Rapid Floristic Quality Assessment Manual

Minnesota Pollution Control Agency

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Cover Photo

A Shallow Marsh community dominated by *Carex lacustris* Willd. (lake sedge) in Cass county. Photo taken by Michael Bourdaghs.

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Contents

1 Introduction

The goal of Minnesota's 'no net loss' wetland policy is to "achieve a no net loss in quantity, quality and biological diversity of Minnesota's wetlands" (Minn. S. 103A 201). While no net loss is often referred to primarily in terms of wetland quantity (acres), the policy clearly includes aspects of wetland quality. Wetland quality monitoring and assessment approaches are therefore needed to measure whether no net loss goals are being met.

Nationwide, there has been a great interest in developing wetland monitoring and assessment techniques, particularly those that can be done quickly. These are known as Rapid Assessment Methods, or RAMs. RAMs are generally qualitative, where the user makes relatively simple on-site field observations to answer categorical questions, and the method can be done with no more than a half day in the field and a half day of office preparation (Fennessy et al. 2004). In this way, RAMs rely on coarse level information that can be quickly obtained, potentially in exchange for greater accuracy that more detailed (or quantitative) assessment approaches might provide. This degree of on-site/rapid/qualitative based assessment has been described as Level 2 in the U.S. Environmental Protection Agency's hierarchical monitoring and assessment classification, falling in between landscape scale/Geographic Information System (GIS)/remote sensing (Level 1) and on-site/intensive sampling/quantitative based (Level 3) monitoring and assessment (US EPA 2006).

RAMs have been developed to measure wetland functions (i.e., the goods and services that wetlands provide) as well as wetland condition (i.e., the deviation of a wetland from a natural or minimally impacted state). Examples include the Minnesota Routine Assessment Method (MnRAM; MN BWSR 2010) which evaluates a suite of different wetland functions and the Ohio (Mack 2001) and California (Collins et al. 2008) RAMs which focus on measuring wetland condition. While functional and condition assessment approaches have often been viewed as unrelated or competing methodologies, they rely on many of the same concepts and are complimentary (Stevenson and Hauer 2002). As evidence of this, both the MnRAM and ORAM have been used in regulatory applications in their respective states.

In addition to the RAMs, there has been much corresponding work to develop Level 3 wetland monitoring and assessment approaches. In MN, these include a hydrogeomorphic (HGM) functional assessment approach for prairie potholes (Gilbert et al. 2006) and macroinvertebrate and vegetation Indices of Biological Integrity (IBIs) that assess depressional marsh condition (Gernes and Helgen 2002, Genet and Bourdaghs 2006, Genet and Bourdaghs 2007).

The Floristic Quality Assessment (FQA) is a vegetation based ecological condition assessment approach that has increasingly been used for wetland monitoring and assessment. FQA is based on the Coefficient of Conservatism (*C*), which is a numerical rating (0 – 10) of an individual plant species' fidelity to specific habitats and tolerance of disturbance–natural or anthropogenic (Swink and Wilhelm 1994). Species that have narrow habitat requirements and/or little tolerance to disturbance have high *C*-values and vice versa. *C*-values are typically assigned for state or regional floras by a group of local botanical experts using consistent guidance and relying on best professional judgment. *C*-values have been developed for many local floras including MN's wetland flora (Milburn et al. 2007). FQA metrics are derived from on-site vegetation sampling data and the *C*-values. They have repeatedly been found to be responsive and reliable wetland condition indicators (Lopez and Fennessy 2002, Cohen et al. 2004, Mack 2004, Bourdaghs et al. 2006, Miller and Wardrop 2006, Rocchio 2007, Milburn et al. 2007) and one of the most frequently used class of metrics in wetland vegetation based monitoring and assessment methods (Mack and Kentula 2010). FQA is typically a considered a Level 3 assessment approach–requiring intensive vegetation sampling by highly trained botanical experts.

Recognizing these competing factors (i.e., the effectiveness of FQA vs. the expertise and intensive sampling barrier to broad usage), the MPCA began a project in 2008 to explore if RAM concepts could be successfully applied to the FQA. Through multiple field trials, a simplified vegetation sampling approach was developed that relies on a plant species checklist and meander type sampling. The checklist has been limited to the

more common and easier to identify species and the meander type sampling can be done rapidly and varies according to site complexity. In addition, data from numerous minimally impacted and severely impacted wetlands were used to develop quantitative assessment criteria that can be used to translate metric scores into meaningful wetland condition assessments. The result of the project is the Rapid FQA (Bourdaghs 2012).

The target Rapid FQA users are natural resource professionals that have a moderate (or greater) level of wetland botanical expertise in MN. The Rapid FQA should be applicable for many wetland monitoring and assessment applications including:

- Ambient and long term status and trend monitoring
- Mitigation sequencing
- Restoration monitoring and mitigation performance standards
- Local and regional planning
- Identifying candidate high quality preservation wetlands

This manual provides the basic knowledge and guidance to complete a Rapid FQA. The details behind the Rapid FQA–including how the sampling methods and assessment criteria were developed–are provided in: *Development of a Rapid Floristic Quality Assessment* (Bourdaghs 2012). The *C*-values for the wetland species of MN are available from: *Floristic Quality Assessment for Minnesota Wetlands* (Milburn et al. 2007). All the FQA reports and associated data forms and files can be found at the MPCA FQA webpage.

2 Key Concepts & Components

The Rapid FQA incorporates a number of novel sampling approaches as well as a recently introduced assessment framework that may be new to most natural resource professionals that have experience sampling wetland vegetation or have done wetland monitoring and assessment. The user should understand the following key concepts and components before proceeding to do the Rapid FQA–as they are referred to frequently in the step-by-step instructions presented in Sections 3 (Rapid FQA Field Sampling Protocol) and 4 (Metric Calculations & Assessment) of this manual.

2.1 The Assessment Area

The Assessment Area (AA) is the wetland area that is being represented by the Rapid FQA sampling. The Rapid FQA sampling approach was designed with the flexibility to be able to sample the wide variety of wetlands that occur in MN. Thus, AAs can vary in size and shape and according to the needs of the user (Figure 1). AAs can be defined as an entire wetland basin–but wetlands often don't occur as discrete basins. Where wetlands are more extensive, an AA can be established in a portion of a larger continuous wetland area. The key factor is that the AA is defined. Discrete breakpoints that can be used to define individual AAs include: upland boundaries; road crossings; constrictions; water control structures; beaver dams; and deep water habitats. Arbitrary AA boundaries can also be established in extensive wetland areas that are poorly defined by obvious breakpoints or when a project needs to only focus on a small area. While sampling trials indicated that AA size alone had no significant effect on Rapid FQA results (Bourdaghs 2012)–it is recommended that AA's not exceed 100 ha (or 250 acres) in size. Few trials have been conducted on AAs larger than this and it is unknown if the Rapid FQA continues to be accurate at this scale.

A

B

C

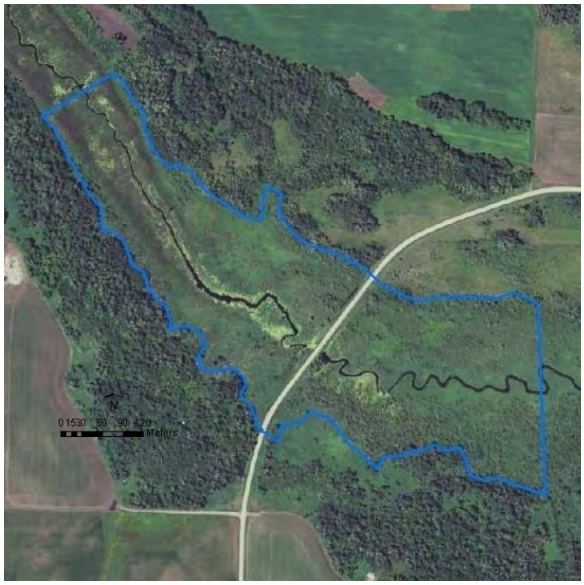

Figure 1. Example AAs (within blue boundaries). A) A relatively large (22.5 ha) depressional wetland with a clear upland boundary that defines the basin. B) Four depressional wetland basins ranging in size from 0.1 – 2.7 ha within a larger work area. Three of the basins are bounded by upland. The smallest basin (SW corner of work area) is cut off from previously adjoining wetland by a road bed. C) Riparian wetland adjacent to a low order stream. Arbitrary boundaries were established as contiguous wetland area extends well beyond the road crossing. The road and stream channel (deep water habitat) were not considered to be significant enough features to map.

2.2 Plant Communities

The natural and impact response ranges of FQA metrics vary significantly according to plant community types (Rooney and Rogers 2002, Milburn et al. 2007, Bourdaghs 2012). This is likely due to plant communities developing under different disturbance regimes. *C*-values are a measure of a species' tolerance to disturbance (both natural and anthropogenic) so FQA metrics will express these differences across community types. Because of this, plant community types should be the basic general sampling and assessment unit and classification is needed for any FQA use.

The Rapid FQA follows the classification system presented in *Wetland Plants and Wetland Plant Communities of Minnesota and Wisconsin* (Eggers and Reed 2011, Table 2)–with a few exceptions. In the Rapid FQA, the Sedge Meadow and Fresh (Wet) Meadow classes have been combined into a single Fresh Meadow type, and the Seasonally Flooded Basin class has been excluded due to insufficient available data to develop assessment criteria for the type (Bourdaghs 2012).

Table 1. Eggers and Reed (2011) plant community classes and brief class descriptions. Two classes have been slightly modified from the original classification. Fresh Meadow combines both the Eggers and Reed Sedge Meadow and Fresh (Wet) Meadow classes into a single class. The Seasonally Flooded Basin class is not being considered at this time.

Community class	Description
Shallow Open Water	Open water aquatic communities with submergent and floating leaved aquatic species
Deep Marsh	Emergent vegetation rooted within the substrate that is typically inundated with > 6" of water. Submergent and floating leaved aquatic species typically a major component of community
Shallow Marsh	Emergent vegetation on saturated soils or inundated with typically < 6" of water. May consist of a floating mat. Submergent and floating leaved aquatic species typically a minor component
Fresh Meadow	Graminoid dominated, soils typically saturated
Wet Prairie	Similar to Fresh Meadow but dominated by prairie grasses
Calcareous Fen	Soils calcareous peat (i.e., organic w/high pH) due to groundwater discharge with high levels of calcium/magnesium bicarbonates. Specialized calcareous indicator species (calciphiles) present-dominant
Sedge Mat	Graminoid dominated communities on circumneutral or slightly acidic peat soils. Often occurs as a floating mat and *Carex lasiocarpa* (wiregrass sedge) is often a dominant
Open Bog	Low shrub or graminoid dominated community on a mat of *Sphagnum* moss/acidic deep peat. Specialized acid tolerant (indicator) species dominant
Coniferous Bog	Forested community dominated by coniferous trees on a mat of Sphagnum moss/acidic deep peat. Specialized acid tolerant (indicator) species dominant
Shrub-Carr	Tall shrub community typically dominated by Willows (*Salix* spp.). Typical understory species composition similar to Fresh Meadow
Alder Thicket	Tall shrub community typically dominated by Alder (*Alnus incana* ssp. *rugosa*)
Hardwood Swamp	Forested community dominated by deciduous hardwood trees on saturated soils
Coniferous Swamp	Forested community dominated by coniferous trees on saturated soils. Soils typically circumneutral or slightly acidic
Floodplain Forest	Forested community dominated by deciduous trees on alluvial soils associated with riverine systems

When conducting a Rapid FQA, the plant communities need to be identified according to the Eggers and Reed (2011) classification and mapped within the AA (Figure 2). Sampling effort will occur (and data will be recorded) separately by type. Assessments will then be made for each community, as the assessment criteria are specific for each type. The community proportions from the mapping are then used to make the overall AA assessment.

Rapid FQA users should understand and be able to confidently determine Eggers and Reed (2011) community types in the field–as differences in interpretation can potentially cause large errors (Bourdaghs 2012, Appendix 6).

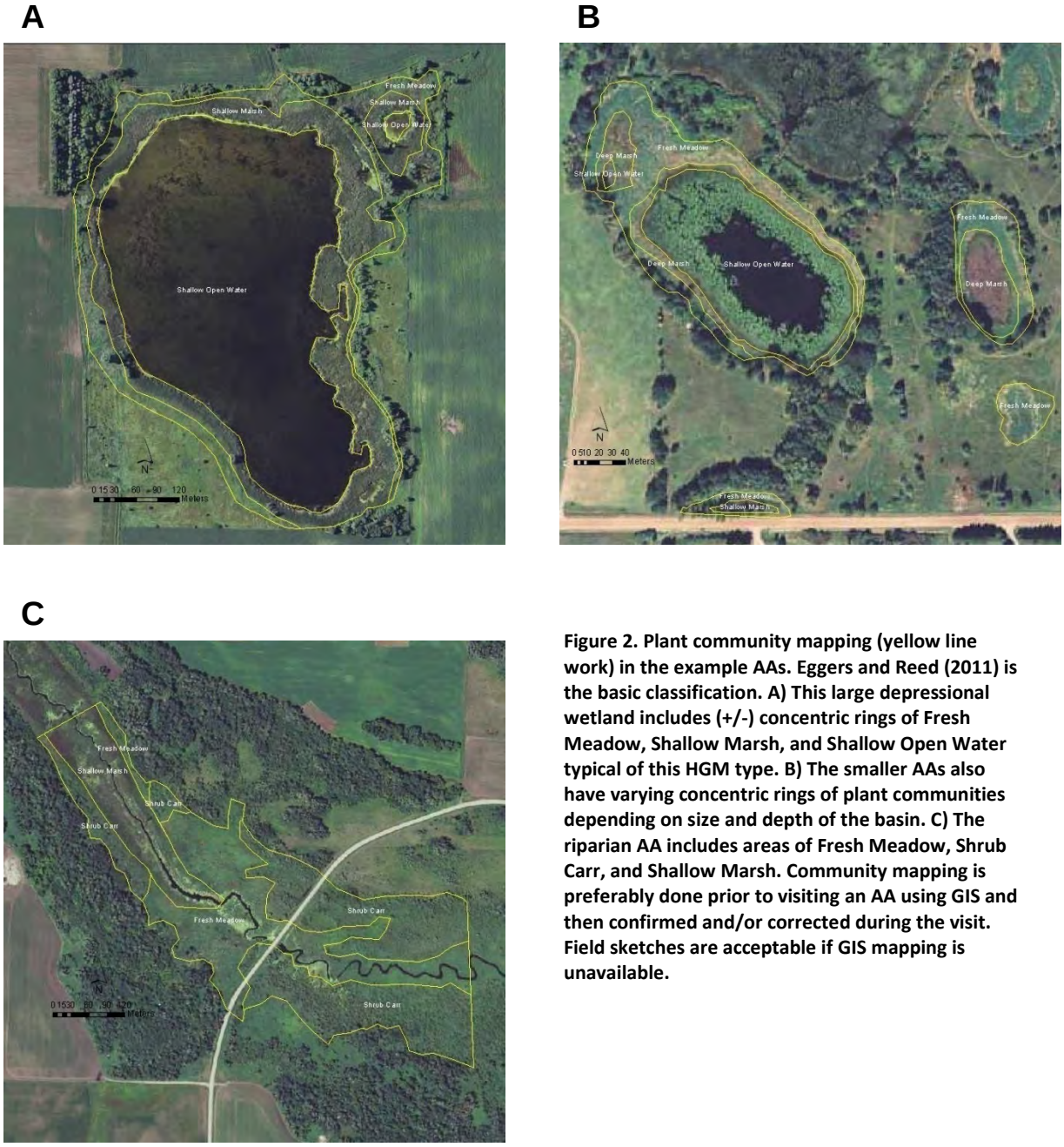

Figure 2. Plant community mapping (yellow line work) in the example AAs. Eggers and Reed (2011) is the basic classification. A) This large depressional wetland includes (+/-) concentric rings of Fresh Meadow, Shallow Marsh, and Shallow Open Water typical of this HGM type. B) The smaller AAs also have varying concentric rings of plant communities depending on size and depth of the basin. C) The riparian AA includes areas of Fresh Meadow, Shrub Carr, and Shallow Marsh. Community mapping is preferably done prior to visiting an AA using GIS and then confirmed and/or corrected during the visit. Field sketches are acceptable if GIS mapping is unavailable.

