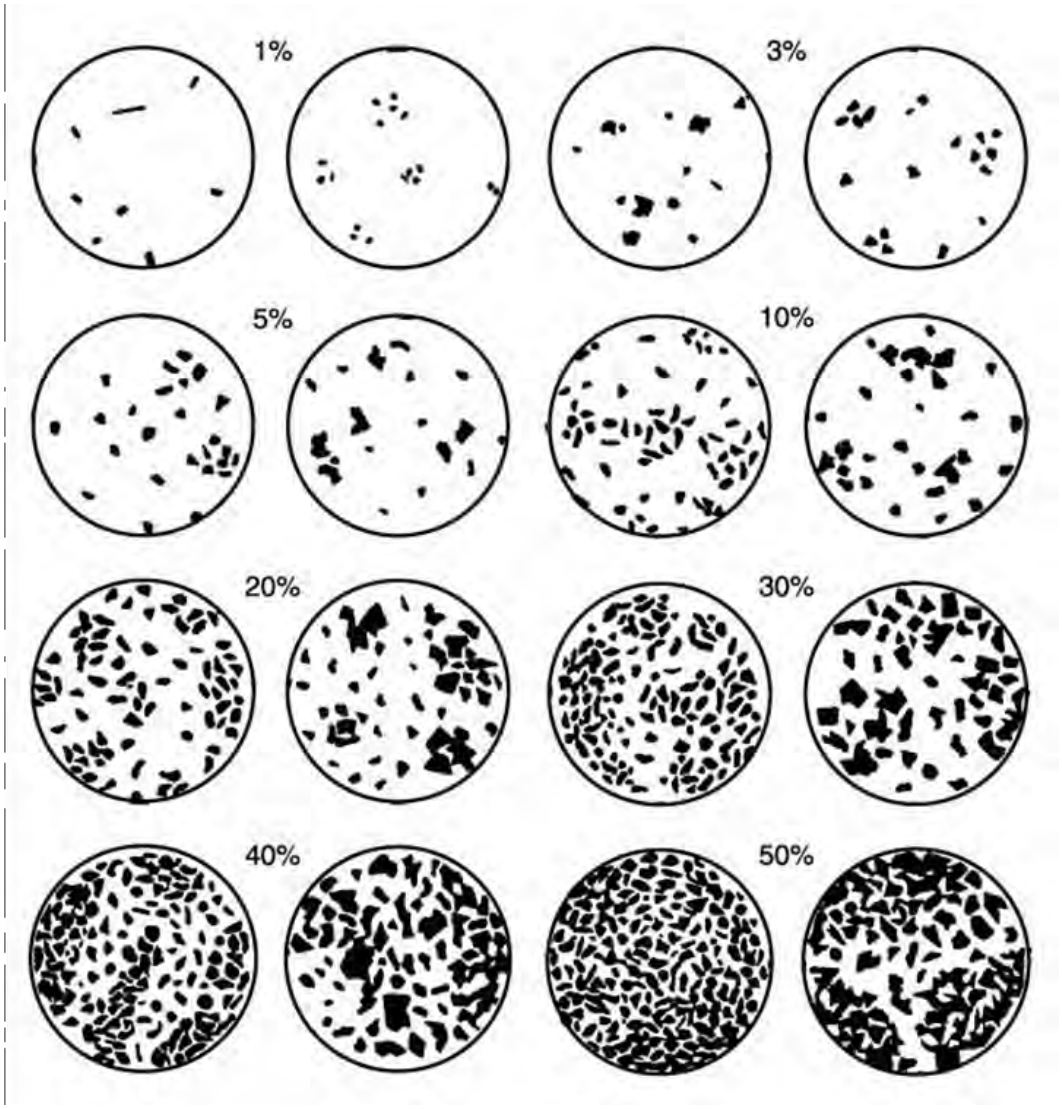


Figure 2: Cover estimates for timed-meander method. LSRI 2013.

