US Army Corps of Engineers ®
St. Paul District

Vegetation Performance Standards for Compensatory Wetland Mitigation

VERSION 1.0

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I. Executive Summary

The U.S. Army Corps of Engineers St Paul District (Corps) prepared this document to aid sponsors in developing appropriate vegetation performance standards (PSs) for wetland compensatory mitigation projects, including mitigation banks and in-lieu fee (ILF) sites, in Minnesota and Wisconsin. We appreciate input from members of the Programmatic Interagency Review Teams (IRT) in both states and look forward to updating this document based on best available science in coordination with the agencies. Further, the Corps welcomes feedback from sponsors and practitioners.

This document outlines six principal components of vegetation PSs and offers examples of each component that would generally reflect high quality target conditions. Sponsors should usually plan and construct mitigation sites with the goal of high-quality vegetation, and then monitor over time and implement adaptive management as needed to ensure high quality target conditions are met. Based on factors such as site-specific conditions, historic alterations or landscape constraints, a sponsor may propose vegetation standards that are lower than the high-quality targets offered as examples in this document. In such situations, the sponsor must provide appropriate justification for review and consideration by the IRT. However, sponsors should be mindful that sites which are unlikely to support a high-quality vegetation community might not be suitable wetland mitigation sites.

This document is not intended to address methods for monitoring vegetation for compensatory mitigation projects. Please refer to *Vegetation Monitoring for Compensatory Wetland Mitigation Sites* for information on vegetation monitoring methodology. Also, for development of hydrology performance standards, please refer to *Target Hydrology Performance Standards for Compensatory Mitigation Sites*.

II. Developing Vegetation Performance Standards

Sponsors and practitioners should consider site-specific factors when developing and justifying performance standards (PSs) for a mitigation site. A list of factors for sponsors to consider is provided below. This is not an exhaustive list, but rather a guide to justifying PSs for a given site, including alternative PSs when the high-quality examples offered in this document are not attainable or appropriate for a given site.

1. **Baseline conditions and mitigation methods**: The starting point for a mitigation site, and the method of mitigation proposed, should influence PS targets. Is the starting point exposed hydric soils and a depleted native seedbank due to decades of an effectively-drained condition and cultivation for row crops (restoration via reestablishment)? Or a wetland creation site with no hydric soils and no wetland seedbank (establishment)? This would require starting from scratch in establishing diverse, native, hydrophytic plant communities. In contrast, is the mitigation site composed of existing but degraded wetlands with remnant native vegetation and a viable native seedbank (restoration via rehabilitation)? Or is the mitigation site predominately composed of native, hydrophytic communities but invasive species are established (enhancement)? The answers to these

questions may factor into species richness PS and native non-invasive (NNI) versus invasive non-native (InNN) cover, and sponsors should develop PSs with consideration for goals and objectives of the mitigation site and what is practicable to achieve.

2. **Target plant community type**: Wide variation in species diversity, species richness, composition, structure, and areal cover across different wetland plant community types may call for individualized PSs. For example, a relatively small number of plant species thrive in the semi-permanently inundated conditions of deep marshes while a much larger number of species thrive in the saturated soil conditions that characterize "drier end" wetland communities.

3. **Reference site information**: To develop attainable PSs, sponsors should consider information from a nearby site with similar characteristics including but not limited to plant community type(s), soils, and landscape setting. This could include monitoring data from a nearby mitigation bank or ILF site, which is publicly available on RIBITS. Sponsors may be able to find other reference information from state and local agencies, educational institutions, or non-profit natural resource entities. State-specific resources are discussed later in the Species Richness and Floristic Quality Assessment sections of this document.

4. **Vegetation establishment method**: Sponsors should consider how the target vegetation will be established. Will establishment rely solely on seed bank regeneration and volunteer species? If so, the target vegetation performance standards should be informed by reference data and baseline information such as a seed bank study. Alternatively, is seeding or planting proposed? Seed mixtures used in Minnesota and Wisconsin for sedge meadow, fresh wet meadow, wet prairie, and upland prairie plantings typically consist of 25-35 NNI species and those for shallow marsh plantings usually include 15-20 NNI species (see https://bwsr.state.mn.us/seed-mixes for example seed mixtures). Not all seeded species will establish or persist during the monitoring period and volunteer NNI species may also supplement the planting. Sponsors should consider the likelihood that certain species in seed mixes may not do well at their site and consider the likelihood that volunteer species will establish and propose species richness PSs accordingly.