2.3 The Rapid Species List

A high level of botanical expertise is typically required to conduct detailed wetland vegetation surveys. In addition, a great deal of effort is often spent identifying the more difficult to identify species–either in the field or back in the office. In an effort to reduce the level of botanical expertise required and adapt the approach so that it falls within the spectrum of a RAM, the Rapid FQA focuses on only the more common and easier to identify species. To do this a 'Rapid Species List' has been created (Appendix 1). This was done by systematically rating all of the plant species that occur in MN wetlands according to: 1) how frequently they occur 2) how distinct they are in appearance; and 3) whether or not they are dominant species. Ratings were completed by a panel of botanists following consistent guidance. The more common and/or easier to identify species were then selected for the Rapid Species List according to the ratings (Bourdaghs 2012).

The Rapid Species List is a central component of the Rapid FQA that not only reduces time in the field, but should also allow natural resource professionals with a moderate degree of wetland botanical expertise to conduct the method. The user should be able to identify and know the scientific names of most of the Rapid List Species that occur within the community types that they commonly work with, as the Rapid FQA sampling is limited to only those species on the Rapid Species List.

2.4 The Data Form

RAMs often rely on simplified data forms that contain the various checklists and categories necessary to facilitate ease of use in the field. This model has been followed for the Rapid FQA, where the data form is a single two sided sheet (Appendix 2). The majority of the data form is the Rapid Species List which essentially serves as a species checklist. When species are observed the user simply has to find the name and mark the data form instead of writing down plant names.

The top section of the form has space for general information. Each form has room for three community types that are recorded in numbered spaces. Typically, a single data form is needed to complete a Rapid FQA for an AA–though additional data forms can be used when AAs exceed three community types. The Rapid Species List is then organized by growth form/strata that (+/-) follow the US Army Corps of Engineers (US ACE) vertical strata used in wetland delineations (US ACE 2010a, US ACE 2010b, US ACE 2012):

- Aquatic Stratum – true aquatic plants that are submergent or have floating leaves
- Tree Stratum – woody plants with typical maximum growth ≥ 3” DBH
- Shrub Stratum – woody plants with typical maximum growth < 3” DBH
- Woody Vine Stratum – all woody vines
- Herb Stratum – all non-aquatic herbaceous plants (e.g., forbs and graminoids) and woody plants with typical maximum growth < 1m tall

Species are then listed alphabetically on the form by scientific name for each stratum. There are three spaces in front of each name that correspond to the communities present in the AA (recorded in the Community Information section). Species presence data is recorded by drawing a circle around the corresponding space when a given species is observed in a community. For example, if Community #1 record for an AA is Fresh Meadow–and *Calamagrostis canadensis* (Michx.) P. Beauv. (bluejoint) is observed while sampling in the Fresh Meadow–the leftmost space in front of *C. canadensis* would be circled. A circle is used so that a cover class can be recorded in the circle following the meander sampling for each species by community type.

2.5 Seasonal Sampling Period

The preferred Rapid FQA seasonal sampling period is generally June-September. During the sampling method trials FQA metrics were found to be stable (and thus returning reliable results) during this time (Bourdaghs 2012). This part of the growing season is typically when the majority of wetland plant species can be readily identified. Prior to June, most wetland plant species are not mature enough to identify during most years (in MN). Likewise, following a hard frost in the fall many species senesce in most years. At both ends of the season plant identification becomes unreliable, affecting the accuracy of the Rapid FQA. Adjustments to the sampling period can be made due to year-year weather at the discretion of the user (e.g., warm spring, early frost).

2.6 Timed Meander Sampling

The Rapid FQA relies on a progressive timed meander sampling approach. In other words, sampling essentially consists of walking around the AA recording the ‘Rapid Species’ that are present for a specified amount of time–with additional time added to the meander according to the complexity of the site and the rate that new species are observed. The approach is ‘plotless’ requiring no equipment or predetermined

points. Sampling effort is measured in terms of time. The meander sampling approach provides great flexibility to meet the challenge of sampling AAs of varying size and complexity. Larger and/or more diverse AAs will tend to have longer timed meanders as more species are present and vice versa. The progressive timed meander also accounts for the speed at which the observer works. Advanced users may complete an AA within the minimum meander time; whereas, a less experienced user should be able to collect comparable data with additional time. Following the meander, areal cover is estimated by cover classes (Table 2) for the species observed by each community present in the AA.

The timed meander rules that guide how the meander proceeds and when it ends are specified in Sections 3.3 – 3.4. All users should be familiar with the timed meander rules prior to conducting a Rapid FQA.

Table 2. Cover classes, cover class ranges, and percent cover midpoints.

Cover Class	Cover Class Range	Midpoint
7	> 95 - 100%	97.5%
6	> 75 - 95%	85%
5	> 50 - 75%	62.5%
4	> 25 - 50%	37.5%
3	> 5 - 25%	15%
2	> 1 - 5%	3%
1	> 0 - 1%	0.5%

2.7 Shoreline Sampling

Water depth and the presence of deep unconsolidated muck are often prohibitive to sampling the Shallow Open Water community type by foot. A shoreline sampling approach has been developed for the Rapid FQA adapted from rake-tow lake aquatic vegetation surveys typically done from boats (Bourdaghs 2012). The shoreline sampling consists of establishing three shoreline sampling stations at representative locations along the emergent vegetation/Shallow Open Water interface (Figure 3). At each station, aquatic species that are observed within visual range are recorded. In addition, aquatic species that are observed when a handheld garden cultivator tied to a 20' length or rope is tossed a retrieved through the Shallow Open Water community are recorded (Figure 4). Three retrieves are made per station: once perpendicular from the shore and both (+/-) 45° from perpendicular. Only aquatic species that are on the Rapid Species List (Appendix 1) are recorded. Areal cover estimates are then made for the community based on the observations from the three sampling stations.

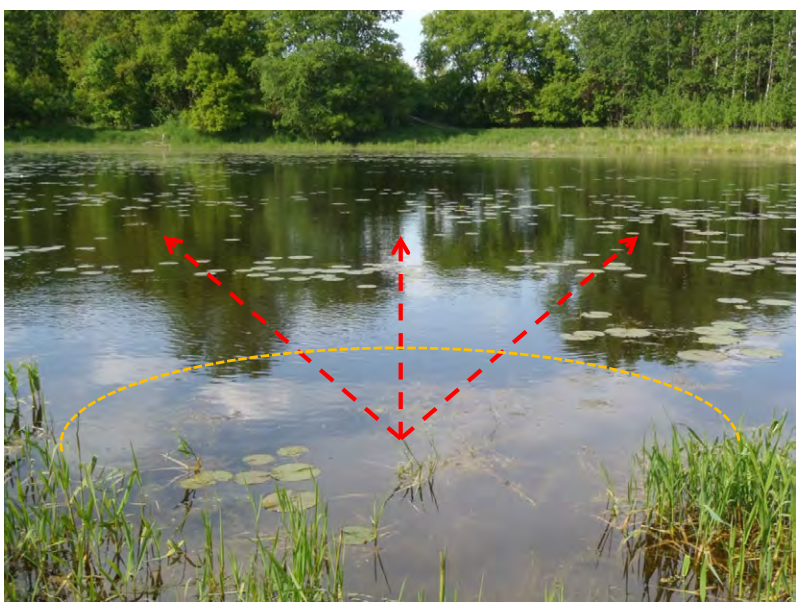

Figure 3. An example Shallow Open Water shoreline sampling station. Record all rapid aquatic species occurring within visual range (orange dashed line) and from three retrieves of the garden cultivator tows (red arrows). Three separate shoreline sampling stations are established at representative locations for sampling Shallow Open Water communities.

Figure 4. Handheld garden cultivator used for shoreline sampling (left) tied to a 20' length of rope with a loop tied on the end to prevent losing the cultivator. The tines are bent backwards to increase grip on aquatic vegetation. The cultivator is tossed and retrieved (above left) three times at each sampling station and aquatic rapid species are identified (above right).

2.8 Metrics

Field sampling is typically only one part of conducting a RAM. The other is calculating scores or metrics from the field data and making the assessment. A number of metrics can be derived from vegetation data and *C*-values–many variations of which (such as whether to include or exclude introduced species) have been introduced and discussed elsewhere (Milburn et al. 2007). The most prominent FQA metrics are the Mean *C* (the average Coefficient of Conservatism) and the *FQI* (the square root of the native species richness multiplied by the Mean *C*). While many different metric calculations can be made for the Rapid FQA, the primary assessment metric is the weighted Coefficient of Conservatism (*wC*)–which incorporates species abundance into the calculation. *wC* is the sum of each species' proportional abundance (*p*) for a community multiplied by its *C*-value:

$$wC = \sum pC$$

wC was chosen as the primary metric because sampling effort has no effect on *wC*–unlike species richness metrics (and subsequently the *FQI*) which increase with sampling effort (Rooney and Rogers 2002, Bourdaghs et al. 2006, Bourdaghs 2012). *wC* has also been found to be a more responsive indicator of wetland condition than Mean *C* (Bourdaghs 2012) due to sites often having similar species composition (but differing abundance distributions) at varying degrees of anthropogenic impacts (Table 3).

To support the increased computation involved with *wC* an Excel spreadsheet calculator has been developed where data can be entered and the metrics are calculated (Appendix 3). The Rapid FQA calculator is available on the MPCA FQA webpage.

Table 3. A hypothetical example illustrating metric calculations when two communities (Fresh Meadow #1 and #2) have the same species composition but different abundance distributions. The top table lists the scientific names of the species observed and their respective *C*-values (C) as well as the Cover Classes (CC); Midpoint % cover (Mid); proportional abundance (Midpoint % cover/Total Midpoint % cover); and the proportional abundance x the *C*-value (*pC*) used to calculate *wC* for both Fresh Meadow #1 and #2. The bottom table summarizes the metrics. Both Meadow #1 and #2 have the same species richness, Mean *C*, and *FQI* values. Meadow #1 has a low abundance of the non-native/invasive *Phalaris arundinacea* L. (Reed canary grass) and subsequently has a high *wC* score (4.3) compared to Meadow #2 which has a high abundance of *P. arundinacea* (1.0).

			Fresh Meadow #1					Fresh Meadow #2			
Scientific Name	***C***		**CC**	**Mid**	***p***	***pC***		**CC**	**Mid**	***p***	***pC***
Calamagrostis canadensis	4		5	62.5	0.5556	2.2222		3	15	0.1364	0.5455
Phalaris arundinacea	0		2	3	0.0267	0.0000		6	85	0.7727	0.0000
Carex stricta	5		4	37.5	0.3333	1.6667		2	3	0.0273	0.1364
Carex lacustris	5		2	3	0.0267	0.1333		1	0.5	0.0045	0.0227
Salix petiolaris	5		2	3	0.0267	0.1333		2	3	0.0273	0.1364
Solidago gigantea	3		1	0.5	0.0044	0.0133		1	0.5	0.0045	0.0136
Rubus idaeus ssp. *strigosus*	3		1	0.5	0.0044	0.0133		1	0.5	0.0045	0.0136
Lycopus uniflorus	5		1	0.5	0.0044	0.0222		1	0.5	0.0045	0.0227
Mentha arvensis	3		1	0.5	0.0044	0.0133		1	0.5	0.0045	0.0136
Typha latifolia	2		1	0.5	0.0044	0.0089		1	0.5	0.0045	0.0091
Impatiens capensis	2		1	0.5	0.0044	0.0089		1	0.5	0.0045	0.0091
Rumex orbiculatus	6		1	0.5	0.0044	0.0267		1	0.5	0.0045	0.0273

Metric	**Fresh Meadow #1**	**Fresh Meadow #2**
Native Spp. Richness	11	11
Introduced Richness	1	1
Mean *C*	3.6	3.6
FQI	11.9	11.9
wC	4.3	1.0
Total Midpoint % Cover	112.5	110
Introduced Spp. % Cover	3	85
Introduced Proportion	0.03	0.77

2.9 The Biological Condition Gradient

The final step in any type of wetland condition assessment is to convert metric results into a meaningful assessment which can then be used to inform management decisions. The Rapid FQA relies on a general model of biological response to anthropogenic impacts called the Biological Condition Gradient (BCG; US EPA 2005) as an underlying theoretical framework for the assessment criteria (Bourdaghs 2012). The BCG describes biological condition according to tiers that range from conditions that are equivalent to those found prior to European settlement– to conditions that are found at sites that are severely impacted. A five tier BCG model specific to wetland vegetation has been developed for the Rapid FQA (Table 4). While the BCG includes five tiers, the Rapid FQA only describes Tiers 1-4. Tier 5 represents a wetland condition where

wetland vegetation is no longer supported (e.g., farmed wetland, storm water pond) and the Rapid FQA is not applicable. Assessment criteria have been determined for each community type (as each community type has different natural and response ranges) by calibrating *wC* scores to the BCG using 725 vegetation samples primarily from the MN Department of Natural Resources County Biological Survey and the MPCA (Bourdaghs 2012).

To complete a Rapid FQA, users will be required to place *wC* scores into the appropriate BCG Tier using a table and then compute a composite BCG Tier for the AA based on the proportions of each community in the AA. Instructions on how to do this are provided in Section 4 (Metric Calculations & Assessment). Users should be familiar with the wetland vegetation BCG (Table 4) as the final Rapid FQA assessment results will be expressed as BCG Tiers.