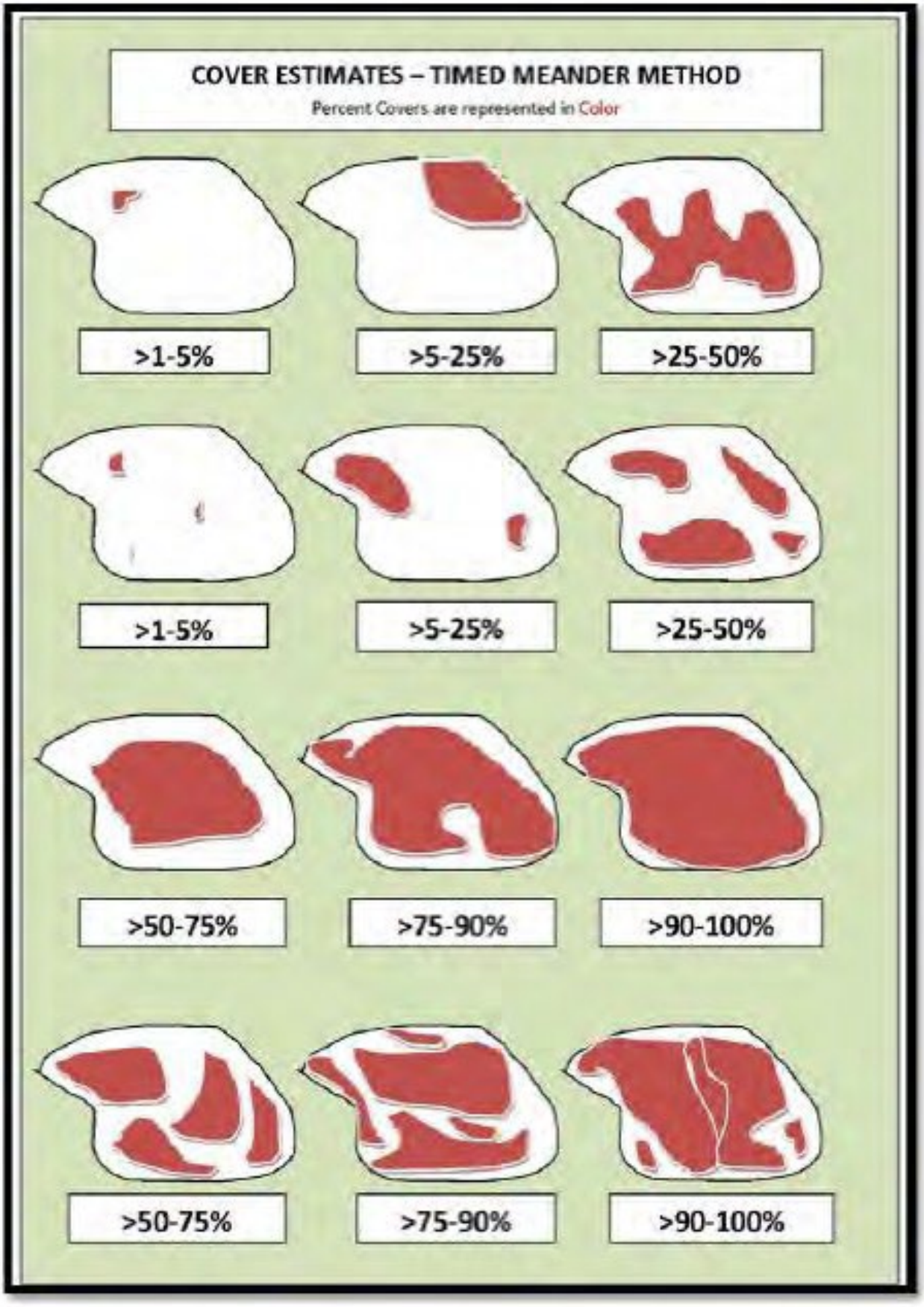


Table 1: Examples of Wetland NHI Natural Communities and Crosswalk to Eggers and Reed (2015) and National Vegetation Classification (USNVC 2.0).[1] (Bolded NHI Communities have FQI benchmarks in development in at least one ecoregion of Wisconsin)

NHI Natural community	Eggers and Reed (2015)	National Vegetation Classification	NVC CODE
Submergent Marsh	Shallow, Open Water Communities	Pondweed Northern Great Lakes Shore Herbaceous Vegetation	CEGL005273
		Midwest Pondweed Submerged Aquatic Wetland	CEGL002282
		Southern Great Lakes Submergent Marsh	CEGL005152
Floating Leaved Marsh		Water-lily Aquatic Wetland	CEGL002386
		Northern Water-lily Aquatic Wetland	CEGL002562
		American Lotus Aquatic Wetland	CEGL004323
Emergent Marsh	Deep and Shallow Water Marsh	Arrowhead - Rice Cutgrass Marsh	CEGL005240
		Northern Great Lakes Shore Emergent Marsh	CEGL005274
		Southern Great Lakes Shore Emergent Marsh	CEGL005112
		Midwestern River Bulrush Marsh	CEGL002221
		Bulrush - Cattail - Bur-reed Shallow Marsh	CEGL002026
		Midwest Mixed Emergent Deep Marsh	CEGL002229
		Midwest Cattail Deep Marsh	CEGL002233
		Wild Rice Marsh	CEGL002382
Northern Sedge Meadow	Sedge Meadow or Fresh (Wet) Meadow (native subtype)	Laurentian & Northeast Bluejoint Wet Meadow	CEGL005448
		Midwest Lake Sedge Wet Meadow	CEGL002256
		Northern Sedge Wet Meadow	CEGL002257
Southern Sedge Meadow		North-Central Bluejoint Wet Meadow	CEGL005449
		Midwest Lake Sedge Wet Meadow	CEGL002256
		Upright (Tussock) Sedge Wet Meadow	CEGL002258
		Upright (Tussock) Sedge Fen	CEGL005241
Wet-mesic Prairie	Wet to Wet-mesic Prairie	Lakeplain Wet-Mesic Prairie	CEGL005095
		Central Wet-Mesic Tallgrass Prairie	CEGL002024
Wet Prairie		Central Cordgrass Wet Prairie	CEGL002224
Ephemeral pond	Seasonally Flooded Basin	Midwest Ephemeral Pond	CEGL002430
Calcareous Fen	Calcareous Fen	Bog Birch / Leatherleaf Rich Fen	CEGL002494
		Prairie Transition Peat Rich Fen	CEGL002383
		Upright (Tussock) Sedge Fen	CEGL005241
		Dogwood - Willow - Poison-sumac Shrub Fen	CEGL005087
		Shrubby-cinquefoil / Dioecious Sedge Prairie Fen	CEGL005139
Open Bog	Open Bog	Open Graminoid / Sphagnum Bog	CEGL005256
		Leatherleaf Bog	CEGL005278
Boreal Rich Fen		Boreal Sedge Rich Fen	CEGL002500
Central Poor Fen		Midwestern Graminoid Poor Fen	CEGL005279
Muskeg		Tamarack Scrub Poor Fen	CEGL005226
		Black Spruce / Leatherleaf Semi-treed Bog	CEGL005218