5. **Surrounding land use/conditions**: Sponsors should consider the benefits and detriments surrounding land use could have on restored vegetation of the site. Mitigation sites surrounded by agriculture or urban development may have stressors that would limit the quality of vegetation conditions, and thus sponsors may be able to propose lower PSs. The extent of influence from adjacent land use may also depend on other variables such as landscape position and size of the mitigation site.

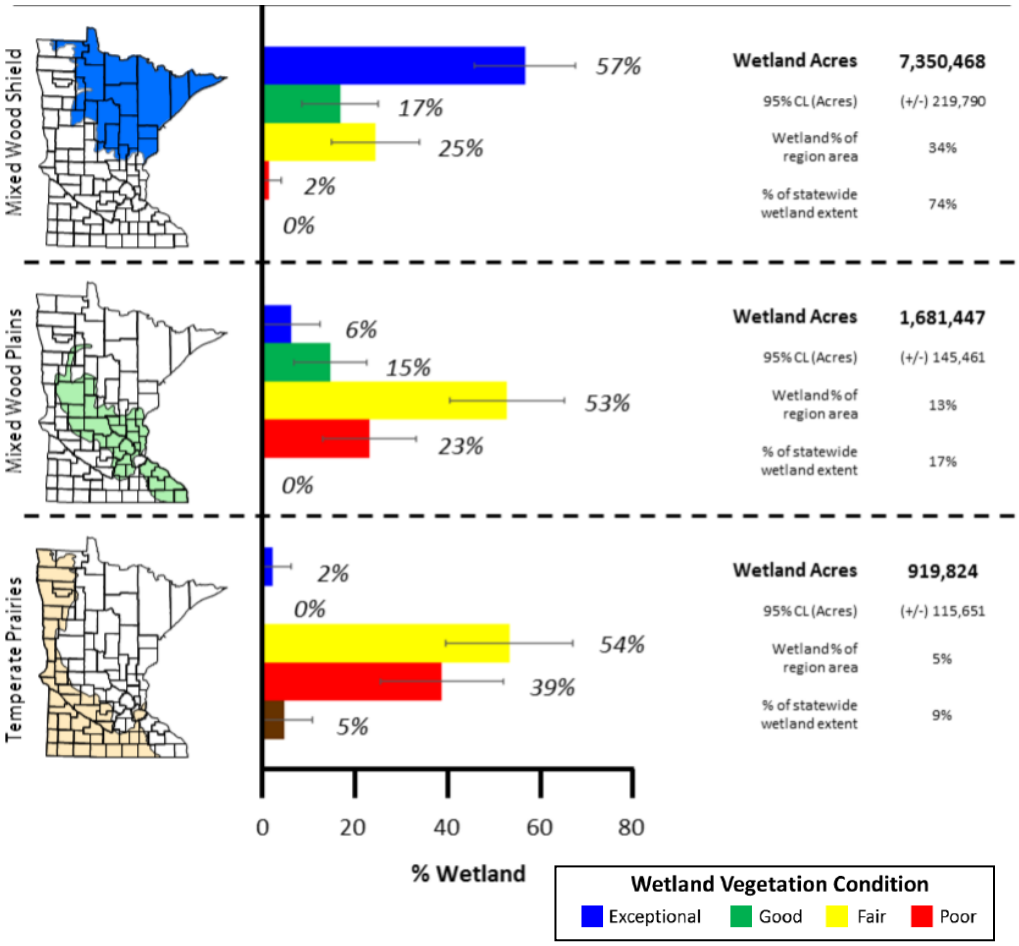
6. **Landscape position**: The landscape position of a mitigation site may influence vegetation PSs. For example, is the mitigation site located in a depressional basin with hydrology driven by surface water runoff? Vegetation at these sites is more likely to be impaired by nutrient-rich runoff, and depending on surrounding land use, may warrant lower PS thresholds. Alternatively, is the mitigation site located in the floodplain of a tributary? Floodplain sites may be characterized by higher amounts of exposed soil and

therefore PSs specifying higher amounts of unvegetated area may be appropriate. Further, are there adjacent, upstream or other sources of native plant propagules that could supplement the applied seed mixture/planting? Or the opposite - adjacent, upstream, or other sources of invasive, non-native propagules?

7. **Monitoring method(s)**: Sponsors must ensure they propose and implement monitoring methods that will effectively measure the PS components selected. For example, meander surveys are better able to measure species richness than plot or transect methods alone. With better species detection, higher species richness PSs are appropriate.