Table 4. The general wetland vegetation Biological Condition Gradient.

BCG Tier	Description
1	Community composition and structure as they exist (or likely existed) in the absence of measurable effects of anthropogenic stressors representing pre-European settlement conditions. Non-native taxa may be present at very low abundance and not causing displacement of native taxa.
2	Community structure similar to natural community. Some additional taxa present and/or there are minor changes in the abundance distribution from the expected natural range. Extent of expected native composition for the community type remains largely intact.
3	Moderate changes in community structure. Sensitive taxa are replaced as the abundance distribution shifts towards more tolerant taxa. Extent of expected native composition for the community type diminished.
4	Large to extreme changes in community structure resulting from large abundance distribution shifts towards more tolerant taxa. Extent of expected native composition for the community type reduced to isolated pockets and/or wholesale changes in composition.
5	Plant life only marginally supported or soil/substrate largely devoid of hydrophytic vegetation due to ongoing severe anthropogenic impacts

3 Rapid FQA Sampling Protocol

The following section provides the step-by-step instructions to complete the Rapid FQA field sampling.

3.1 Map/Sketch the Approximate Boundaries of the AA and Plant Communities

The AA is the targeted wetland area that is being represented in the assessment and it should be defined. Individual plant communities are the basic Rapid FQA assessment unit and it will be necessary to determine relative proportions of the different community types within the AA to complete a Rapid FQA. It will be beneficial to define the AA and determine the community types present as best as possible prior to field sampling to plan potential meander starting points and pathways. The preferred method is to map AA and community polygons in GIS, using aerial photography, topographic maps, and National Wetlands Inventory (NWI) maps to guide interpretations (Figure 1, Figure 2). An acceptable method is to sketch AA and community boundaries on printed aerial photos/maps or create a rough AA/community sketch. Communities should follow Eggers and Reed (2011) types (Table 1).

3.2 Confirm and Correct AA and Community Types/Boundaries on Site

When first arriving at the AA effort should be spent doing an initial confirmation and (if necessary) correction of the AA boundaries and community types. Record any differences with the mapping done in Step 3.1 on a printed aerial photo or AA sketch. Following field sampling this information should be used to update any GIS polygons. Record the community types in the numbered spaces provided on the data form (Appendix 2).

Each data form has the capacity to record data for 3 community types in a single AA. If the AA has more than 3 community types, use an additional data form. Final confirmation and correction of the AA and communities can be done while doing the meander sampling to avoid the need to walk the AA multiple times.

3.3 Determine the Base Meander Time

The base meander time is the minimum amount of sampling time for an AA while doing a Rapid FQA timed meander. It varies according to the number of different communities present within the AA. Once the communities have been confirmed onsite–determine the base meander time according to the following rule:

- **30 minutes for the first community and add 20 minutes for each additional community**

For example, if the AA includes: Fresh Meadow, Shrub-Carr, and Shallow Marsh–the base meander time = 30 + 20 + 20 = 70 minutes.

3.4 Conduct the Composite Timed Meander

Timed meander sampling can now begin. All communities within the AA (except Shallow Open Water) are sampled in a single composite meander; however, data are recorded separately by community type. **Begin the meander in a representative area** (i.e., the most typical or predominant) of Community #1 and record the meander start time on the data form. Record the presence of plant species on the checklist provided on the data form (Appendix 2). This is done by circling the space in front of a species name that corresponds with the correct designated community number which the species is observed. **Only record species that are on the checklist and can be confidently identified during the time of sampling**. The same species can occur in multiple community types in a single AA (e.g., *Typha latifolia* L. [Broad-leaved cattail]) occurs in both the Shallow Marsh and Fresh Meadow communities in an AA and should be recorded as present in each community). Leave enough room within the circle to record a cover class (Section 3.6).

The meander path should move from community to community so that **approximately equal amounts of time are spent in each community** present in the AA. Mentally keep track of the approximate areal cover of each species per community type as the meander proceeds. The meander time can be paused to identify species, move to different locations in the AA, or conduct shoreline sampling (Section 3.5) and started again at the discretion of the observer.

The meander ends (or continues) based on the number of new Rapid Species observed near the end of the base meander time. **During the final 10 minutes of the base meander time begin keeping track of any new species encountered** in the Species Tally space provided on the data form. Proceed according to the following rules:

- **If < 3 new species are encountered during these 10 minutes, stop the meander at the end of the base meander time**
- **If ≥ 3 new species are encountered during the last 10 minutes of the base meander time, continue the meander for an additional 10 minute time period**
- **Continue adding 10 minute periods to the meander until < 3 new species are encountered in a time period. Once this occurs, the meander can be stopped.**

At small AAs the composite **meander may be stopped before the base meander time expires if the entire AA has been observed**.

Record the meander stop time and determine the total meander time in the space provided on the data form.

3.5 Conduct Shoreline Sampling (if Shallow Open Water Community Present)

If the Shallow Open Water community is present in the AA, establish three shoreline sampling stations along the emergent/aquatic vegetation interface at representative locations. Make species observations within visual range of the station and by tossing and retrieving the garden cultivator through the Shallow Open Water community three times at each station (Figure 3, Figure 4). Species presence is recorded in the same fashion as the meander sampling–a circle placed around the space corresponding to the species and designated community number. Shoreline sampling can be done concurrently with the meander sample (Section 3.4) so that walking the AA multiple times is avoided. The timed meander is paused when shoreline sampling is being conducted. Species encountered during the shoreline sampling do not count towards the species tally used to add time to the meander.

3.6 Make Areal Cover Estimations

Estimate the areal cover of each species observed by community type according to the cover classes (Table 2) provided on the data form (Appendix 2). This includes cover estimates for aquatic species that occur in the Shallow Open Water community (if present). Record the cover class of each species within the circle according to the corresponding community number.

The Rapid FQA field sampling is now complete. The steps in Section 4 (Metric Calculations & Assessment) can be completed back at the office.

4 Metric Calculations & Assessment

The following section provides the step-by-step instructions to calculate *wC* scores, make the community assessments, and the overall AA assessment.

4.1 Revise AA/Community Map/Sketch and Determine Community Proportions

To complete an overall Rapid FQA for the AA (Section 4.4) it will be necessary to determine the proportions of the AA occupied by each community. First, **revise the AA/community map/sketch based on the field observations**. Next, **calculate (or estimate) the percent of the AA occupied by each community type** and record these values on the data form (Appendix 2). If the AA and community polygons were mapped using GIS this can be calculated by dividing the area of the community by the total AA area and multiplying by 100. If a site sketch was made, estimate the percentage of each community in the AA based on the sketch.

4.2 Calculate *wC* Scores

The primary metric of the Rapid FQA is the abundance weighted Coefficient of Conservatism (*wC*). ***wC* requires several steps to calculate**. First, the community data needs to be arranged in a table with the species names in the rows and the following columns: the cover classes recorded for each species in the field; the midpoint percent cover that corresponds to each cover class (Table 2); and the corresponding *C*-value for each species (Appendix 1). Next, sum all of the midpoint percent cover values for the community to get a total cover estimate. Create a new column in the table and compute the proportional abundance (*p*) of each species by dividing the individual species midpoint percent cover by the total percent cover. Create another column in the table and multiply the *C*-value by the proportional abundance of each species. Finally, sum all

of these values for the community to get *wC*. An example of how to create the data table and calculate *wC* is provided in Table 3.

Repeat the *wC* calculation for each community type in the AA. Any other metrics calculated (e.g., Mean *C*, *FQI*) do not factor into the assessment, but may be used as supporting information. The Rapid FQA calculator provides an easy way to enter data and computes *wC* scores automatically (Appendix 3).

4.3 Determine the Community Assessments

Once *wC* scores have been calculated, **BCG Tier assessments (Table 4) for each community are made by looking up *wC* scores in the BCG Tier assessment criteria table (Table 5)**. The BCG Tier thresholds are specific for each community. If a *wC* score meets the Tier 1 numerical criteria for a community, re-examine the data and sum the total midpoint percent cover of all introduced species. A community must also have < 1% total introduced species cover to be considered Tier 1. If the community has > 1% introduced species cover (even though it has a *wC* score that meets the Tier 1 numerical criteria) it is considered Tier 2. Determine the BCG Tier of each community present in the AA. The Rapid FQA calculator also automatically determines community BCG Tiers (Appendix 3).

Table 5. BCG Tier assessment criteria for all community types based on *wC*. Red type indicates that the threshold is preliminary due to <10 samples available in the analysis pool to determine the threshold. An additional narrative criteria (*) is required to meet Tier 1: Total introduced species cover <1 percent (i.e., an AA must score above the numeric threshold and meet the narrative requirement to meet Tier 1).

	Community						
Tier	**Shallow Open Water**	**Deep Marsh**	**Shallow Marsh**	**Fresh Meadow**	**Wet Prairie**	**Calcareous Fen**	**Sedge Mat**
1			> 4.9*	> 4.2*	> 4.4*	> 6.4*	> 6.2*
2	> 5.0	> 4.0	> 4.2	> 4.1	> 3.9	> 5.2	> 5.5
3	< 5.0	< 4.0	1.6 - 4.2	1.3 - 4.1	1.3 - 3.9	4.7 - 5.2	1.8 - 5.5
4			< 1.6	< 1.3	< 1.3	< 4.7	< 1.8

	Community						
Tier	**Open Bog**	**Coniferous Bog**	**Shrub-Carr**	**Alder Thicket**	**Hardwood Swamp**	**Coniferous Swamp**	**Floodplain Forest**
1	> 7.3*	> 7.3*	> 4.5*	> 3.9*	> 4.6*	> 5.6*	> 3.3*
2	> 7.1	> 7.2	> 4.3	> 3.5	> 4.2	> 5.5	> 2.7
3	5.4 - 7.1	5.8 - 7.2	3.2 - 4.3	2.2 - 3.5	2.5 - 4.2	5.5 - 3.6	2.1 - 2.7
4	< 5.4	< 5.8	< 3.2	< 2.2	< 2.5	< 3.6	< 2.1

* Total introduced species cover < 1 percent

4.4 Make the Overall AA Assessment

Once the Tiers for the individual communities have been determined, **the overall AA assessment is made by taking the weighted average of the community BCG Tiers**. This is done by multiplying each community BCG Tier by its proportional extent and summing the values. Rounding to the nearest whole number will return the weighted average BCG Tier for the AA–which is the most representative overall BCG Tier (Table 4) for the AA. Again, the Rapid FQA calculator can compute the overall AA assessment when the vegetation and community proportion data have been entered (Appendix 3).

The Rapid FQA is now complete. A Rapid FQA example that includes an AA and community map; a timed meander; *wC* calculations; and an overall AA assessment is provided in Appendix 4.

5 Reporting

A standard reporting structure has not yet been established for the Rapid FQA. It is recommended, however, that the reporting of results contain the following elements:

- General information including the: AA identifier, date, surveyor name
- A site map/sketch showing AA and community boundaries
- Vegetation data tables that include the species present and cover classes by community type
- A summary table of *wC* scores and BCG Tiers by community type
- The overall AA assessment

The Rapid FQA calculator can be used to produce data tables and results summaries (Appendix 3). Narrative descriptions of the AA, communities, potential impacts, and interpretation of the assessment may also be insightful.

6 Adaptations

Like many vegetation sampling approaches, the goal of the Rapid FQA sampling is to accurately represent the species composition and the abundance distribution of a community. It follows that a sampling method that measures composition and abundance may also have potential to be used to produce Rapid FQA results. In other words, alternative sampling methods may produce data that are consistent with the Rapid FQA method–making the assessment criteria applicable. This was illustrated in the Rapid FQA meander and MN DNR relevé sampling comparability trial, where (overall) each method produced consistent results for the same locations. This result supported the use of MN DNR relevé data during the development of the assessment criteria (Bourdaghs 2012). Adapting sampling methods or applying data to the Rapid FQA assessment criteria that were collected using alternative methods may be useful to generate assessments from existing data or when other sampling methods are well established.

To adapt alternative methods or apply existing data to the Rapid FQA assessment criteria the sampling methods must meet the following general conditions:

- **Sampling is done by community types** that can be related to the Eggers and Reed (2011: Table 1) classification
- **Sampling intensity is adequate to produce a 'representative' sample** (i.e., a generally accurate representation of the species composition and abundance distribution)
- **Species are identified at least to the level of the Rapid Species List** (i.e., increased species ID will be required for coarser approaches and data will need to be reduced for comprehensive species data).
- **Areal cover estimates are made**

If these conditions are met, the resulting data should generally be comparable to what would be produced from the Rapid FQA field sampling protocol–producing accurate assessments when the criteria are applied. Appendix 5 provides an example of how to adapt an existing method (US ACE vegetation sampling for wetland delineation) to produce a Rapid FQA.

Similarly, FQA criteria are available (upon request) for data sets where all the species have been identified. These criteria were developed following the same approach and concurrently with the Rapid FQA criteria (Bourdaghs 2012). They are intended for users with a high level of botanical expertise that can confidently collect vegetation data above the level of the Rapid Species list. The only difference between the Rapid and comprehensive species criteria development was that all species were included in the computations and analyses. Conceptually, a full species based assessment provides increased accuracy compared to the Rapid FQA, as it draws from complete data. Please email Michael Bourdaghs for the comprehensive species FQA criteria.

The Rapid FQA also has the potential to be used as the vegetation component in more comprehensive types of assessment methods–where vegetation is one of multiple components. Currently, the Rapid FQA could be substituted as an alternative vegetation component in the MnRAM (MN BWSR 2010). The BCG Tier assessment categories (Table 4) are generally equivalent to the four MnRAM Vegetation Integrity and Diversity ratings allowing direct input of Rapid FQA community assessment results into the MnRAM. Incorporating the Rapid FQA into the MnRAM is discussed in Appendix 6.