NHI Natural community	Eggers and Reed (2015)	National Vegetation Classification	NVC CODE
Alder Thicket	Alder Thicket	Gray (Tag) Alder Shrub Swamp	CEGL002381
Shrub-Carr	Shrub-Carr	Red-osier Dogwood - Willow Shrub Swamp	CEGL002186
		Dogwood - Willow - Poison-sumac Shrub Fen	CEGL005087
		Dogwood - Willow - Blueberry Fen	CEGL005083
		Sandbar Willow Wet Shrubland	CEGL008562
Black Spruce Swamp	Coniferous Bog	Black Spruce - Tamarack / Labrador-tea Poor Swamp Forest	CEGL005271
		Black Spruce / Alder Intermediate Swamp	CEGL002452
Northern Tamarack Swamp		Northern Tamarack Swamp Forest	CEGL002472
		Northern Tamarack Rich Swamp Forest	CEGL002471
Southern Tamarack Swamp	Coniferous Swamp	Southern Tamarack - Red Maple Rich Swamp Forest	CEGL005232
Northern Wet-Mesic Forest (Cedar Swamp)		Midwest Northern White-cedar Swamp Forest	CEGL002455
		Northern White-cedar - Black Ash Swamp Forest	CEGL005165
White Pine-Red Maple Swamp	N/A	White Pine - Red Maple Swamp Forest	CEGL002482
Floodplain Forest	Floodplain Forest	Midwestern Silver Maple - Elm Floodplain Forest	CEGL002586
		Midwestern Cottonwood - Black Willow - Silver Maple Floodplain Forest	CEGL002018
		Bur Oak - Swamp White Oak Mixed Bottomland Forest	CEGL002098
Northern Hardwood Swamp	Hardwood Swamp	Red Maple - Ash - Birch Swamp Forest	CEGL002071
		Black Ash - Mixed Hardwoods Swamp	CEGL002105
Southern Hardwood Swamp		Maple - Ash - Elm Swamp Forest	CEGL005038
N/A (Disturbance Community)	Fresh (Wet) Meadow (disturbed subtype)	Eastern Ruderal Reed Canarygrass Marsh (Dominated by *Phalaris arundinacea*)	CEGL006044
	Deep and Shallow Water Marsh	Eastern North America Temperate Ruderal Common Reed Marsh (Dominated by *Phragmites australis* ssp. *australis*)	CEGL004141
	Shallow Open Water Communities	Eastern NA Ruderal Aquatic Vegetation Group (Dominated by *Myriophyllum spicatum* or other floating-leaved or submersed aquatic; Natives < 20-25%)	G595
	Shrub-Carr	Common Buckthorn Ruderal Shrubland (Wetlands dominated by *Rhamnus cathartica*).	CEGL005461
	Hardwood Swamp	Red Maple - Green Ash - Box-elder Ruderal Flooded & Swamp Forest Group (Dominants = *Acer rubrum, Fraxinus pennsylvanica*, or *Acer negundo*. Shrub and herb layer dominated by >80% exotics).	G552

[1] Additional wetland community types, e.g., patterned peatland, interdunal wetland, etc., may be surveyed. For a detailed description of each Natural Community, please refer to "Wisconsin's Natural Communities" on the WDNR NHI website.

Table 2. Abundance Classification

Symbol	Abundance Code	Description
A	Abundant	The dominant plants throughout the site
C	Common	Locally abundant or frequently encountered
O	Occasional	Occasionally encountered, or locally common but absent or infrequent across much of site
U	Uncommon	Infrequently encountered
R	Rare	Very few plants seen

Appendix B: Timed-Meander Sampling Field-Form (hard copy version; 2024)

WDNR Timed-Meander Survey Data Sheet

Site & AA Name _____ Date _____

Community Type _____ County _____

Access Route/ Owner _____ Surveyors _____

Start point (Dec Deg) _____ Track Name _____

Time	Species	%	Notes	Time	Species	%	Notes
0-5	1				29		
	2				30		
	3				31		
	4				32		
	5				33		
	6				34		
	7				35		
	8				36		
	9				37		
	10				38		
	11				39		
	12				40		
	13				41		
	14				42		
	15				43		
	16				44		
	17				45		
	18				46		
	19				47		
	20				48		
	21				49		
	22				50		
	23				51		
	24				52		
	25				53		
	26				54		
	27				55		
	28				56		

Additional Site Data:

Water Depth (in)* _____
*e.g., depth of water table above or below ground to 18".

Soil Type: _____

Soil pH: _____

Sphagnum (peat) moss % Cover: _____

Non-*Sphagnum* moss % Cover: _____

Time	Species	%	Notes	Time	Species	%	Notes
	57				89		
	58				90		
	59				91		
	60				92		
	61				93		
	62				94		
	63				95		
	64				96		
	65				97		
	66				98		
	67				99		
	68				100		
	69				101		
	70				102		
	71				103		
	72				104		
	73				105		
	74				106		
	75				107		
	76				108		
	77				109		
	78				110		
	79				111		
	80				112		
	81				113		
	82				114		
	83				115		
	84				116		
	85				117		
	86				118		
	87				119		
	88				120		

Notes:

Appendix C: Wisconsin DNR Wetland Disturbance Factors Checklist Version 3/2024

Wetland Disturbance Factors Checklist

DFC2024

Assessment Area (AA) Name:	Community Type:
Observers:	Date:

Instructions: *Consider whether the following alterations are present within the wetland AA (Soil and Vegetation alterations), or within both the wetland AA or catchment (Hydrologic and Nutrient Alterations). When present, rate the impact level as Low, Medium, or High depending on the size of the alteration, distance from the wetland and/or time since the alteration occurred. See DFC guidance document for more information.*	**Impact Level (L, M, H)**
HYDROLOGIC ALTERATIONS: *(Within AA or catchment)*	
Drainage structures (ditch, tile)	
Impounding structures (dam, dike, water control, road, rail)	
Flood barriers (levee, channelization, high banks)	
Altered surface water inputs/outputs (pipes, channels, gullies, grading)	
High capacity well (within 2 miles of AA boundary)	
Loss of natural land cover in catchment	
Dredging/ Excavation	
Other hydrologic alteration (write in):	
NUTRIENT/CHEMICAL ALTERATIONS: (*Within AA or catchment*)	
Agriculture (plowed fields, animal lots)	
Urban development (housing, golf course, lawns)	
Drained organic-rich soils	
Road salt application areas	
Pesticide/herbicide use:	
Other nutrient/chemical alterations (write in):	
SOIL ALTERATIONS: (*Within AA*)	
History of row-cropping, plowing	
Sedimentation	
History of earthwork (grading, etc.)	
Motor vehicle use (or other compaction sources)	
Fill, dumping	
Other soil alteration (write in):	

VEGETATION ALTERATIONS *(Within AA)*	**Impact Level (L, M, H)**
Mowing/cutting	
Logging	
Herbicide use	
High browse pressure (forested wetlands)	
Loss of tree or shrub canopy (disease, flooding)	
High public use (trails, boat launch)	
Fire suppression (fire dependent landscapes only)	
Invasive species cover >25%	
Other vegetation stressor (write in):	

OVERALL DISTURBANCE: *Based on <u>all</u> the alterations, what is the overall disturbance level at the site?* ***Select only one.***	
1	Non-disturbed: Very few alterations; none greater than low intensity.
2	Minimal: Small number of alterations of low intensity, none greater than moderate intensity.
3	Moderate: Alterations of mostly low and moderate intensity, no high intensity alterations.
4	Major: Many alterations, including at least one of high intensity
5	Severe: Many alterations, including multiple of high intensity.
OVERALL DISTURBANCE SCORE:	

PLANT COMMUNITY CONDITION: *<u>Based on the vegetation</u>, what is your best professional judgment of plant community condition (intactness) in this assessment area?* ***Select only one.***	
1	Natural structure & function of plant community maintained.
2	Minimal changes in structure and function.
3	Evident changes in structure & minimal changes in function.
4	Moderate changes in structure & minimal changes in function.
5	Major changes in structure & moderate changes in function.
6	Severe changes in structure & function.
PLANT COMMUNITY CONDITION SCORE:	

General comments regarding stressors or the condition of this wetland AA: Also note any management activities that may be improving wetland vegetation condition (prescribed fire, invasive species removal, nutrient management).

Appendix D: Wisconsin DNR Wetland Disturbance Factors Checklist User Guide (2024)

Wisconsin DNR Wetland Disturbance Factors Checklist User Guide

The Wetland Disturbance Factors Checklist (DFC) identifies and rates the severity of anthropogenic alterations negatively impacting wetlands. The DFC is intended to be a quick assessment to gather evidence in support of two ratings: an Overall Disturbance (OD) rating on a scale of 1 to 5 and a Plant Community Condition (PCC) score on a scale of 1 to 6 for a wetland assessment area (AA). The form should be filled out in the field following a vegetation condition survey or a walk-through based on stressors observed in and adjacent to the wetland. A desktop review, either before or after the site visit is recommended in addition to identify stressors not visible on the ground.

Instructions

In the field:

1. Fill out the DFC by writing "Low", "Medium", or "High" in the Impact Level column next to each disturbance factor observed. Use your best professional judgement to estimate the impact the disturbance factor is having on the wetland. Depending on the factor, you may consider the size of the disturbance, its proximity to the wetland, or age of the disturbance to estimate an impact level. Decisions should be made independently of your observations about the quality of the vegetation in the wetland, although the vegetation can offer clues.
2. Choose an Overall Disturbance score from 1 to 5 that best matches your answers in the Impact Level column.
3. Choose a Plant Community Condition score from 1 to 6 that best matches your observations of the intactness of the wetland plant community compared to an undisturbed, reference-quality example of the same community.
4. Under "General Comments" write in any comments you may have about stressors or the overall condition of the wetland AA.

In the office:

Review of desktop resources is important when assessing the disturbances that are located within the wetland catchment area or to identify some features, such as tile or plow lines, that are often easier to identify with aerial images than in the field. In some situations, the assessor does not have access to the catchment or portions of the assessment area (AA) and can use current and historical images to complete reviews of these areas. Use desktop viewers (details below) to check the following at minimum:

1. LiDAR surface elevation model for ground surface/soil alterations
2. WHD-plus catchments layer for % natural landcover in the catchment
3. Historical imagery to assess history of row-cropping, plowing.
4. The Drinking Water and Groundwater Viewer for high capacity wells within 2 miles of the AA boundary

Desktop resources to identify wetland disturbance factors:

- Wisconsin Wetland Inventory LiDAR Viewer
    a. LiDAR Based Elevation (DEM). This layer loads automatically in this viewer. LiDAR is high resolution elevation data that can detect the presence of ditches, old plow lines, fill, and other alterations.
        i. Elevation is color coded in this viewer (see Elevation color key on left of screen on Home page) to easily be able to see relative highs and lows in the landscape.
        ii. To see actual elevations in meters or feet, click on any point.
    b. Leaf-On or Leaf -Off aerial imagery (NAIP) and other layers are found under Map→ Layer List. It may be helpful to toggle off the wetland layer (WWI) for easier viewing.
    c. WHD-Plus Catchments under the Layers-→ Surface Water Resources→ WHD-Plus Catchments.
        i. Highlight the catchment: Click the Identify Tool in the top bar in the Home tab and click on your AA.
        ii. Find land use statistics for the catchment under Details by clicking on the results bar on the left after using the Identify tool. Summing the "Agriculture %" plus "Urban or Developed %" and subtracting from 100 can give an estimate of natural land cover.
    d. Dams & Floodplains Layer – for identifying dams that may be affecting the hydrology of wetlands associated with rivers. Select Dam & Floodplain in the Layers list.
    e. Original Vegetation Cover – this layer is found under the header "Forest Land Cover" and can be helpful to gauge the pre-settlement fire regime of the area surrounding the wetland. Look for yellow (Prairie, 12), yellow green (Jack Pine, barrens, 6), beige (oak woodland, 10), light pink (oak savanna, 11 and open lowlands,16).
- WDNR's Drinking Water and Groundwater (DG) Viewer (DNR Staff) can be used to check if high-capacity wells are present within 2 miles of the wetland. For non-DNR staff the WI Water Quantity Data Viewer will show approximate locations.
- **Wisconsin Historic Aerial Imagery Finder**
    a. Provides easy-to-access black and white aerial photos across the state for one of the years between 1937 to 1941.
    b. Can be used to check past land use and changes in vegetation.
- Google Earth Pro
    a. Recent high-resolution aerial imagery.
    b. Historical imagery from a handful of dates as far back as 1985 with varying quality. Note this feature is only available on the desktop version, Google Earth Pro.
- WEx -WDNR's Water Explorer
    a. Land use in the cumulative watershed in addition to the WHD-Plus catchment (incremental watershed) can be viewed.

b. Water quality results from data collected in local lakes and streams can be viewed when present, including total phosphorus, chlorophyll-a, and water clarity measurements.

Identifying disturbance factors: Location

A **wetland assessment area (AA)** is defined as a single homogeneous plant community in floristic quality assessment methodology and corresponds to a specific wetland natural community, (e.g. floodplain forest, shrub-carr) or class (e.g., "shrub, emergent, forested). The **catchment** refers to the area of land from which the wetland AA receives its water, both above and below ground. This may also be referred to as the drainage basin or watershed. The area of the catchment immediately surrounding the boundary of the wetland is referred to as a "buffer". While any disturbance within a wetland's catchment may impact the wetland, usually those in the buffer have the greatest effect. Past work has shown that land use within 300 meters or 1/5th of a mile from the center of the AA had the greatest correlation with wetland floristic quality, compared to 200 or 500m (Bernthal 2007). This suggests that the area of the catchment close to the wetland boundary should be given greater weight in terms of impact.

In the field, observations can be made of the area immediately adjacent to the wetland, making note of water inputs and land use. Desktop resources can provide a larger view: Within DNR's viewers, the best approximation of the wetland's catchment is found within the layer called "WHD-Plus Catchments". Some wetlands are fed by both a local drainage basin and a cumulative drainage basin when a stream or river enters the local drainage basin from an adjoining area. This bigger area is called the cumulative catchment. For our purposes, considering the most local catchment possible will be the most relevant. However, it might be worth considering the cumulative catchment in the case of riverine wetlands.

Disturbance factors are divided into four categories on the checklist: Hydrologic, Nutrient/Chemical, Soil, and Vegetation. The first two categories, Hydrologic and Nutrient/Chemical Stressors direct the observer to look both within the wetland assessment area (AA) and its catchment. The remaining 2 categories, Soil Stressors and Vegetation Stressors focus on alterations occurring directly within the AA.

Identifying disturbance factors: Explanation of individual alterations

HYDROLOGIC ALTERATIONS:

The user should use this section to identify disturbances to the wetland AA's natural hydrologic regime using their best professional judgement. Stressors should be identified within the AA as well as any hydrologic stressors within the AA's catchment.

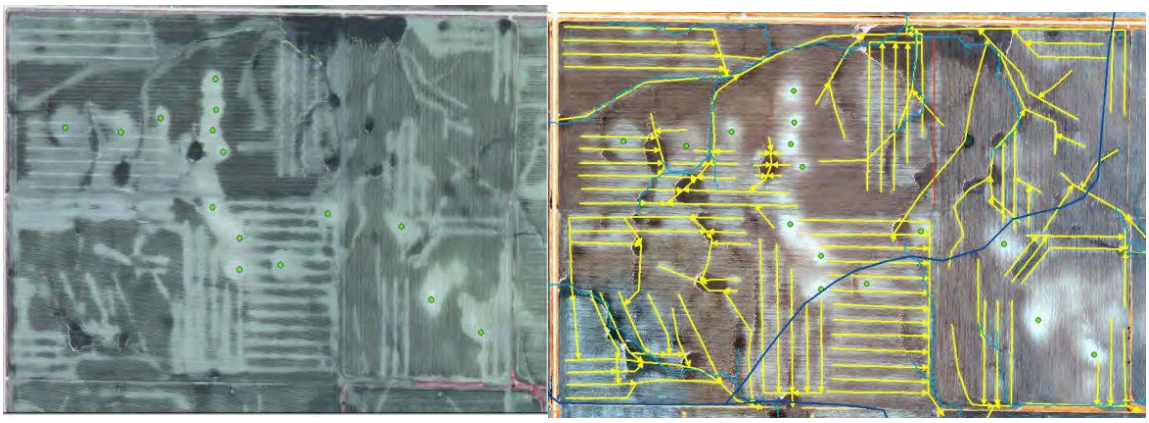
Drainage structures (ditches, tiles)

Agricultural drainage structures such as ditches and tile (underground plastic or clay channels) commonly remain in wetlands long after farming ceased. Intact ditches and tile lower the water table and alter the hydroperiod of wetlands. The larger, and deeper the ditch and the closer it is from the AA, the higher the drainage effect. Deep ditches with water continuously flowing off-site have the biggest, farthest-reaching effect, especially in soils with high hydraulic conductivity like

sand. Ditches are usually visible in the field, but LiDAR imagery can detect even smaller, older ditches hidden by vegetation.