8. **Length of monitoring period**: Can PSs be realistically achieved within the monitoring timeframe? Sponsors must keep in mind it may take longer than the typical 5-year monitoring period to achieve optimal PSs for a given site. This may be especially true for wooded wetland communities, where sponsors may need to propose a 5–7-year monitoring period, or a 7–10-year monitoring period.

9. **Ecoregion**: Significant differences in wetland vegetation condition categories may prompt regionalized PSs. Lower standards than the high-quality examples for species richness and NNI/InNN may be appropriate for sites located in regions that have been subject to significant landscape alterations such as the temperate prairie region of MN (see Figure 1, and further described in IV.A.). Site specific conditions and potential should still serve as the primary basis for developing PSs for a given site while also considering regional wetland vegetation conditions.



Condition Category	Description
Exceptional	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.
Good	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.
Fair	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.
Poor	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.
Absent	Plant life only marginally supported or soil/substrate largely devoid of hydrophytic vegetation due to ongoing severe anthropogenic impacts

Figure 1: Regional differences in wetland vegetation condition category proportion and extent in Minnesota illustrate why some vegetation performance standards may need to be regionalized (figure and definitions of condition categories from MPCA 2019).

III. Tiered Approach to Vegetation Performance Standards and Credit Releases

The Corps generally requires three tiers of monitoring related to vegetation performance, where the sponsor must demonstrate during monitoring that the site is meeting progressively higher PSs. The Corps will release a certain proportion of credits as PSs are met, with the final credit release approved once all tiers are met. In some cases, two or four tiers may be appropriate. Furthermore, one or more tiers may require that a PS be met for more than one growing season prior to release of credits associated with that tier.

IV. Components of Performance Standards for Vegetation

Vegetation PSs primarily involve six components:

- **Relative Areal Cover by NNI Species versus InNN Species**
- **Species Richness/Composition**
- **Relative Areal Cover by Hydrophytes**
- **Maximum Allowance for Unvegetated Areas**
- **Establishment of Woody Vegetation**
- **Floristic Quality Assessment**

Note that Examples 1 through 8 shown below in yellow text boxes are just that—examples. These examples are not appropriate for all sites and sponsors should evaluate site-specific variables when proposing PSs for their sites.

A. Relative Areal Cover by Native, Non-Invasive Species (NNI) v. Invasive and/or Non-Native (InNN) Species

Requirements for this PS vary depending on the goals and objectives for a mitigation site. Generally, sponsors are expected to establish and maintain plant communities with composition and structure representing high function and high-quality condition, with consideration for practicability and hydrologic restoration goals of the site. For example, a sponsor may be able to propose a higher relative areal cover by InNN species for a mitigation site with a focus on providing floodwater storage, or one with a goal of restoring habitat for northern pike spawning.

Sponsors should use the following formulas to determine the relative proportion of areal cover by NNI species versus that by InNN species:

$$\text{Relative Areal Cover by NNI Species (\%)} = \left[\frac{\text{Sum of absolute areal cover by NNI species}}{\text{Sum of abs. areal cover by NNI and InNN species}}\right] \times 100$$

$$\text{Relative Areal Cover by InNN Species (\%)} = \left[\frac{\text{Sum of absolute areal cover by InNN species}}{\text{Sum of abs. areal cover by NNI and InNN species}}\right] \times 100$$

Example 1—A three-tier approach to this PS could consist of the following[1]:

1. Interim 1: There shall be ≥50% relative areal cover by NNI species;<50% by InNN species for ≥1 growing season
2. Interim 2: There shall be ≥70% relative areal cover by NNI species;<30% by InNN species for ≥2 consecutive growing seasons after Interim 1 is met
3. Final: There shall be ≥80% relative areal cover by NNI species;<20% by InNN species for ≥1 growing season after Interim 2 is met

In Example 1, a minimum of four growing seasons are required for meeting all PSs: (1) Interim 1 is met the first full growing season post-restoration; (2) Interim 2 is met the following two growing seasons; and (3) the Final PS is met the growing season after Interim 2 is met.[1]

Both the Corps and state agencies in Minnesota and Wisconsin require that NNI dominance is minimally equal to or greater than 50% relative areal cover, therefore this serves as Interim 1 vegetation PS in some cases. The Corps has required final PSs specifying 90/10, 85/15, 80/20 and 70/30 ratios of relative areal cover by NNI/InNN species, with 80/20 being the most common.