7 Limitations

While the Rapid FQA is presented as an improved wetland rapid assessment approach that has broad flexibility and applicability, users should be aware that some limitations exist. Foremost is that the Rapid FQA is designed as a RAM–it relies on coarser level information to provide a wetland quality assessment within a reasonable timeframe that can be used by natural resource professionals with a moderate level of botanical expertise. In many scenarios this level of information may be sufficient; however, there may be cases where more detailed information is desirable. Other specific limitations to the Rapid FQA include (some of which have been previously discussed but are being reinforced here):

- **Users should have at least a moderate level of botanical expertise in MN wetlands**. The Rapid FQA requires the user to be able to identify (by site) most of the species on the Rapid Species in the wetland types that they normally work in. This may take a year or more of experience identifying MN's wetland flora to be able to do.
- **Sampling outside of the preferred sampling period may cause inaccurate results**. This may be due to not being able to identify species and/or the true cover of dominant species becomes less apparent very early in the growing season or following senescence.
- **It may be possible that the dominant species occurring in a community is not on the Rapid Species List**. While species that can be dominant components of MN's wetland plant communities were favored to be selected for the Rapid Species List, occasionally a community may be encountered where the dominant species is not on the list. If this occurs, proceed with the Rapid FQA as directed–ignoring the dominant species. This species should be noted in the remarks (particularly if it can be identified). The assessment criteria were developed with at least several samples where the dominant species was not on the Rapid Species List, so this situation has been somewhat factored in to the process.
- **The Rapid FQA covers most of the wetland community types in MN–but not all**. Due to a lack of available data, assessment criteria were not developed for the Seasonally Flooded Basin community type (Eggers and Reed 2011). Vernal pool wetlands were also not included for similar reasons and that vegetation is often not a prominent feature in this wetland type.
- **Community interpretation inconsistencies can cause large errors.** The Rapid FQA relies on the observer to interpret community type and extent. AAs that have: many or a mosaic of communities; communities that are in transition from one type to another; and/or broad transition zones between types can be very difficult to interpret. Differences in community interpretation between users can cause large differences in Rapid FQA outcomes (Bourdaghs 2012). In these cases making more detailed field notes and sketch/map annotation may be warranted to further document community interpretations.
- **Communities can be interpreted as former types–but only under certain conditions.** Wetlands are dynamic systems where community types can change due to changing conditions. Typically, community types should be interpreted as they currently exist when doing a Rapid FQA. Depending on the context, however, it may be appropriate to assess a community as a former type–as wholesale changes in type can result from severe anthropogenic impacts. If evidence of a former community is present *and* there is clear evidence of an anthropogenic impact, the community may be assessed as a former type–even though it no longer meets the definition of that type. For example, if an AA is currently dominated by Shallow Marsh vegetation yet standing dead *Larix*

laricina (Du Roi) K. Koch (tamarack) trees are present and there is evidence that the site was flooded due to a human activity–the AA may be assessed as a (severely impacted) Coniferous Swamp. If the same current conditions were true (i.e., Shallow Marsh vegetation and dead standing trees), but the disturbance was caused by beaver–the AA may more appropriately be assessed as a Shallow Marsh as the disturbance was natural.

- **Some sampling variability exists.** A number of sources of variation exist that can affect the Rapid FQA including: the natural variability of vegetation; the sampling location (i.e., meander starting point and path); and sampling error (e.g., species identification and cover estimate errors). These sources of variation are common to all vegetation sampling approaches. A limited repeatability trial (where the same AAs were sampled multiple times) indicated that the Rapid FQA returns consistent assessment outcomes the majority of the time (≥ 79%) when all of these factors are considered simultaneously (Bourdaghs 2012). While this trial indicated that the Rapid FQA has a moderately high degree of consistency, these sources of variability can cause inaccurate results.
- **The BCG Tier assessment criteria for some of the community types are preliminary.** The assessment criteria were developed from a large number of community samples (725; Bourdaghs 2012). There were some cases, however, where there was limited data available (< 10 samples) or none available for a data analysis group in a community to determine a threshold. In these cases, criteria for tiers with no data were not created or were considered preliminary when only limited data were available. Criteria developed with limited data are indicated with red type in the BCG Tier assessment criteria table (Table 5). Future Rapid FQA development efforts will focus on gathering more data to clarify these thresholds.

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Appendix 1-Rapid Species List

The Rapid Species List with select attributes from Wetlist 1.4 (Milburn et al. 2007) included.

Scientific Name	Common Name	MN Native Status	C	Growth Habit	tsn
Abies balsamea	balsam fir	Native	4	Tree	18032
Acer negundo	boxelder	Native	1	Tree	28749
Acer rubrum var. *rubrum*	red maple	Native	3	Tree	28729
Acer saccharinum	silver maple	Native	3	Tree	28757
Acer spicatum	mountain maple	Native	5	Tree, Shrub	28758
Achillea millefolium	common yarrow	Native	1	Forb/herb	35423
Acorus americanus	sweetflag	Native	7	Forb/herb	182561
Adiantum pedatum	northern maidenhair	Native	7	Forb/herb	17311
Agrostis gigantea	redtop	Introduced	0	Graminoid	40414
Alisma subcordatum	American water plantain	Native	4	Forb/herb	38895
Alisma triviale	northern water plantain	Native	4	Forb/herb	182441
Alliaria petiolata	garlic mustard	Introduced	0	Forb/herb	184481
Alnus incana ssp. *rugosa*	speckled alder	Native	3	Tree, Shrub	181888
Ambrosia artemisiifolia	annual ragweed	Native	0	Forb/herb	36496
Ambrosia trifida var. *trifida*	great ragweed	Native	0	Forb/herb	182422
Amorpha fruticosa	desert false indigo	Native	4	Shrub	25368
Amphicarpaea bracteata	American hogpeanut	Native	2	Forb/herb	182067
Andromeda polifolia var. *glaucophylla*	bog rosemary	Native	9	Shrub	526876
Andropogon gerardii	big bluestem	Native	4	Graminoid	40462
Anemone canadensis	Canadian anemone	Native	3	Forb/herb	18436
Anemone quinquefolia var. *bifolia*	twoleaf anemone	Native	5	Forb/herb	531161
Angelica atropurpurea	purplestem angelica	Native	6	Forb/herb	29436
Apocynum cannabinum	Indianhemp	Native	3	Forb/herb	30157
Aralia nudicaulis	wild sarsaparilla	Native	4	Forb/herb	29376
Argentina anserina	silverweed cinquefoil	Native	4	Forb/herb	184598
Arisaema triphyllum	Jack in the pulpit	Native	4	Forb/herb	42525
Asclepias incarnata ssp. *incarnata*	swamp milkweed	Native	4	Forb/herb	184805
Athyrium filix-femina ssp. *angustum*	subarctic ladyfern	Native	4	Forb/herb	17414

Beckmannia syzigachne	American sloughgrass	Native	4	Graminoid	41325
Betula alleghaniensis var. *alleghaniensis*	yellow birch	Native	7	Tree	183520
Betula papyrifera var. *papyrifera*	paper birch	Native	3	Tree	19490
Betula pumila var. *glandulifera*	bog birch	Native	7	Shrub	183527
Bidens cernua	nodding beggartick	Native	3	Forb/herb	35710
Boehmeria cylindrica	smallspike false nettle	Native	5	Forb/herb	19121
Botrychium virginianum	rattlesnake fern	Native	6	Forb/herb	17173
Brasenia schreberi	watershield	Native	7	Forb/herb	18370
Bromus ciliatus var. *ciliatus*	fringed brome	Native	6	Graminoid	566208
Bromus inermis	smooth brome	Introduced	0	Graminoid	40502
Calamagrostis canadensis	bluejoint	Native	4	Graminoid	40544
Calamagrostis stricta ssp. *stricta*	slimstem reedgrass	Native	7	Graminoid	523718
Calla palustris	water arum	Native	8	Forb/herb	42546
Caltha palustris var. *palustris*	yellow marsh marigold	Native	6	Forb/herb	527037
Calystegia sepium	hedge false bindweed	Native	1	Vine	30650
Campanula aparinoides	marsh bellflower	Native	5	Forb/herb	34476
Carex aquatilis var. *aquatilis*	water sedge	Native	7	Graminoid	527072
Carex atherodes	wheat sedge	Native	5	Graminoid	39449
Carex comosa	longhair sedge	Native	4	Graminoid	39384
Carex interior	inland sedge	Native	7	Graminoid	39652
Carex intumescens	greater bladder sedge	Native	5	Graminoid	39403
Carex lacustris	hairy sedge	Native	5	Graminoid	39409
Carex lasiocarpa var. *americana*	American woollyfruit sedge	Native	7	Graminoid	527107
Carex oligosperma	fewseed sedge	Native	8	Graminoid	39729
Carex pellita	woolly sedge	Native	4	Graminoid	507767
Carex stipata var. *stipata*	owlfruit sedge	Native	3	Graminoid	527159
Carex stricta	upright sedge	Native	5	Graminoid	39435
Carex utriculata	Northwest Territory sedge	Native	7	Graminoid	501288
Carex vulpinoidea	fox sedge	Native	3	Graminoid	39442
Celtis occidentalis var. *occidentalis*	common hackberry	Native	3	Tree, Shrub	527229
Ceratophyllum demersum	coon's tail	Native	2	Forb/herb	18403
Chamaedaphne calyculata var. *angustifolia*	leatherleaf	Native	8	Shrub	527274
Chamerion angustifolium ssp. *circumvagum*	fireweed	Native	3	Forb/herb	566020
Chelone glabra	white turtlehead	Native	7	Forb/herb	33182
Cicuta bulbifera	bulblet-bearing water hemlock	Native	7	Forb/herb	29459

Cicuta maculata	spotted water hemlock	Native	5	Forb/herb	29456
Circaea alpina ssp. *alpina*	small enchanter's nightshade	Native	6	Forb/herb	27564
Circaea lutetiana ssp. *canadensis*	broadleaf enchanter's nightshade	Native	2	Forb/herb	27569
Cirsium arvense	Canada thistle	Introduced	0	Forb/herb	36335
Cirsium muticum	swamp thistle	Native	6	Forb/herb	36387
Clematis virginiana	devil's darning needles	Native	4	Vine	18716
Clintonia borealis	bluebead	Native	7	Forb/herb	42903
Comarum palustre	purple marshlocks	Native	7	Forb/herb	501615
Conyza canadensis var. *canadensis*	Canadian horseweed	Native	0	Forb/herb	527476
Coptis trifolia	threeleaf goldthread	Native	7	Forb/herb	18767
Cornus canadensis	bunchberry dogwood	Native	6	Forb/herb	27816
Cornus racemosa	gray dogwood	Native	2	Shrub	501635
Cornus sericea ssp. *sericea*	redosier dogwood	Native	3	Tree, Shrub	523904
Cryptotaenia canadensis	Canadian honewort	Native	3	Forb/herb	29475
Cyperus esculentus var. *leptostachyus*	chufa flatsedge	Introduced	0	Graminoid	534184
Cypripedium reginae	showy lady's slipper	Native	8	Forb/herb	43538
Dasiphora floribunda	shrubby cinquefoil	Native	7	Shrub	565123
Dioscorea villosa	wild yam	Native	4	Forb/herb	43367
Doellingeria umbellata	parasol whitetop	Native	5	Forb/herb	508093
Drosera rotundifolia var. *rotundifolia*	roundleaf sundew	Native	8	Forb/herb	527791
Dryopteris carthusiana	spinulose woodfern	Native	6	Forb/herb	502157
Dryopteris cristata	crested woodfern	Native	7	Forb/herb	17531
Dulichium arundinaceum	threeway sedge	Native	8	Graminoid	40009
Echinochloa crus-galli	barnyardgrass	Introduced	0	Graminoid	502210
Echinocystis lobata	wild cucumber	Native	2	Vine	22378
Eleocharis obtusa	blunt spikerush	Native	3	Graminoid	40017
Eleocharis palustris	common spikerush	Native	5	Graminoid	40019
Elodea canadensis	Canadian waterweed	Native	4	Forb/herb	38937
Elymus virginicus	Virginia wildrye	Native	4	Graminoid	40681
Epilobium leptophyllum	bog willowherb	Native	7	Forb/herb	27311
Equisetum arvense	field horsetail	Native	1	Forb/herb	17152
Equisetum fluviatile	water horsetail	Native	7	Forb/herb	17150
Eupatorium maculatum	spotted joepyeweed	Native	4	Forb/herb	502517
Eupatorium perfoliatum var. *perfoliatum*	common boneset	Native	4	Forb/herb	528117
Euthamia graminifolia	flat-top goldentop	Native	4	Forb/herb	37352

Fragaria virginiana	Virginia strawberry	Native	2	Forb/herb	24639
Frangula alnus	glossy buckthorn	Introduced	0	Tree, Shrub	504744
Fraxinus nigra	black ash	Native	6	Tree	32945
Fraxinus pennsylvanica	green ash	Native	2	Tree	32929
Galium aparine	stickywilly	Native	1	Forb/herb	34797
Gaultheria hispidula	creeping snowberry	Native	8	Subshrub	23653
Gentiana andrewsii	closed bottle gentian	Native	6	Forb/herb	29967
Geranium maculatum	spotted geranium	Native	4	Forb/herb	29107
Glyceria borealis	small floating mannagrass	Native	8	Graminoid	40841
Glyceria canadensis	rattlesnake mannagrass	Native	7	Graminoid	40842
Glyceria grandis var. *grandis*	American mannagrass	Native	6	Graminoid	528256
Glyceria striata	fowl mannagrass	Native	4	Graminoid	40833
Gymnocarpium dryopteris	western oakfern	Native	6	Forb/herb	17579
Hackelia virginiana	beggarslice	Native	1	Forb/herb	31921
Helenium autumnale var. *autumnale*	common sneezeweed	Native	4	Forb/herb	528347
Helianthus giganteus	giant sunflower	Native	4	Forb/herb	36612
Helianthus grosseserratus	sawtooth sunflower	Native	3	Forb/herb	36644
Heracleum maximum	common cowparsnip	Native	4	Forb/herb	502953
Heuchera richardsonii	Richardson's alumroot	Native	7	Forb/herb	24372
Hordeum jubatum ssp. *jubatum*	foxtail barley	Native	0	Graminoid	524156
Hydrophyllum virginianum	Shawnee salad	Native	3	Forb/herb	31396
Hypoxis hirsuta	common goldstar	Native	8	Forb/herb	503146
Ilex verticillata	common winterberry	Native	6	Tree, Shrub	27985
Impatiens capensis	jewelweed	Native	2	Forb/herb	29182
Iris versicolor	harlequin blueflag	Native	4	Forb/herb	43196
Kalmia polifolia	bog laurel	Native	9	Shrub	23679
Lactuca serriola	prickly lettuce	Introduced	0	Forb/herb	36608
Laportea canadensis	Canadian woodnettle	Native	3	Forb/herb	19127
Larix laricina	tamarack	Native	7	Tree	183412
Lathyrus palustris	marsh pea	Native	6	Forb/herb	25866
Lathyrus venosus	veiny pea	Native	6	Forb/herb	25886
Ledum groenlandicum	bog Labrador tea	Native	8	Shrub	23546
Leersia oryzoides	rice cutgrass	Native	3	Graminoid	40886
Lemna minor	common duckweed	Native	5	Forb/herb	42590
Lemna trisulca	star duckweed	Native	5	Forb/herb	42595