Ditches that are shallow (< 1ft deep), obstructed, or in clay or muck soils will have limited water-table- lowering capacity. However, any remnant ditches or channels may be collecting or moving water and dewatering the upper soil layers to some degree.

Tile is generally too difficult to detect for the purposes of this checklist but occasionally clues are visible such as broken tile, outlet pipes exiting into a ditch, or tile lines may happen to be visible as dryer or wetter lines in aerial imagery (see below). The figure below is provided to show how extensive tile lines can be in a field and serve as an example of how tile might be arranged. Older tile systems from abandoned fields may have broken lines and may no longer be carrying water offsite, reducing the drainage effect. However, some areas may still be experiencing enough drainage to impact the plant community wherever the tile is intact.



(L) Aerial image of actively cropped field in Iowa showing patterns in soil wetness revealed after a rain. (R) The same field with tile identified by yellow lines. Note that plow lines are also visible and are more densely spaced than tile in these images. From iowaview.org

Impounding structures (dams, dikes, water control structures, roads, rail)

Any human-made structures acting to hold water longer than is natural should be noted here. Examples include dams associated with rivers to smaller impoundments or berms created to hold water for wildlife habitat. The impact to hydrology is likely to correlate with the size of the structure, both length and height, which can vary widely. Also, the materials used to construct the dam, and its structural integrity can relate to its effectiveness and permanence on the landscape. Wetland hydrology may be impacted on both sides of the structure, increasing the retention of surface water on one side, and dewatering the other side.

- The Dam & Floodplains layer in the WWI LiDAR Viewer indicates the location of many dams, dikes and levees associated with rivers and streams.
- LiDAR imagery can detect topographic alterations which may be impacting surface hydrology.

Flood barriers (levees, channelization, high banks)

This factor applies only to wetlands associated with surface waters that regularly flood, i.e., riverine, or lacustrine wetlands. When alterations exist that block natural flooding, e.g., stream channelization, spoil piles associated with ditches or channelized streams, or levees or berms intended to prevent flooding, wetland hydroperiods will be altered. In hilly agricultural landscapes, historical sedimentation along a stream bank can also create high banks reducing floodplain connectivity.

Altered surface water inputs, outputs (pipes, channels, gullies, grading)

Note the presence of pipes, channels or stormwater conveyance features designed to drain water to or from the AA. LiDAR imagery can be used to detect alterations to the ground surface surrounding the wetland.

High capacity well (within 2 miles of AA boundary)

High capacity wells have the capacity to withdraw more than 100,000 gallons of water a day for agricultural or municipal purposes. They reduce groundwater levels in a cone of depression around the well and have been shown to negatively affect ground-water dependent wetlands, particularly fens. Center-pivot irrigation systems can be visible in agricultural fields adjacent to wetlands. Most use a high capacity well to pull from groundwater aquifers but some may be using surface water.

Resources: WDNR's Water Quantity Data Viewer shows the location of high-capacity wells in Wisconsin. A high capacity well within 2 miles of the wetland AA boundary may be causing impacts. Impacts will increase with the number of wells in the area.

Loss of natural land cover in catchment

When natural vegetation is replaced with plowed fields, bare soil, impervious surfaces, or lawns, water runs off the surface of the land rather than infiltrating. The result is a decrease in groundwater supplies and an increased in surface flows to the wetlands which can change nutrient availability, favoring invasive species. As a rule of thumb, consider watersheds with less than 75% natural cover to be impacted to some degree. Both a scan of the area surrounding the wetland in the field and use of desktop resources to assess percent natural land cover are recommended.

Resources: WWI LiDAR Viewer → Surface Water Resources →WHD-Plus Catchments. Use the "identify tool" to select the catchment and view % Urban or Developed and % Agriculture in the Details panel.

Dredging/excavation

Excavation creates areas of water too deep for wetland vegetation and may have a draining effect in adjacent areas. These efforts can also release previously stored toxins or nutrients that can impact vegetation condition and/or water quality.

NUTRIENT/CHEMICAL STRESSORS:

Look for the presence of the following stressor in both the wetland AA and its catchment. Knowledge of the historical presence of these factors may also be considered. Wetlands with surface water inputs from a river or stream may also be impacted by the larger, cumulative watershed.

Agriculture (plowed fields, animal lots)

Agricultural land in the catchment of the AA, especially plowed fields, are a source of herbicides, fungicides, fertilizers, and sediment to downstream wetlands. For instance, the USDA reported that in 2021 88 % of Wisconsin corn fields received 142 pounds of nitrogen per acre on average. Herbicide was applied to 95% of corn acres and fungicide to 22% of acres. Wetland vegetation is sensitive to changes in nutrient availability, typically responding with increases in non-native invasive species and a reduction in diversity. The presence pf natural vegetation between fields and the wetland can mitigate the effects of plowed areas but if they were absent in the past, legacy nutrients and sediment may continue to be impacting the wetland. Slope may also be a factor for consideration, with steeper slopes generally leading to greater runoff.