As described above and illustrated in Figure 1 (MPCA 2019), regional differences in vegetation condition may influence the relative area cover of NNI species that a sponsor may practicably establish and maintain over time. For example, higher ratios of relative areal cover by NNI species may be a practicable goal in northern Minnesota's Mixed Wood Shield Region, where 57% of wetland vegetation is in exceptional condition and 17% in good condition, invasive species are generally absent or have low presence, and native seedbanks are viable. That same ratio may not be practicable in Minnesota's intensively agricultural Temperate Prairies Region where only 2% of wetlands have vegetation with a condition category of exceptional or good, invasive species dominate existing wetlands and native seedbanks are depleted by decades of drainage and cultivation. Shallow and deep marsh restorations in the Temperate Prairies Region are particularly problematic as ideal conditions are created for non-native cattails,[2] which are difficult to successfully control. A realistic goal for shallow and deep marsh restorations may need to account for this with Final PSs that specify, for example, 70 percent relative areal cover by NNI species. In Wisconsin, similar regional differences may influence vegetation conditions, as the southern two-thirds of the state are predominately agricultural/urban and may necessitate higher InNN cover, while the northern one-third of the state is predominately forested with less agriculture and could practicably support higher NNI cover.

An additional consideration for relative aerial cover addresses maximum allowable size of patches/stands of InNN species. For example, a wet meadow community that meets the Final PS of ≥80% relative areal cover by NNI species could have several patches of reed canary grass (*Phalaris arundinacea*) of two or more acres each, and these patches could compromise long-term

[1] This is a typical example applied in Wisconsin. In Minnesota, it is common for Interim 1, rather than Interim 2, to have a requirement for being met in two or more consecutive growing seasons.
[2] *Typha angustifolia* and *T.* x *glauca*.

success of the site. A PS stating a maximum allowable size of 0.25 acre (or some other acreage as deemed appropriate) for patches/stands of InNN species would address this.

Calculation of vegetative areal cover described above excludes unvegetated areas within a reference area or plot. Unvegetated areas are addressed by a separate PS (see IV.D., below).

B. Species Richness/Composition

A PS specifying a minimum number of NNI species will ensure floristic diversity. Otherwise, a plant community consisting of a monotype of a hydrophytic, NNI species could meet most vegetation PSs. In some cases, species composition is more important than species richness, i.e., characteristic species that define a community. Northern sedge meadows, for example, are characterized by certain species, e.g., yellow lake sedge (*Carex utriculate*), lake sedge (*Carex lacustris)* as well as Canada blue-joint grass (*Calamagrostis canadensis*). PSs in these scenarios can specify minimum areal cover by characteristic species rather than species richness.

All species, to include perennial, biennial and annual, are included for purposes of species richness. All are natural components of native plant communities including reference standard wetlands. See example 2.

> ***Example 2***—Proposed restoration of a wet prairie community; starting point is exposed soils; no viable native seedbank (site was effectively-drained and cultivated for decades); seed mixture/cover crop with 35 NNI species would be applied; natural influx of NNI plant propagules expected due to adjacent native wet prairie.
>
> 1. Interim1: There shall be ≥20 NNI species
> 2. Interim 2: There shall be ≥25 NNI species
> 3. Final: There shall be ≥30 NNI species

Reference standard wetlands can inform this PS or published botanical literature[3] can provide a species list for consideration. Additionally, the Wisconsin Department of Natural Resources (WDNR) has collected quantitative data that sponsors may consult in coordination with that agency to identify appropriate species richness PS by plant community. Sponsors may also use data in the Minnesota relevé database for this purpose but would need to consolidate and analyze the data for this specific application.

An additional consideration for species richness is to specify minimum areal cover by a minimum number of perennial NNI species to address the situation where the species richness PS is met, but very few NNI species comprise most of the areal cover.[4] See example 3. Specifying perennial is

[3] The Minnesota Department of Natural Resources field guides to the native vegetation of Minnesota (MnDNR 2003, 2005a, 2005b) and *The Vegetation of Wisconsin* (Curtis 1959) are examples.

[4] This approach replaces earlier performance standards that specified a minimum number of dominant NNI species using the "50/20 Rule." In herbaceous communities, for example, the "50/20 Rule" often only identified one to three dominant species per stratum, which provided a limited evaluation of the overall community. Specifying a minimum number of NNI

important because dominance by annuals could be observed during monitoring if seeding of annuals is occurring. Dominance by annuals over the long-term is not sustainable, and once annual seeding ceases, the site may be more susceptible to dominance by InNN.