Liatris pycnostachya var. *pycnostachya*	prairie blazing star	Native	7	Forb/herb	528786
Linnaea borealis ssp. *americana*	twinflower	Native	7	Forb/herb	525179
Lobelia kalmii	Ontario lobelia	Native	9	Forb/herb	34525
Lobelia siphilitica var. *ludoviciana*	great blue lobelia	Native	5	Forb/herb	528853
Lobelia spicata	palespike lobelia	Native	7	Forb/herb	34532
Lycopus americanus	American water horehound	Native	4	Forb/herb	32254
Lycopus uniflorus	northern bugleweed	Native	5	Forb/herb	32257
Lysimachia ciliata	fringed loosestrife	Native	5	Forb/herb	23984
Lysimachia thyrsiflora	tufted loosestrife	Native	6	Forb/herb	24000
Lythrum salicaria	purple loosestrife	Introduced	0	Forb/herb	27079
Maianthemum canadense	Canada mayflower	Native	5	Forb/herb	503653
Maianthemum stellatum	starry false lily of the vally	Native	5	Forb/herb	503656
Maianthemum trifolium	threeleaf false lily of the vally	Native	9	Forb/herb	503657
Matteuccia struthiopteris	ostrich fern	Native	5	Forb/herb	17596
Menispermum canadense	common moonseed	Native	4	Vine	18871
Mentha arvensis	wild mint	Native	3	Forb/herb	565302
Menyanthes trifoliata	buckbean	Native	9	Forb/herb	30102
Mertensia virginica	Virginia bluebells	Native	6	Forb/herb	31673
Mimulus ringens var. *ringens*	Allegheny monkeyflower	Native	5	Forb/herb	529204
Mitella nuda	naked miterwort	Native	7	Forb/herb	24410
Monotropa uniflora	Indianpipe	Native	6	Forb/herb	23778
Muhlenbergia richardsonis	mat muhly	Native	8	Graminoid	41938
Myrica gale	sweetgale	Native	8	Shrub	19265
Najas flexilis	nodding waternymph	Native	5	Forb/herb	38996
Nelumbo lutea	American lotus	Native	8	Forb/herb	18398
Nuphar lutea ssp. *variegata*	varigated yellow pond-lily	Native	6	Forb/herb	524345
Nymphaea odorata	American white waterlily	Native	6	Forb/herb	18384
Oligoneuron riddellii	Riddell's goldenrod	Native	8	Forb/herb	507638
Onoclea sensibilis	sensitive fern	Native	4	Forb/herb	17637
Orthilia secunda	sidebells wintergreen	Native	7	Shrub	504066
Osmorhiza claytonii	Clayton's sweetroot	Native	3	Forb/herb	29789
Osmunda cinnamomea var. *cinnamomea*	cinnamon fern	Native	7	Forb/herb	529311
Osmunda regalis var. *spectabilis*	royal fern	Native	7	Forb/herb	529314
Ostrya virginiana var. *virginiana*	hophornbeam	Native	4	Tree, Shrub	195247
Panicum virgatum var. *virgatum*	switchgrass	Native	2	Graminoid	529371

Parnassia glauca	fen grass of Parnassus	Native	9	Forb/herb	24210
Parnassia palustris	marsh grass of Parnassus	Native	8	Forb/herb	24206
Parthenocissus vitacea	woodbine	Native	2	Vine	28605
Pedicularis lanceolata	swamp lousewort	Native	8	Forb/herb	33365
Penthorum sedoides	ditch stonecrop	Native	3	Forb/herb	504241
Petasites frigidus var. *palmatus*	arctic sweet coltsfoot	Native	6	Forb/herb	529540
Phalaris arundinacea	reed canarygrass	Introduced	0	Graminoid	41335
Phragmites australis	common reed	Native	1	Graminoid	41072
Physocarpus opulifolius	common ninebark	Native	5	Shrub	25282
Physostegia virginiana ssp. *virginiana*	obedient plant	Native	6	Forb/herb	196102
Picea glauca	white spruce	Native	5	Tree	183295
Picea mariana	black spruce	Native	7	Tree	183302
Pilea pumila var. *pumila*	Canadian clearweed	Native	3	Forb/herb	529663
Pinus strobus	eastern white pine	Native	5	Tree	183385
Poa palustris	fowl bluegrass	Native	5	Graminoid	41151
Poa pratensis ssp. *pratensis*	Kentucky bluegrass	Introduced	0	Graminoid	566071
Polygonum amphibium	water knotweed	Native	4	Forb/herb	20865
Polygonum lapathifolium	curlytop knotweed	Native	2	Forb/herb	20860
Polygonum pensylvanicum	Pennsylvania smartweed	Native	1	Forb/herb	20861
Polygonum sagittatum	arrowleaf tearthumb	Native	4	Forb/herb	20863
Pontederia cordata	pickerelweed	Native	8	Forb/herb	42620
Populus balsamifera ssp. *balsamifera*	balsam poplar	Native	4	Tree	22454
Populus deltoides ssp. *monilifera*	plains cottonwood	Native	1	Tree	22447
Populus tremuloides	quaking aspen	Native	2	Tree	195773
Potamogeton amplifolius	largeleaf pondweed	Native	7	Forb/herb	39021
Potamogeton crispus	curly pondweed	Introduced	0	Forb/herb	39007
Potamogeton natans	floating pondweed	Native	5	Forb/herb	39008
Potamogeton zosteriformis	flatstem pondweed	Native	6	Forb/herb	39055
Potentilla norvegica ssp. *monspeliensis*	Norwegian cinquefoil	Native	1	Forb/herb	524586
Prenanthes racemosa	purple rattlesnakeroot	Native	9	Forb/herb	38281
Pycnanthemum virginianum	Virginia mountainmint	Native	6	Forb/herb	32670
Quercus macrocarpa var. *macrocarpa*	bur oak	Native	5	Tree, Shrub	531113
Quercus rubra	northern red oak	Native	5	Tree	19408
Ranunculus flabellaris	yellow water buttercup	Native	6	Forb/herb	18563
Ranunculus longirostris	longbeak buttercup	Native	7	Forb/herb	18623

Ranunculus trichophyllus var. *trichophyllus*	threadleaf crowfoot	Native	7	Forb/herb	529983
Rhamnus alnifolia	alderleaf buckthorn	Native	7	Shrub	28562
Rhamnus cathartica	common buckthorn	Introduced	0	Tree, Shrub	28573
Ribes americanum	American black currant	Native	4	Shrub	24451
Rubus idaeus ssp. strigosus	grayleaf red raspberry	Native	3	Shrub	524636
Rubus pubescens var. *pubescens*	dwarf red blackberry	Native	6	Forb/herb	530148
Rudbeckia hirta var. *pulcherrima*	blackeyed Susan	Native	3	Forb/herb	530172
Rudbeckia laciniata var. *laciniata*	cutleaf coneflower	Native	4	Forb/herb	530178
Rumex crispus ssp. *crispus*	curly dock	Introduced	0	Forb/herb	566082
Rumex orbiculatus	greater water dock	Native	6	Forb/herb	20967
Sagittaria latifolia	broadleaf arrowhead	Native	3	Forb/herb	38908
Sagittaria rigida	sessilefruit arrowhead	Native	7	Forb/herb	38928
Salix amygdaloides	peachleaf willow	Native	5	Tree, Shrub	22499
Salix bebbiana	Bebb willow	Native	6	Tree, Shrub	22507
Salix candida	sageleaf willow	Native	9	Shrub	22514
Salix discolor	pussy willow	Native	3	Tree, Shrub	22524
Salix interior	sandbar willow	Native	2	Shrub, Tree	520829
Salix nigra	black willow	Native	4	Tree	22484
Salix petiolaris	meadow willow	Native	5	Tree, Shrub	22567
Salix X rubens	hybrid crack willow	Introduced	0	Tree	22579
Sambucus nigra ssp. *canadensis*	common elderberry	Native	3	Tree, Shrub	525079
Sanguinaria canadensis	bloodroot	Native	6	Forb/herb	18990
Sarracenia purpurea ssp. *purpurea*	purple pitcherplant	Native	9	Forb/herb	195652
Saxifraga pensylvanica	eastern swamp saxifrage	Native	7	Forb/herb	24234
Scheuchzeria palustris ssp. *americana*	rannoch-rush	Native	9	Forb/herb	38985
Schoenoplectus acutus var. *acutus*	hardstem bulrush	Native	6	Graminoid	531332
Schoenoplectus fluviatilis	river bulrush	Native	4	Graminoid	521092
Schoenoplectus pungens	common threesquare	Native	6	Graminoid	508146
Schoenoplectus tabernaemontani	softstem bulrush	Native	4	Graminoid	507797
Scirpus cyperinus	woolgrass	Native	3	Graminoid	40228
Scolochloa festucacea	common rivergrass	Native	7	Graminoid	41349
Scutellaria galericulata	marsh skullcap	Native	5	Forb/herb	32798
Scutellaria lateriflora	blue skullcap	Native	5	Forb/herb	32765
Sicyos angulatus	oneseed burr cucumber	Native	2	Vine	22402
Sium suave	hemlock waterparsnip	Native	5	Forb/herb	29558

Solanum dulcamara var. *dulcamara*	climbing nightshade	Introduced	0	Vine	530416
Solidago canadensis	Canada goldenrod	Native	1	Forb/herb	36224
Solidago gigantea	giant goldenrod	Native	3	Forb/herb	36259
Solidago uliginosa var. *uliginosa*	bog goldenrod	Native	9	Forb/herb	530486
Sonchus arvensis	field sowthistle	Introduced	0	Forb/herb	38421
Sorbus americana	American mountain ash	Native	5	Tree, Shrub	25319
Sorghastrum nutans	Indiangrass	Native	5	Graminoid	42102
Sparganium eurycarpum	broadfruit bur-reed	Native	5	Forb/herb	42316
Spartina pectinata	prairie cordgrass	Native	5	Graminoid	41272
Spiraea alba	white meadowsweet	Native	5	Shrub	25329
Spiraea tomentosa var. *rosea*	steeplebush	Native	7	Shrub	530522
Spirodela polyrrhiza	common duckmeat	Native	5	Forb/herb	505347
Stachys palustris	marsh hedgenettle	Native	4	Forb/herb	32344
Staphylea trifolia	American bladdernut	Native	6	Tree, Shrub	28646
Stellaria longifolia	longleaf starwort	Native	6	Forb/herb	20185
Streptopus lanceolatus var. *longipes*	twistedstalk	Native	7	Forb/herb	531400
Stuckenia pectinatus	sago pondweed	Native	3	Forb/herb	565547
Symphyotrichum lanceolatum	white panicle aster	Native	5	Forb/herb	522219
Symphyotrichum lateriflorum	calico aster	Native	4	Forb/herb	522220
Symphyotrichum novae-angliae	New England aster	Native	3	Forb/herb	522226
Symphyotrichum puniceum	purplestem aster	Native	6	Forb/herb	522241
Symplocarpus foetidus	skunk cabbage	Native	8	Forb/herb	42538
Taraxacum officinale	common dandelion	Introduced	0	Forb/herb	36213
Thalictrum dasycarpum	purple meadow-rue	Native	4	Forb/herb	18667
Thelypteris palustris var. *pubescens*	eastern marsh fern	Native	7	Forb/herb	530656
Thuja occidentalis	arborvitae	Native	7	Tree	505490
Tilia americana var. *americana*	American basswood	Native	5	Tree	530690
Toxicodendron rydbergii	western poison ivy	Native	1	Shrub	28822
Toxicodendron vernix	poison sumac	Native	7	Tree, Shrub	28823
Triadenum fraseri	Fraser's marsh St. Johnswort	Native	6	Forb/herb	21473
Trientalis borealis ssp. *borealis*	starflower	Native	6	Forb/herb	524769
Trillium cernuum	whip-poor-will flower	Native	7	Forb/herb	43065
Typha angustifolia	narrowleaf cattail	Introduced	0	Forb/herb	42325
Typha latifolia	broadleaf cattail	Native	2	Forb/herb	42326
Typha X glauca	hybrid cattail	Introduced	0	Forb/herb	42328

Ulmus americana	American elm	Native	3	Tree	19049
Urtica dioica ssp. *gracilis*	California nettle	Native	1	Forb/herb	19154
Utricularia macrorhiza	common bladderwort	Native	5	Forb/herb	34456
Vaccinium angustifolium	lowbush blueberry	Native	5	Shrub	23579
Vaccinium macrocarpon	cranberry	Native	9	Shrub	23599
Vaccinium oxycoccos	small cranberry	Native	8	Shrub	505635
Vallisneria americana	American eelgrass	Native	6	Forb/herb	38951
Verbena hastata	swamp verbena	Native	6	Forb/herb	32071
Vernonia fasciculata	prairie ironweed	Native	5	Forb/herb	38629
Veronicastrum virginicum	Culver's root	Native	6	Forb/herb	34073
Viburnum lentago	nannyberry	Native	4	Tree, Shrub	35266
Viburnum opulus var. *americanum*	American cranberrybush	Native	5	Tree, Shrub	530811
Vitis riparia	riverbank grape	Native	2	Vine	28624
Wolffia columbiana	Columbian watermeal	Native	5	Forb/herb	42602
Xanthium strumarium	rough cockleburr	Native	0	Forb/herb	38692
Zizania palustris	northern wildrice	Native	8	Graminoid	505807
Zizia aurea	golden zizia	Native	6	Forb/herb	29906

Appendix 2-Rapid FQA Data Form

Continued on next page.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

Rapid FQA Data Form

Biological Monitoring
Floristic Quality Assessment (FQA)

General Information

Site/AA name:	Date:	Surveyors name:
Remarks:		

Community Information

Eggers & Reed Plant Community Type	% of AA
#1) _____	_____
#2) _____	_____
#3) _____	_____

Start Time	End Time	Total Time
_____	_____	_____

Species Tally (# of spp. observed during final 10 min)

Base	Add 1	Add 2	Add 3

Cover Classes	
7	>95 - 100%
6	>75 - 95%
5	>50 - 75%
4	>25 - 50%
3	>5 - 25%
2	>1 - 5%
1	>0 - 1%

Species Checklist (circle community space when species is present in community, record cover class in circle following meander)

Aquatic Stratum (true aquatic plants that are submergent or have floating leaves)

Community # 1 2 3		Community # 1 2 3		Community # 1 2 3	
_ _ _	Brasenia schreberi	_ _ _	Nymphaea odorata	_ _ _	Ranunculus trichophyllus var. trichophyllus
_ _ _	Ceratophyllum demersum	_ _ _	Polygonum amphibium	_ _ _	Spirodela polyrrhiza
_ _ _	Elodea canadensis	_ _ _	Potamogeton amplifolius	_ _ _	Stuckenia pectinatus
_ _ _	Lemna minor	_ _ _	Potamogeton crispus	_ _ _	Utricularia macrorhiza
_ _ _	Lemna trisulca	_ _ _	Potamogeton natans	_ _ _	Vallisneria americana
_ _ _	Najas flexilis	_ _ _	Potamogeton zosteriformis	_ _ _	Wolfia columbiana
_ _ _	Nelumbo lutea	_ _ _	Ranunculus flabellaris		
_ _ _	Nuphar lutea ssp. variegata	_ _ _	Ranunculus longirostris		