The Landcover tab in WEx can be used to estimate the percent cover of Continuous Corn or Cash Grain or other agricultural land uses in the incremental watershed.

Urban development, (housing, golf course, lawns)

Developed urban and suburban areas can be a source of many chemical pollutants including oil, grease, pesticides, fertilizers, road salt, heavy metals, and human and pet waste. The Landcover tab in WEx can be used to estimate the percent cover of developed land uses in the incremental watershed of the AA.

Drained organic-rich soils

Organic and muck soils develop under continuously saturated, anoxic conditions; therefore, the presence of unsaturated, dried mucky soils is usually a sign of an alteration. The source of the drainage may or may not be apparent, but the effect is elevated nitrogen and phosphorus due to the decomposition of organic matter in the soil. Look for black soils with a greasy or spongy texture that may be moist but not flooded or saturated.

Road salt application areas

This stressor applies when roads or other large, paved surfaces likely to be receiving regular salt applications in the winter months are present and draining to the wetland. (Examples are highways, county roads, parking areas). To avoid duplication, this stressor can be disregarded if Urban/suburban development (above) has already been indicated.

Pesticide/herbicide use

To avoid duplication, this stressor can be disregarded if Agriculture (Plowed fields, animal lots) (above) has already been indicated. Though herbicide use within the wetland AA is uncommon, those under management for invasive or nuisance species may be receiving herbicide applications. Other sources of herbicides include rights-of-way (roads, railroads, transmission lines) and new forestry plantings. Herbicide runoff may be directly detrimental to wetland vegetation or indirectly by affecting soil microbes and increasing nutrient availability.

SOIL ALTERATIONS:

The user should use this section to identify disturbances to the wetland soil structure, composition, chemistry, or other physical and chemical properties. Stressors should be identified only within the AA.

History of row-cropping, plowing

This factor only refers to plowing within the wetland AA and the alteration of soils that results. Plowing or row cropping has long-lasting effects on soil properties and reduces natural topographic variation. The degree of soil alteration is likely to correlate with the number of years the site was plowed. Remnant ditches are a sign the site was likely to have been plowed even if only for a few years. If a site is reasonably flat and accessible it was likely to have been used to grow crops at some point in time, particularly in the southern 2/3 of the state.

Resources:

- Aerial imagery, especially LiDAR imagery, can reveal old plow lines in the soil surface.
- Wisconsin Historic Aerial Imagery Finder can be used to find an image of the site between 1937 – 1941.

Sedimentation

Sedimentation refers to burial by a significant layer of fine-grained sediment from uphill erosion in post-European settlement times. The silty soil accumulation raises the soil surface above the anoxic zone, changes the wetland hydroperiod, and raises nutrient levels, leading to colonization by species adapted to drier conditions and higher nutrient levels such as reed canary grass.

Look for sedimentation in hilly terrain at the base of slopes and stream banks where it can entrench streams, i.e., lift the banks high above the surface of the water. Sometimes it can be seen on LiDAR imagery as a flattened areas fanning out from the base of a slope or along streams. Sedimentation can be confirmed in the field by looking at the soil profile and finding the dark organic layer buried under a lighter colored silt layer. Sedimentation can also be a legacy of dam removed.

History of earthwork (grading)

Earthwork also has long-lasting effects on soil properties including soil structure, loss of microtopography, and soil compaction from heavy equipment use. The degree of soil alteration will correlate to the degree of earthwork in extent, depth, and the equipment used.

Motor vehicle use

Look for signs of soil compaction such as off-road vehicle use, a history of the use of heavy machinery from excavation or grading activities, or extensive use of the wetland for cattle browse.

Fill, dumping

Look for evidence of materials having been deposited in the wetland (e.g., spoil piles or trash) that now bury the original surface.

VEGETATION ALTERATIONS:

The user should use this section to identify disturbances to the wetland AA's vegetation and rate their impact using best professional judgement. Stressors should be identified only within the AA boundary.

Mowing/cutting

Mowing wetlands for marsh hay is a common example. Include historical vegetation removal activities if signs are still evident. While these should be noted as stressors, a small amount can be harmless or even beneficial to a wetland, especially where they mimic low-level natural disturbances such as fire.

Logging

Clear-cutting a wooded wetland is an example of a high impact in this category. Additional examples may include forested thinning and underbrush forestry mowing. In most logging operations, not only are the trees disturbed, but much of the understory vegetation is also disturbed or lost entirely; it may be multiple years before vegetation is able to re-establish. The type, extent, and recurrence of logging should be considered when evaluating the intensity of impacts.

Herbicide use

Herbicide application, as intended, will kill some or all of the plants it comes in contact with. The type of herbicide application, the extent, and the impacts of the herbicide across the full extent of the wetland vegetation should be considered.

High browse pressure (forested wetlands)

Note whether the wetland has been used to graze cattle or in forested wetlands, look for signs that white tailed deer are abundant (trails, browse, and sleeping areas). Many forested wetlands are currently being over-grazed by deer, reducing tree regeneration (especially white cedar, eastern hemlock, and oaks). When deer are over-abundant, grasses, sedges, and ferns dominate at the expense of a diversity of herbs, especially orchids, trilliums, and lilies.

Loss of tree or shrub canopy (disease, pests, or flood event)

Look for patches of standing dead trees or shrubs. Common causes may be emerald ash borer or a flood event. The loss of an entire canopy alters the structure of the vegetation but may also affect hydrology due to the loss of transpiration and the increase in surface and ground water that follows.