Example 3—The following PS could be applied for an herbaceous community*:

1. Interim1: There shall be ≥3 perennial NNI species with ≥5% relative areal cover
2. Interim 2: There shall be ≥4 perennial NNI species with ≥5% relative areal cover
3. Final: There shall be ≥5 perennial NNI species with ≥5% relative areal cover

*For multi-strata communities (e.g., forested, shrub), a minimum number of NNI species with ≥5% relative areal cover could be specified for each stratum.

Exceptions to specifying "perennial" for this PS may include seasonally flooded basins, which are characterized by temporary ponding followed by drawdown, mudflats, and colonization of those mudflats by annual species. NNI annuals can also be dominants in shallow marshes, e.g., beggarticks (*Bidens* spp.), blunt spikerush (*Eleocharis obtusa*) and the ground layer of floodplain forests, e.g., jewelweed (*Impatiens capensis*), Canadian clearweed (*Pilea pumila*).

Final PSs specifying a minimum of four to six NNI species for tree and shrub strata are suitable in most cases. Note that if forested and shrub communities are proposed, sponsors should develop PSs for the forested and shrub components as well as herbaceous components of these communities.

C. Relative Areal Cover by Hydrophytes (in wetland communities)

Specifying a PS for relative areal cover by hydrophytes (OBL, FACW and FAC) is important to set a target for hydrophytic plant communities. However, for communities characterized by seasonal to permanent inundation (e.g., shallow and deep marshes), this PS may be optional. Sponsors should use the following formula to calculate relative areal cover by hydrophytes:

$$\textit{Relative Areal Cover by Hydrophytes} = \frac{\textit{Sum of absolute areal cover by OBL, FACW and FAC species}}{\textit{Sum of abs. areal cover by OBL, FACW, FAC, FACU and UPL species}} \times 100$$

While >50% relative areal cover by hydrophytes would minimally meet the criterion for a hydrophytic plant community,[5] this minimum is typically not the optimum for establishing target wetland plant communities. Instead, a Final PS specifying >85% relative areal cover by hydrophytes is appropriate for most cases. In some wetland types, like wet prairie, lower relative aerial cover by hydrophytes may be appropriate because non-invasive, facultative-upland species are a natural component of many wetland communities.

species with a minimum relative areal cover is more informative because the minimum number of species is typically greater than the number of dominants determined by the "50/20 Rule."

[5] Using the Hydrophytic Cover Index (Lichvar and Gillrich 2014).

Example 4—Specify a minimum relative areal cover by hydrophytes:

1. Interim1: There shall be >60% relative areal cover by hydrophytes
2. Interim 2: There shall be >70% relative areal cover by hydrophytes
3. Final: There shall be >85% relative areal cover by hydrophytes

D. Maximum Allowance for Unvegetated Areas

A mitigation site with large patches of unvegetated areas could potentially meet the PSs discussed in A-C above because those PSs focus exclusively on vegetated areas; therefore, the Corps may require a PS specifying the maximum allowable extent of unvegetated areas. Sponsors may develop this PS by using a percentage of the acreage of a target plant community.

Seed mixtures for fresh wet meadow, wet mesic prairie, and upland prairie include, as standard practice, a fast-growing cover crop to aid in stabilizing soils and providing conditions conducive for germination and establishment of the overall seed mix. Exposed soils should be minor in areal extent at the close of the first full growing season and nearly absent by the close of the second growing season. See example 5. If unvegetated bare areas are present at greater percentages, this likely indicates problems including: (1) erosion; (2) incorrect hydrologic regime; (3) unsuitable substrate; (4) excessive herbivory; (5) improper seed installation/planting; and/or (6) drought. Sponsors will likely need to propose and implement adaptive management or corrective actions in such cases.

Example 5—Proposed restoration of a fresh wet meadow community; starting point is exposed hydric soils; seed mixture/cover crop would be applied.

1. Interim 1: Unvegetated areas shall not exceed 5% (2,178 ft^2)/acre
2. Interim 2: Unvegetated areas shall not exceed 2% (871 ft^2)/acre
3. Final: Unvegetated areas shall not exceed 1% (436 ft^2)/acre

Conversely, shallow marshes, vernal pools, seasonally flooded basins, channels in floodplain forests, and sparsely-vegetated concave surfaces in hardwood swamps are characterized by extended periods of inundation followed by drawdowns. These alternating patterns of inundation and drawdown naturally result in unvegetated areas to varying degrees. PSs specific to these wetland communities should include allowances for unvegetated areas as a long-term, natural condition. See Example 6. Sponsors should consider timing of monitoring as higher unvegetated conditions early in the growing season and maximum vegetation cover late in the growing season is typical.