Tree Stratum (woody plants with typical max growth ≥ 3" DBH)

Community # 1 2 3		Community # 1 2 3		Community # 1 2 3	
_ _ _	Abies balsamea	_ _ _	Larix laricina	_ _ _	Quercus rubra
_ _ _	Acer negundo	_ _ _	Ostrya virginiana var. virginiana	_ _ _	Salix amygdaloides
_ _ _	Acer rubrum var. rubrum	_ _ _	Picea glauca	_ _ _	Salix nigra
_ _ _	Acer saccharinum	_ _ _	Picea mariana	_ _ _	Salix X rubens
_ _ _	Betula alleghaniensis var. alleghaniensis	_ _ _	Pinus strobus	_ _ _	Sorbus americana
_ _ _	Betula papyrifera var. papyrifera	_ _ _	Populus balsamifera ssp. balsamifera	_ _ _	Thuja occidentalis
_ _ _	Celtis occidentalis var. occidentalis	_ _ _	Populus deltoides ssp. monilifera	_ _ _	Tilia americana var. americana
_ _ _	Fraxinus nigra	_ _ _	Populus tremuloides	_ _ _	Ulmus americana
_ _ _	Fraxinus pennsylvanica	_ _ _	Quercus macrocarpa var. macrocarpa		

Shrub Stratum (woody plants with typical max growth < 3" DBH and > 1m tall)

Community # 1 2 3		Community # 1 2 3		Community # 1 2 3	
_ _ _	Acer spicatum	_ _ _	Myrica gale	_ _ _	Salix interior
_ _ _	Alnus incana ssp. rugosa	_ _ _	Physocarpus opulifolius	_ _ _	Salix petiolaris
_ _ _	Amorpha fruticosa	_ _ _	Rhamnus alnifolia	_ _ _	Sambucus nigra ssp. canadensis
_ _ _	Betula pumila var. glandulifera	_ _ _	Rhamnus cathartica	_ _ _	Spiraea alba
_ _ _	Cornus racemosa	_ _ _	Ribes americanum	_ _ _	Spiraea tomentosa var. rosea
_ _ _	Cornus sericea ssp. sericea	_ _ _	Rubus idaeus ssp. strigosus	_ _ _	Staphylea trifolia
_ _ _	Dasiphora floribunda	_ _ _	Salix bebbiana	_ _ _	Toxicodendron vernix
_ _ _	Frangula alnus	_ _ _	Salix candida	_ _ _	Viburnum lentago
_ _ _	Ilex verticillata	_ _ _	Salix discolor	_ _ _	Viburnum opulus var. americanum

Woody Vine Stratum (all woody vines)

Community # 1 2 3		Community # 1 2 3		Community # 1 2 3	
_ _ _	Clematis virginiana	_ _ _	Parthenocissus vitacea	_ _ _	Vitis riparia
_ _ _	Menispermum canadense	_ _ _	Solanum dulcamara var. dulcamara		

Herb Stratum (all non-aquatic herbaceous plants and woody plants with typical max growth < 1m tall)

Community # 1 2 3		Community # 1 2 3		Community # 1 2 3	
_ _ _	Achillea millefolium	_ _ _	Ambrosia trifida var. trifida	_ _ _	Aralia nudicaulis
_ _ _	Acorus americanus	_ _ _	Amphicarpaea bracteata	_ _ _	Argentina anserina
_ _ _	Adiantum pedatum	_ _ _	Andromeda polifolia var. glaucophylla	_ _ _	Arisaema triphyllum
_ _ _	Agrostis gigantea	_ _ _	Andropogon gerardii	_ _ _	Asclepias incarnata ssp. incarnata
_ _ _	Alisma subcordatum	_ _ _	Anemone canadensis	_ _ _	Athyrium filix-femina ssp. angustum
_ _ _	Alisma triviale	_ _ _	Anemone quinquefolia var. bifolia	_ _ _	Beckmannia syzigachne
_ _ _	Alliaria petiolata	_ _ _	Angelica atropurpurea	_ _ _	Bidens cernua
_ _ _	Ambrosia artemisiifolia	_ _ _	Apocynum cannabinum	_ _ _	Boehmeria cylindrica

Herb Stratum *Continued* (all non-aquatic herbaceous plants and woody plants < 1m tall)

Community # 1	2	3	
_	_	_	Botrychium virginianum
_	_	_	Bromus ciliatus var. ciliatus
_	_	_	Bromus inermis
_	_	_	Calamagrostis canadensis
_	_	_	Calamagrostis stricta ssp. stricta
_	_	_	Calla palustris
_	_	_	Caltha palustris var. palustris
_	_	_	Calystegia sepium
_	_	_	Campanula aparinoides
_	_	_	Carex aquatilis var. aquatilis
_	_	_	Carex atherodes
_	_	_	Carex comosa
_	_	_	Carex interior
_	_	_	Carex intumescens
_	_	_	Carex lacustris
_	_	_	Carex lasiocarpa var. americana
_	_	_	Carex oligosperma
_	_	_	Carex pellita
_	_	_	Carex stipata var. stipata
_	_	_	Carex stricta
_	_	_	Carex utriculata
_	_	_	Carex vulpinoidea
_	_	_	Chamaedaphne calyculata var. angustifolia
_	_	_	Chamerion angustifolium ssp. circumvagum
_	_	_	Chelone glabra
_	_	_	Cicuta bulbifera
_	_	_	Cicuta maculata
_	_	_	Circaea alpina ssp. alpina
_	_	_	Circaea lutetiana ssp. canadensis
_	_	_	Cirsium arvense
_	_	_	Cirsium muticum
_	_	_	Clintonia borealis
_	_	_	Comarum palustre
_	_	_	Conyza canadensis var. canadensis
_	_	_	Coptis trifolia
_	_	_	Cornus canadensis
_	_	_	Cryptotaenia canadensis
_	_	_	Cyperus esculentus var. leptostachyus
_	_	_	Cypripedium reginae
_	_	_	Dioscorea villosa
_	_	_	Doellingeria umbellata
_	_	_	Drosera rotundifolia var. rotundifolia
_	_	_	Dryopteris carthusiana
_	_	_	Dryopteris cristata
_	_	_	Dulichium arundinaceum
_	_	_	Echinochloa crus-galli
_	_	_	Echinocystis lobata
_	_	_	Eleocharis obtusa
_	_	_	Eleocharis palustris
_	_	_	Elymus virginicus
_	_	_	Epilobium leptophyllum
_	_	_	Equisetum arvense
_	_	_	Equisetum fluviatile
_	_	_	Eupatorium maculatum
_	_	_	Eupatorium perfoliatum var. perfoliatum
_	_	_	Euthamia graminifolia
_	_	_	Fragaria virginiana
_	_	_	Galium aparine
_	_	_	Gaultheria hispidula
_	_	_	Gentiana andrewsii
_	_	_	Geranium maculatum
_	_	_	Glyceria borealis
_	_	_	Glyceria canadensis

Community # 1	2	3	
_	_	_	Glyceria grandis var. grandis
_	_	_	Glyceria striata
_	_	_	Gymnocarpium dryopteris
_	_	_	Hackelia virginiana
_	_	_	Helenium autumnale var. autumnale
_	_	_	Helianthus giganteus
_	_	_	Helianthus grosseserratus
_	_	_	Heracleum maximum
_	_	_	Heuchera richardsonii
_	_	_	Hordeum jubatum ssp. jubatum
_	_	_	Hydrophyllum virginianum
_	_	_	Hypoxis hirsuta
_	_	_	Impatiens capensis
_	_	_	Iris versicolor
_	_	_	Kalmia polifolia
_	_	_	Lactuca serriola
_	_	_	Laportea canadensis
_	_	_	Lathyrus palustris
_	_	_	Lathyrus venosus
_	_	_	Ledum groenlandicum
_	_	_	Leersia oryzoides
_	_	_	Liatris pycnostachya var. pycnostachya
_	_	_	Linnaea borealis ssp. americana
_	_	_	Lobelia kalmii
_	_	_	Lobelia siphilitica var. ludoviciana
_	_	_	Lobelia spicata
_	_	_	Lycopus americanus
_	_	_	Lycopus uniflorus
_	_	_	Lysimachia ciliata
_	_	_	Lysimachia thyrsiflora
_	_	_	Lythrum salicaria
_	_	_	Maianthemum canadense
_	_	_	Maianthemum stellatum
_	_	_	Maianthemum trifolium
_	_	_	Matteuccia struthiopteris
_	_	_	Mentha arvensis
_	_	_	Menyanthes trifoliata
_	_	_	Mertensia virginica
_	_	_	Mimulus ringens var. ringens
_	_	_	Mitella nuda
_	_	_	Monotropa uniflora
_	_	_	Muhlenbergia richardsonis
_	_	_	Oligoneuron riddellii
_	_	_	Onoclea sensibilis
_	_	_	Orthilia secunda
_	_	_	Osmorhiza claytonii
_	_	_	Osmunda cinnamomea var. cinnamomea
_	_	_	Osmunda regalis var. spectabilis
_	_	_	Panicum virgatum var. virgatum
_	_	_	Parnassia glauca
_	_	_	Parnassia palustris
_	_	_	Pedicularis lanceolata
_	_	_	Penthorum sedoides
_	_	_	Petasites frigidus var. palmatus
_	_	_	Phalaris arundinacea
_	_	_	Phragmites australis
_	_	_	Physostegia virginiana ssp. virginiana
_	_	_	Pilea pumila var. pumila
_	_	_	Poa palustris
_	_	_	Poa pratensis ssp. pratensis
_	_	_	Polygonum amphibium
_	_	_	Polygonum lapathifolium

Community # 1	2	3	
_	_	_	Polygonum pensylvanicum
_	_	_	Polygonum sagittatum
_	_	_	Pontederia cordata
_	_	_	Potentilla norvegica ssp. monspeliensis
_	_	_	Prenanthes racemosa
_	_	_	Pycnanthemum virginianum
_	_	_	Rubus pubescens var. pubescens
_	_	_	Rudbeckia hirta var. pulcherrima
_	_	_	Rudbeckia laciniata var. laciniata
_	_	_	Rumex crispus ssp. crispus
_	_	_	Rumex orbiculatus
_	_	_	Sagittaria latifolia
_	_	_	Sagittaria rigida
_	_	_	Sanguinaria canadensis
_	_	_	Sarracenia purpurea ssp. purpurea
_	_	_	Saxifraga pensylvanica
_	_	_	Scheuchzeria palustris ssp. americana
_	_	_	Schoenoplectus acutus var. acutus
_	_	_	Schoenoplectus fluviatilis
_	_	_	Schoenoplectus pungens
_	_	_	Schoenoplectus tabernaemontani
_	_	_	Scirpus cyperinus
_	_	_	Scolochloa festucacea
_	_	_	Scutellaria galericulata
_	_	_	Scutellaria lateriflora
_	_	_	Sicyos angulatus
_	_	_	Sium suave
_	_	_	Solidago canadensis
_	_	_	Solidago gigantea
_	_	_	Solidago uliginosa var. uliginosa
_	_	_	Sonchus arvensis
_	_	_	Sorghastrum nutans
_	_	_	Sparganium eurycarpum
_	_	_	Spartina pectinata
_	_	_	Stachys palustris
_	_	_	Stellaria longifolia
_	_	_	Streptopus lanceolatus var. longipes
_	_	_	Symphyotrichum lanceolatum
_	_	_	Symphyotrichum lateriflorum
_	_	_	Symphyotrichum novae-angliae
_	_	_	Symphyotrichum puniceum
_	_	_	Symplocarpus foetidus
_	_	_	Taraxacum officinale
_	_	_	Thalictrum dasycarpum
_	_	_	Thelypteris palustris var. pubescens
_	_	_	Toxicodendron rydbergii
_	_	_	Triadenum fraseri
_	_	_	Trientalis borealis ssp. borealis
_	_	_	Trillium cernuum
_	_	_	Typha angustifolia
_	_	_	Typha latifolia
_	_	_	Typha X glauca
_	_	_	Urtica dioica ssp. gracilis
_	_	_	Vaccinium angustifolium
_	_	_	Vaccinium macrocarpon
_	_	_	Vaccinium oxycoccos
_	_	_	Verbena hastata
_	_	_	Vernonia fasciculata
_	_	_	Veronicastrum virginicum
_	_	_	Xanthium strumarium
_	_	_	Zizania palustris
_	_	_	Zizia aurea

Appendix 3-Rapid FQA Calculator

Overview

The Rapid FQA calculator is an Excel spreadsheet created to provide users with a tool to quickly enter data, calculate *wC* scores, derive BCG Tier assessments, and be used for reporting. The calculator is designed to process a single Assessment Area (AA) containing up to 3 different plant community types. Additional copies should be made for additional AA's. The calculator is organized by Worksheets (tabs) to enter data, calculate metrics, and make the assessment.

Instructions

1) **Enter community information (green highlighted):** Enter the Eggers & Reed plant community type for community Worksheets 1-3 using the drop-down list provided and enter the estimated percent extent they occupy in the AA (Section 4.1)
2) **Enter vegetation data (blue highlighted):** For each community, enter the *Scientific Names* and *Cover Classes* of the observed species using the drop down lists provided. Data can be typed in but only correct values will be allowed. There is space for 60 species per community. Leaving extra rows blank doesn't affect the calculator. When a record is entered the remaining columns in the row automatically populate:
    - *Common Name*: The common name for the species (Appendix 1)
    - *CC Range*: The Cover Class (CC) percent cover range (Table 2)
    - *Midpoint CC*: The midpoint percent cover for each cover class (Table2)
    - *Native Status*: The MN native status of the species (Appendix 1)
    - *Rapid FQA Stratum*: The typical growth form/strata of the species (Appendix 1)
    - *C*: *C*-value of the species (Appendix 1)
    - *p*: Relative cover (Midpoint CC/Total Midpoint % Cover)
    - *pC*: Relative cover times the *C*-value (p x *C*)
3) **View results:** Once the data have been entered, the calculator automatically computes metrics and makes the assessment (Sections 4.2-4.4). Metric results and individual community assessments are found on the **Metrics** Worksheet. *wC* is the primary metric (Section 2.8), but additional metrics are provided for ancillary information. See Section 2.9 for BCG Tier narrative descriptions. The **AA-Assessment** Worksheet provides the overall AA assessment (Section 4.4).