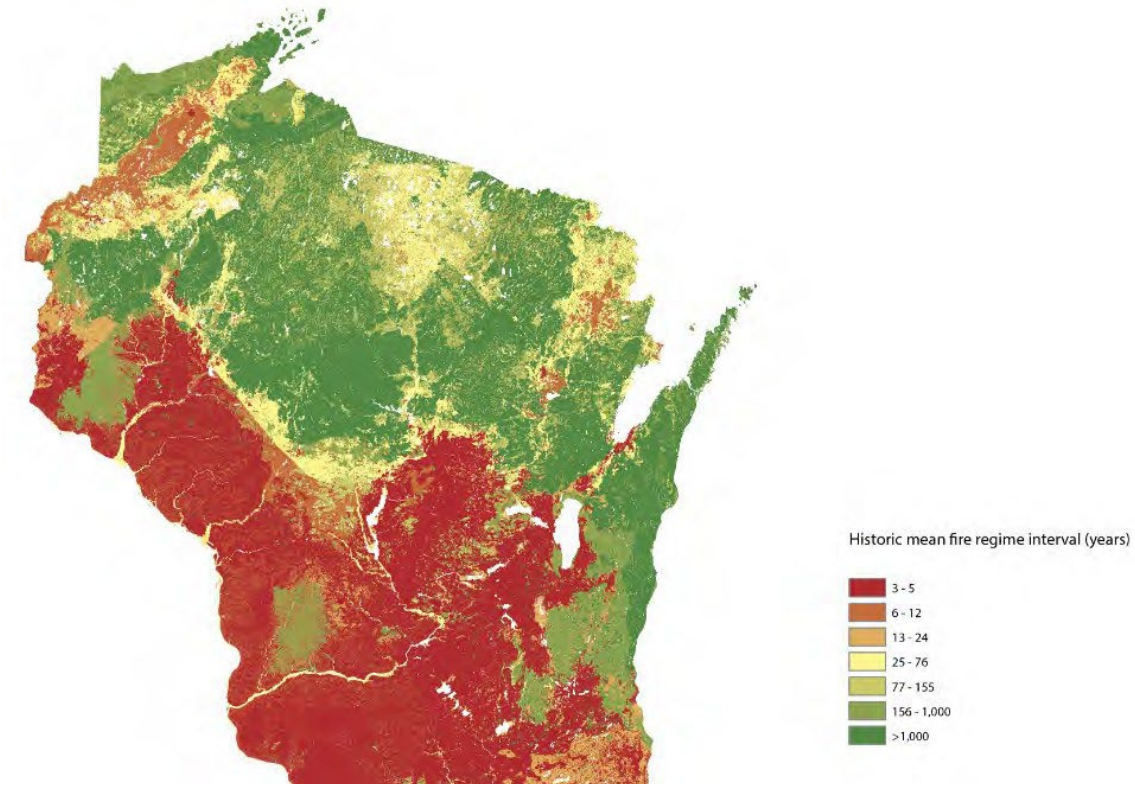
High public use (trails, boat launch)

High public use can facilitate the spread of non-native species, introduces pollutants, and causes some degree of degradation of soils and vegetation.

Fire suppression (fire dependent landscapes only)

Fire suppression may be a factor in open wetlands (sedge meadows, fens, wet-to wet-mesic prairies, and open peatlands) where shrub growth has become high, reducing diversity. Wetlands occurring in parts of the state that historically had the highest fire frequency are shown in red and

orange in the map below and may be considered the most altered by fire suppression. Areas in yellow might be considered at moderate risk of the negative effects of fire suppression for the purposes of this checklist.



Source: LANDFIRE Biophysical Settings model, 2016. Landfire.gov. https://staceymarion.com/fna/

For more fine scaled mapping, use the Original Vegetation Cover spatial layer, found in the WWI LiDAR viewer and the Surface Water Data Viewer. Wetlands found in areas indicated as prairie, oak openings, and barrens should be considered especially fire dependent while pine-dominated areas might be considered moderately impacted.

Invasive species cover > 25%

Wetlands in which 25% or more of the native vegetation cover has been replaced by non-native species are likely to be negatively impacted by the displacement through changes to structure, regeneration, nutrient cycling, or other ecological processes. While invasive species are also considered to be a consequence, rather than a cause of wetland degradation, once established and widespread they can add additional impacts.

Final Scoring

Choose an Overall Disturbance (OD) Score for the wetland between 1 (undisturbed) to 5 (severely disturbed taking into consideration all the disturbance factors indicated in the checklist and their impact levels. When deciding if disturbance factors are “many” and/or “high intensity” keep in mind that because disturbance factors are interrelated in various ways, there may be some double-

counting inherent in the form, or, conversely there may be a single disturbance factor that results in a cascade of other disturbance factors that may not all be accounted for in the form.

Next, choose a Plant Community Condition Score (PCC) for the wetland between 1 (intact) to 6 (severely altered) taking into consideration all observations of the plant community. How intact is the wetland plant community? How does it compare in its physical structure or functioning to an undisturbed or reference example of the same community in the region? The PCC score is intended to provide a rating of the condition of the plant community independent of how many disturbance factors were observed to account for variation in the way individual wetlands respond to alterations. Each wetland will respond differently depending on landscape position, size, the relative balance of surface and groundwater inputs, and water chemistry.

The PCC score should be considered optional in cases when the DFC was filled out in the absence of a floristic quality survey (FQA).

References

Bernthal, T.W., J. Kline, and A. Reis. 2007. *Floristic Quality Assessment Benchmarks for Wetlands in Southeast Wisconsin. Final Report to USEPA-Region V.* Wisconsin Department of Natural Resources.