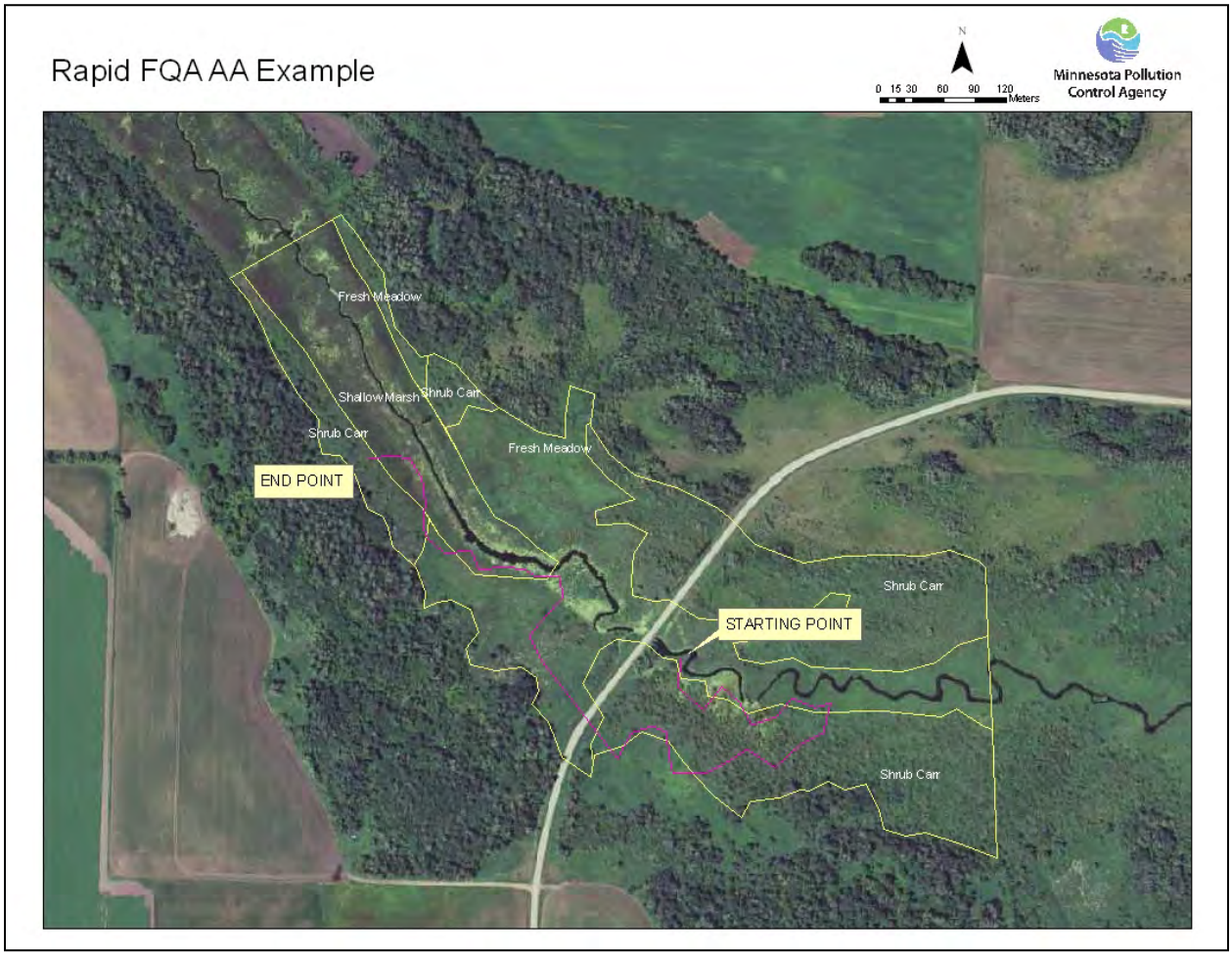
Appendix 4-Worked Example

A Rapid FQA example according to the numbered steps provided in the Results and Discussion section.

FIELD SAMPLING

Steps 1 and 2

Below is the final site map for the example. Prior to sampling, AA and community polygons were drawn in GIS based on aerial photos, topographic maps, and NWI interpretation (yellow line work). The base photography is 2010 1m resolution FSA. The community types follow those described in Table 1. After field sampling, the polygons were revised based on the observations made during Step 2. Once the GIS project was setup (which can be dedicated to Rapid FQA mapping), total mapping time was about 30 minutes.



Step 3

There are three community types within this AA: Shrub-Carr, Fresh Meadow, and Shallow Marsh. The base meander time is then: 30 minutes + 20 minutes + 20 minutes = 70 minutes.

Step 4

The meander path is provided in the AA map (magenta). Species listed on the data sheet (i.e., the rapid species; Appendix 4) were recorded as the meander proceeded. The meander started in the Fresh Meadow and preceded east crossing into the Shrub-Carr. The path then crossed through the Shrub-Carr heading west and the upland boundary of the AA was confirmed. The meander was then paused for a few minutes as the observer headed northwest across the road into a different area of the AA. The meander finished by working through the Fresh Meadow and Shallow Marsh in the northwestern portion of the AA. Five rapid species were observed during the final 10 minutes of the base meander time, so an additional 10 minute meander time period was added. During this period, only 2 more rapid species were observed so the meander was stopped. The meander covered all three communities in the AA with approximately equal time in each type.

Step 5

During Step 2, it was determined that the stream channel was deep water habitat, not a Shallow Open Water wetland community. Step 5 was not necessary.

Step 6

Cover was estimated for each rapid species occurring in each community type according to the cover classes in Table 2. Field sampling was now complete with a total field time at the AA of about 120 minutes.

Data and assessment

Step 1

Field data (scientific names and cover classes/CC) were entered into an excel spreadsheet by community type to calculate wC (see below). The CC ranges and Midpoint percent Cover came from Table 2. Species attributes (Minnesota Native Status, Minnesota NWI, and C) came from the Rapid Species List (Appendix 3). The Total Midpoint percent Cover, and Total Introduced Spp. Cover was then calculated for each community. Next the proportional cover (p) for each species was calculated by dividing the species' midpoint percent cover by the total cover. Each species C-value was then multiplied by its proportional abundance (pC). Finally, these values were summed to produce wC for each community type.

Shrub Carr

SciName	Cover Class	CC Range	Midpoint CC	MN Native Status	MN NWI	C	p	pC
Salix petiolaris	5	>50 - 75%	62.5	Native	FACW+	5	0.3655	1.82749
Phalaris arundinacea	4	>25 - 50%	37.5	Introduced	FACW+	0	0.2193	0
Calamagrostis canadensis	3	>5 - 25%	15	Native	OBL	4	0.0877	0.35088
Cornus sericea ssp. sericea	3	>5 - 25%	15	Native	[FACW]	3	0.0877	0.26316
Salix discolor	3	>5 - 25%	15	Native	FACW	3	0.0877	0.26316
Carex stricta	2	>1 - 5%	3	Native	OBL	5	0.0175	0.08772
Eupatorium maculatum	2	>1 - 5%	3	Native	[OBL]	4	0.0175	0.07018
Impatiens capensis	2	>1 - 5%	3	Native	FACW	2	0.0175	0.03509
Polygonum amphibium	2	>1 - 5%	3	Native	OBL	4	0.0175	0.07018
Salix bebbiana	2	>1 - 5%	3	Native	FACW+	6	0.0175	0.10526
Salix interior	2	>1 - 5%	3	Native	[OBL]	2	0.0175	0.03509
Ambrosia trifida var. trifida	1	>0 - 1%	0.5	Native	[FAC+]	0	0.0029	0
Bidens cernua	1	>0 - 1%	0.5	Native	OBL	3	0.0029	0.00877
Caltha palustris var. palustris	1	>0 - 1%	0.5	Native	[OBL]	6	0.0029	0.01754
Cirsium arvense	1	>0 - 1%	0.5	Introduced	FACU	0	0.0029	0
Echinocystis lobata	1	>0 - 1%	0.5	Native	FACW-	2	0.0029	0.00585
Lemna minor	1	>0 - 1%	0.5	Native	OBL	5	0.0029	0.01462
Lycopus uniflorus	1	>0 - 1%	0.5	Native	OBL	5	0.0029	0.01462
Pilea pumila var. pumila	1	>0 - 1%	0.5	Native	[FACW]	3	0.0029	0.00877
Poa palustris	1	>0 - 1%	0.5	Native	FACW+	5	0.0029	0.01462
Rhamnus cathartica	1	>0 - 1%	0.5	Introduced	FACU	0	0.0029	0
Rumex orbiculatus	1	>0 - 1%	0.5	Native	OBL	6	0.0029	0.01754
Solidago gigantea	1	>0 - 1%	0.5	Native	FACW	3	0.0029	0.00877
Symphyotrichum puniceum	1	>0 - 1%	0.5	Native	[OBL]	6	0.0029	0.01754
Thalictrum dasycarpum	1	>0 - 1%	0.5	Native	FACW-	4	0.0029	0.0117
Urtica dioica ssp. gracilis	1	>0 - 1%	0.5	Native	[FAC+]	1	0.0029	0.00292
Vitis riparia	1	>0 - 1%	0.5	Native	FACW-	2	0.0029	0.00585
		Total Midpoint % Cover	171				**wC**	3.3
		Total Introduced Spp. Cover	38.5					

Fresh Meadow

SciName	Cover Class	CC Range	Midpoint CC	MN Native Status	MN NWI	C	p	pC
Phalaris arundinacea	5	>50 - 75%	62.5	Introduced	FACW+	0	0.2778	0
Calamagrostis canadensis	4	>25 - 50%	37.5	Native	OBL	4	0.1667	0.66667
Ambrosia trifida var. trifida	3	>5 - 25%	15	Native	[FAC+]	0	0.0667	0
Carex lacustris	3	>5 - 25%	15	Native	OBL	5	0.0667	0.33333
Carex stricta	3	>5 - 25%	15	Native	OBL	5	0.0667	0.33333
Eupatorium maculatum	3	>5 - 25%	15	Native	[OBL]	4	0.0667	0.26667
Typha angustifolia	3	>5 - 25%	15	Introduced	OBL	0	0.0667	0
Apocynum cannabinum	2	>1 - 5%	3	Native	FAC	3	0.0133	0.04
Cirsium arvense	2	>1 - 5%	3	Introduced	FACU	0	0.0133	0
Cornus sericea ssp. sericea	2	>1 - 5%	3	Native	[FACW]	3	0.0133	0.04
Impatiens capensis	2	>1 - 5%	3	Native	FACW	2	0.0133	0.02667
Phragmites australis	2	>1 - 5%	3	Native	FACW+	1	0.0133	0.01333
Polygonum amphibium	2	>1 - 5%	3	Native	OBL	4	0.0133	0.05333
Populus tremuloides	2	>1 - 5%	3	Native	[FAC]	2	0.0133	0.02667
Rumex orbiculatus	2	>1 - 5%	3	Native	OBL	6	0.0133	0.08
Salix discolor	2	>1 - 5%	3	Native	FACW	3	0.0133	0.04
Salix interior	2	>1 - 5%	3	Native	[OBL]	2	0.0133	0.02667
Salix petiolaris	2	>1 - 5%	3	Native	FACW+	5	0.0133	0.06667
Solidago gigantea	2	>1 - 5%	3	Native	FACW	3	0.0133	0.04
Symphyotrichum puniceum	2	>1 - 5%	3	Native	[OBL]	6	0.0133	0.08
Thalictrum dasycarpum	2	>1 - 5%	3	Native	FACW-	4	0.0133	0.05333
Urtica dioica ssp. gracilis	2	>1 - 5%	3	Native	[FAC+]	1	0.0133	0.01333
Acer negundo	1	>0 - 1%	0.5	Native	FACW-	1	0.0022	0.00222
Echinocystis lobata	1	>0 - 1%	0.5	Native	FACW-	2	0.0022	0.00444
Helianthus giganteus	1	>0 - 1%	0.5	Native	FACW	4	0.0022	0.00889
Helianthus grosseserratus	1	>0 - 1%	0.5	Native	FACW-	3	0.0022	0.00667
Lycopus uniflorus	1	>0 - 1%	0.5	Native	OBL	5	0.0022	0.01111
Mentha arvensis	1	>0 - 1%	0.5	Native	FACW	3	0.0022	0.00667
Parthenocissus vitacea	1	>0 - 1%	0.5	Native	FACU	2	0.0022	0.00444
Rubus idaeus ssp. strigosus	1	>0 - 1%	0.5	Native	[FACU+]	3	0.0022	0.00667
Thelypteris palustris var. pubescens	1	>0 - 1%	0.5	Native	[FACW+]	7	0.0022	0.01556
Typha latifolia	1	>0 - 1%	0.5	Native	OBL	2	0.0022	0.00444
		Total Midpoint % Cover	225				**wC**	2.3
		Total Introduced Spp. Cover	80.5					

Shallow Marsh

SciName	Cover Class	CC Range	Midpoint CC	MN Native Status	MN NWI	C	p	pC
Typha angustifolia	6	>75 - 95%	85	Introduced	OBL	0	0.6719	0
Calamagrostis canadensis	3	>5 - 25%	15	Native	OBL	4	0.1186	0.47431
Carex lacustris	3	>5 - 25%	15	Native	OBL	5	0.1186	0.59289
Lemna minor	2	>1 - 5%	3	Native	OBL	5	0.0237	0.11858
Acorus americanus	1	>0 - 1%	0.5	Native	[OBL]	7	0.004	0.02767
Bidens cernua	1	>0 - 1%	0.5	Native	OBL	3	0.004	0.01186
Carex stricta	1	>0 - 1%	0.5	Native	OBL	5	0.004	0.01976
Cicuta bulbifera	1	>0 - 1%	0.5	Native	OBL	7	0.004	0.02767
Cirsium arvense	1	>0 - 1%	0.5	Introduced	FACU	0	0.004	0
Cornus sericea ssp. sericea	1	>0 - 1%	0.5	Native	[FACW]	3	0.004	0.01186
Impatiens capensis	1	>0 - 1%	0.5	Native	FACW	2	0.004	0.00791
Leersia oryzoides	1	>0 - 1%	0.5	Native	OBL	3	0.004	0.01186
Mentha arvensis	1	>0 - 1%	0.5	Native	FACW	3	0.004	0.01186
Phalaris arundinacea	1	>0 - 1%	0.5	Introduced	FACW+	0	0.004	0
Pilea pumila var. pumila	1	>0 - 1%	0.5	Native	[FACW]	3	0.004	0.01186
Polygonum amphibium	1	>0 - 1%	0.5	Native	OBL	4	0.004	0.01581
Polygonum lapathifolium	1	>0 - 1%	0.5	Native	FACW+	2	0.004	0.00791
Rubus idaeus ssp. strigosus	1	>0 - 1%	0.5	Native	[FACU+]	3	0.004	0.01186
Rumex orbiculatus	1	>0 - 1%	0.5	Native	OBL	6	0.004	0.02372
Salix petiolaris	1	>0 - 1%	0.5	Native	FACW+	5	0.004	0.01976
Spirodela polyrrhiza	1	>0 - 1%	0.5	Native	[OBL]	5	0.004	0.01976
		Total Midpoint % Cover	126.5				**wC**	1.4
		Total Introduced Spp. Cover	86					

Step 2

The *wC* values were then compared to the BCG Tier thresholds in Table 7 to determine the assessment Tier for each community

Community Type	wC	BCG Tier
Shrub Carr	3.3	3
Fresh Meadow	2.3	3
Shallow Marsh	1.4	4

Step 3

The area of each community and the total AA area were calculated using GIS. Next, the proportion of each community was calculated by dividing the community area by the total. Finally, the proportion was multiplied by the BCG Tier for each community, summed, and rounded to the nearest whole number to produce the weighted average Tier for the AA.

Community Type	wC	BCG Tier	Area in AA (M^2)	Proportion of AA	Proportion x Tier
Shrub Carr	3.3	3	81287	0.4823668	1.4471003
Fresh Meadow	2.3	3	59526	0.3532344	1.0597032
Shallow Marsh	1.4	4	27704	0.1643988	0.6575954

Total AA Area (M^2) 168517

Weighted Average Tier 3

Appendix 5-Adapting US ACE Methods for the Rapid FQA

The US Army Corps of Engineers (US ACE) has established vegetation sampling guidelines for wetland determinations/delineations through the 1987 Corps of Engineers Wetlands Delineation Manual (US ACE 1987) and the more recently published regional supplements for the Midwest (US ACE 2010a), Great Plains (US ACE 2010b), and Northcentral/Northeast (US ACE 2012) regions. The goal of the vegetation sampling in a wetland delineation is to characterize the vegetation sufficiently to apply hydrophytic vegetation indicators (i.e., Rapid test for hydrophytic vegetation, Dominance Test, etc.) to determine if a site supports a prevalence of hydrophytic vegetation.

In summary, the US ACE recommends that hydrophytic vegetation determinations should be based on samples taken within representative locations by vegetation unit (i.e., plant communities). This can be done within a community as a whole–but locating one or more sampling plots at representative locations by community type is preferred. Plot size depends on the prevalent structural type of the vegetation present (i.e., trees, shrubs, herbaceous plants, etc.). Establishing nested circular plots of varying size by structural type are recommended. Vertical vegetation strata (tree, shrub, woody vine, herb) are sampled separately. Species are identified and absolute areal cover is estimated by strata. Dominant species are determined in each stratum using the 50/20 rule (though qualitative assessments of dominant species are adequate in relatively simple plant communities). Once the dominants have been determined–no further species identification is required to make the hydrophytic vegetation determination unless the site does not pass Indicators 1 (Rapid Test for Hydrophytic Vegetation) and 2 (Dominance Test). If this occurs, the next step is Indicator 3 (Prevalence Index), which requires that a minimum of 80 percent of the total vegetative cover on the plot (summed across all strata) is correctly identified to the species level and those species have an assigned indicator status.

For routine wetland determinations, the recommended US ACE vegetation sampling procedure meets three of the four general conditions to complete a Rapid FQA (Section 6: Adaptations):

- The sampling is done by community type
- It is a representative sample (if plots are sized and placed according to the guidance)
- Areal cover estimates are made

The remaining general condition to adapt alternative sampling methods for the Rapid FQA requires that species be identified to the level of the Rapid Species List (Appendix 1). USACE guidance focuses on identifying only the dominant species (as determined by the 50/20 rule). Both in training and practice, however, delineators are encouraged to identify all the species in sampling plots to the extent possible given the skills of the delineator and the condition of the vegetation. If the level of species identification meets (or exceeds) the Rapid Species List during US ACE sampling–the resulting data may be applicable to complete a Rapid FQA in addition to making a hydrophytic vegetation determination.

General Guidance

The following provides step-by-step guidance on how to adapt US ACE standard vegetation sampling to also return a Rapid FQA.

- **Define the AA and community types:** This should be done according to sections 3.1-3.2 of this manual.
- **Establish vegetation sampling plots:** This should be done according to US ACE guidance provided in the 1987 Delineation Manual (US ACE 1987) and the appropriate regional supplement (US ACE 2010a, US ACE 2010b, US ACE 2012). Plots should be of sufficient size according to the vegetation present and established at representative locations within each plant community occurring in the AA.

- **Identify species by vertical strata within the sampling plots:** In general, this should be done to the level of the Rapid Species List (Appendix 1). The Rapid FQA data form (Appendix 2) is organized according to US ACE strata and may be used as a primary field data form. There may be cases where the apparent dominant species is not on the Rapid Species List. If this occurs, these species need to be recorded in the margins and ultimately factored into the hydrophytic vegetation determination.
- **Estimate absolute percent cover:** This should be done for all of the species present that are on the Rapid Species List (and any that are perceived as dominates not on the list) according to US ACE guidance. Absolute cover can be recorded on the Rapid FQA data form in place of cover classes.
- **Determine the dominant species and make the hydrophytic vegetation determination:** Transfer the necessary data to the US ACE data form, determine the dominant species using the 50/20 rule, and complete the hydrophytic vegetation indicators according to the US ACE guidance.
- **Compute *wC* scores and complete the Rapid FQA:** This should be done according to sections 4.1-4.4 of this manual. Absolute cover can be used in the *wC* calculation or the Rapid FQA Calculator (Appendix 3) can be used if corresponding cover classes are entered. Unlike the US ACE sampling method, cover data are not analyzed by strata in the Rapid FQA. If the same species occurs within multiple strata in the same community, sum the cover prior to *wC* calculation.

Literature cited

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Appendix 6-Incorporating the Rapid FQA with the MnRAM

The Minnesota Routine Assessment Method (MnRAM) was created as a practical assessment tool to systematically evaluate wetland functions (i.e., the goods and services wetlands provide) for both regulatory and planning applications following the passage of the MN Wetland Conservation Act (MN BWSR 2010). The MnRAM relies on the observer making coarse/simplified field observations and then answering a series of categorical questions. This information is then used to produce functional ratings (Exceptional, High, Medium, and Low) for up to 12 separate wetland functions:

- Maintenance of Characteristic Vegetative Diversity/Integrity
- Maintenance of Hydrologic Regime
- Flood/Stormwater Attenuation
- Downstream Water Quality
- Maintenance of Wetland Water Quality
- Shoreline Protection
- Maintenance of Characteristic Wildlife Habitat Structure
- Maintenance of Characteristic Fish Habitat
- Maintenance of Characteristic Amphibian Habitat
- Aesthetics/Recreation/Education/Cultural
- Commercial Uses
- Ground Water Interaction

The MnRAM functional rating scales are conceptually calibrated to a theoretical pre-European-settlement condition baseline. A Management Classification System (MN BWSR 2012) has also been created to provide a basis to translate MnRAM results into management recommendations. In this way, the MnRAM produces results universally relative to minimally impacted wetlands, but those results can then be further evaluated according to a local context through Management Classification. An Access database has also been created to manage data and automate the reporting of MnRAM results.

The Vegetative Diversity/Integrity function is integral to the MnRAM. Making the vegetation observations typically is the most time consuming portion of the MnRAM field sampling. First, the plant communities (Eggers and Reed 2011) in a wetland are determined; the dominant species (according to the 50/20 rule) are identified; and the cover of invasive species is estimated for each community. The vegetation quality ratings are then derived based on the observations and a narrative guidance for each community. The overall Vegetative Diversity/Integrity function ratings for a wetland is then expressed as the: Highest Quality Community; Non-Weighted; and Weighted Average (based on the percent extent of each community) Quality of all communities. Vegetative Diversity/Integrity function results are incorporated into both the Maintenance of Wetland Water Quality and Characteristic Wildlife Habitat Structure functions and the community type/proportional information is used in the Wetland Sensitivity to Stormwater Input and Urban Development assessment. Vegetative Diversity/Integrity results also feed into the Management Classification System–where the quality ratings directly affect management recommendations.

The Rapid FQA has the potential to be substituted as an alternative vegetation component in the MnRAM. Both methods are similarly structured where vegetation observations are made and results are expressed by plant community types. They also share conceptually similar theoretical assessment frameworks. A pre-European-settlement wetland condition is the assessment baseline and the Rapid FQA BCG Tiers are more or less equivalent to the four MnRAM Vegetation Integrity/Diversity ratings (Table 1). This allows for direct input of Rapid FQA community assessment results into the MnRAM.

Table 1. Comparison of Rapid FQA BCG Tiers and MnRAM Vegetation Quality Categories. The MnRAM Vegetation Quality ratings are unique by community type. The summary descriptions provided here have been synthesized from the individual community ratings.

Rapid FQA BCG Tiers		MnRAM Vegetation Diversity & Integrity Categories	
BCG Tier	**Description**	**Veg Quality Category**	**Summary Description**
1	Community composition and structure as they exist (or likely existed) in the absence of measurable effects of anthropogenic stressors representing pre-European settlement conditions. Non-native taxa may be present at very low abundance and not causing displacement of native taxa.	Exceptional	Plant community is undisturbed, or sufficiently recovered from past disturbances, such that it represents pre-European settlement conditions
2	Community structure similar to natural community. Some additional taxa present and/or there are minor changes in the abundance distribution from the expected natural range. Extent of expected native composition for the community type remains largely intact.	High	The characteristic native assemblage for the community type is present and dominant. Multiple native dominant taxa (as determined by the 50/20 rule) typically present. Invasive species comprise < 20% cover in any stratum.
3	Moderate changes in community structure. Sensitive taxa are replaced as the abundance distribution shifts towards more tolerant taxa. Extent of expected native composition for the community type diminished.	Medium	The number of native species is reduced. Invasive species comprise 20-50% cover in one or more strata.
4	Large to extreme changes in community structure resulting from large abundance distribution shifts towards more tolerant taxa. Extent of expected native composition for the community type reduced to isolated pockets and/or wholesale changes in composition.	Low	Few native species are dominants/present. Invasive species cover > 50% in one or more strata. > 50% of the canopy may be dead and/or no evidence of tree regeneration present in forested types.

The advantage of substituting the Rapid FQA for the MnRAM Vegetative Diversity/Integrity is a more rigorous method and consequently improved accuracy. This is due to the greater relative sampling intensity; quantitative results (*wC*); and the data-driven assessment criteria of the Rapid FQA. The Rapid FQA assessment criteria were derived from a large data set that included sites ranging from pre-European settlement conditions to severely impacted conditions. The MnRAM criteria were derived by the MnRAM workgroup based on the best professional judgment of the group and the best available information at the time. The disadvantage of substituting the Rapid FQA is the greater degree of botanical expertise and sampling effort required–making it not appropriate or attainable in all situations.

General Guidance

The following provides step-by-step guidance on how to substitute the Rapid FQA as the vegetation sampling and assessment component in the MnRAM.

- **Define the AA and community types prior to field sampling:** This should be done according to section 3.1 of this manual. Note that the AA as defined in the Rapid FQA is the wetland area that is being represented by the sampling (see Section 2.1). MnRAM guidance refers to the equivalent area as 'wetlands' or 'sites' and an 'assessment area' as being a larger land area that may include upland and multiple wetlands.
- **Complete the MnRAM GIS/Office observations:** The MnRAM requires information from non-field observations that include noting special features and designations; as well as, answering questions on landscape, buffer, and soil characteristics. Complete these portions of the MnRAM according to the MnRAM guidance.

- **Complete the Rapid FQA field sampling:** This should be done according to sections 3.2-3.6 of this manual. MnRAM vegetation sampling (#2) would not be done.
- **Complete additional MnRAM required field observations:** The Rapid FQA typically will provide enough observation to complete the MnRAM questions pertaining to within-wetland features. The MnRAM also requires observations of the surface water inputs/outputs (if present) and the immediate buffer surrounding the AA. Make these observations according to the MnRAM guidance. Results should be recorded on the MnRAM data sheet or directly entered into the database. Field sampling should be complete at this point and the remaining steps can be completed in the office.
- **Calculate *wC* Scores and complete the Rapid FQA assessment:** This should be done according to sections 4.1-4.3 of this manual.
- **Enter vegetation community information into the MnRAM:** Enter the community type and extent information recorded during the Rapid FQA sampling into the MnRAM database.
- **Convert Rapid FQA community BCG Tiers to MnRAM Vegetation Quality Categories and enter into MnRAM:** Using Table 1–convert the BCG Tier assessment of each community into the corresponding MnRAM Vegetation Quality Category. Enter this information into the MnRAM database.
- **Complete the MnRAM:** Complete any remaining MnRAM questions and enter results according to the MnRAM guidance. The MnRAM functional assessment should now be complete.
- **Additional Considerations:** The following are specific situations where completing the MnRAM requires deviation from the above guidance:
    - All Calcareous Fen communities will be rated as 'Exceptional' in the MnRAM regardless of the BCG Tier it is assessed as in the Rapid FQA.
    - The Rapid FQA has combined the Eggers and Reed (2011) Sedge Meadow and Fresh (Wet) Meadow into the more general class of Fresh Meadow (see Section 2.2). The more refined class designations can be made when substituting Rapid FQA into the MnRAM. In those cases, use the Fresh Meadow BCG assessment criteria for each class.
    - The Seasonally Flooded Basin community type is not included in the Rapid FQA (see Section 2.2). Proceed with the MnRAM vegetation procedure for this community type.
    - MnRAM Question #4 refers to the presence of listed rare plant species. If listed species are present and this question is answered as yes–then the overall Vegetative Diversity/Integrity function is rated as 'Exceptional' regardless of the BCG Tier the AA is assessed as in the Rapid FQA.
    - MnRAM Question #5 refers to whether the AA (or portion of) is mapped as a rare natural community/habitat in the MN DNR Natural Heritage Database/County Biological Survey. If the AA includes a rare natural community/habitat and this question is answered as yes–then the overall Vegetative Diversity Function is rated as 'Exceptional' regardless of which BCG Tier the AA is assessed as in the Rapid FQA.
    - MnRAM Question #6 asks the user if the AA represents pre-European settlement conditions. If all communities in the AA are assessed as BCG Tier 1 in the Rapid FQA then answer this question 'yes'. If any community is assessed as BCG Tier 2 or greater, answer this question 'no'.
- **Complete the Management Classification:** This should be done according to the Wetland Management Classification System guidance (MN BWSR 2012).
- **Reporting:** Clearly indicate in the results reporting if the Rapid FQA was substituted as the Vegetation Diversity/Integrity function and include additional Rapid FQA data and results according to the guidelines in Section 5 of this manual.

Literature cited

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