Example 6—Proposed restoration of a seasonally flooded basin community; starting point is exposed hydric soils; seed mixture composed of NNI annual species would be applied. Timing of monitoring is late growing season to observe maximum extent of vegetative cover.

1. Interim: Unvegetated areas shall not exceed 40% (17,424 ft²)/acre
2. Final: Unvegetated areas shall not exceed 30% (13,068 ft²)/acre

Another situation involves wetlands consisting of deep marsh or shallow, open water (semi-permanent to permanent inundation), with water depths ≤2 meters [Figure 2]. These wetlands naturally include submergent, floating-leaved and floating aquatic plant species. PSs should specify requirements for areal cover by NNI species, species richness and allowable extent of unvegetated areas that are reflective of natural conditions. While cover classes are not considered suitable for most PSs, the Corps can consider exceptions for shallow, open water or deep marsh communities due to difficulty sampling these areas. For example: unvegetated (<5% areal cover), somewhat to moderately vegetated (5%-50% areal cover) to well vegetated (>50% areal cover).

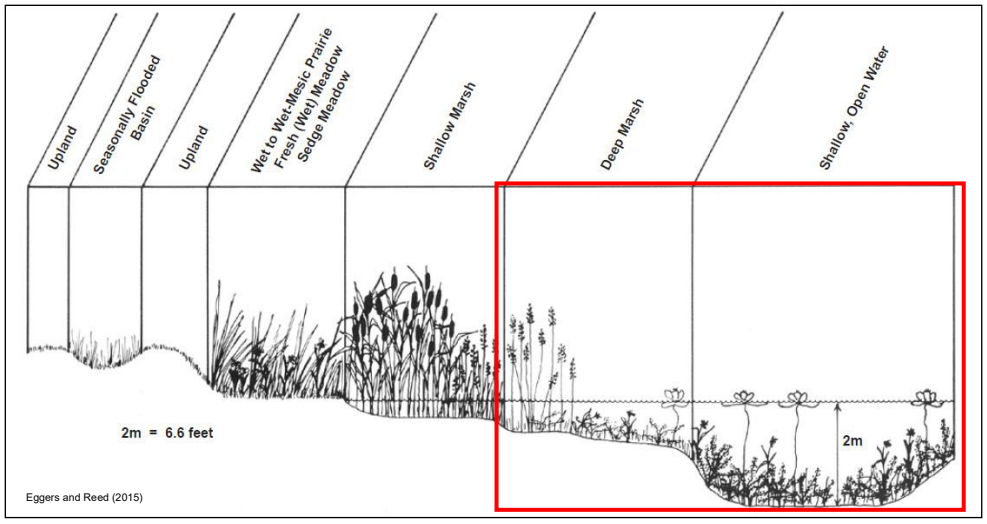


Figure 2: Red box illustrates deep marsh and shallow, open water with little to no aquatic emergent vegetation but supporting floating, floating-leaved and/or submergent vegetation.

E. Establishment of Woody Vegetation

PSs addressing plantings and establishment of forested and shrub wetland communities include:

- **Survival of planted woody stock**
- **Number of live stems/acre**
- **Minimum height**
- **Areal cover**

Early monitoring of planted woody stock survival is the initial focus, then monitoring may often expand to include number of live stems/acre of NNI tree and/or shrub species that are both native

and volunteer.[6] For both trees and shrubs, minimum live stems/acre and minimum height requirements become important metrics for Interim 2 and Final PS. See example 7. A minimum areal cover by NNI tree species was used in past PSs but did not work well as this metric was found to be highly variable at the close of the typical 10-year monitoring periods. For shrubs, minimum areal cover can be a useful metric given faster growing, multiple-stemmed growth forms.

Example 7—Proposed restoration of a shrub-carr community—PSs for establishment of shrub species (note that PS would also be needed for establishing the ground layer):

1. Interim1: There shall be >70% survival of planted shrub seedlings, OR >400* live, NNI shrub seedlings/acre for ≥3 consecutive growing seasons
2. Interim 2: There shall be >300* live, NNI shrub seedlings/acre ≥2.0 feet in height comprised of ≥4 NNI shrub species for ≥1 growing season after Interim 1 is met
3. Final: There shall be >250* live, NNI shrubs/acre ≥4.0 feet in height comprised of ≥6 NNI species for ≥1 growing season after Interim 2 is met

*Higher densities may be appropriate depending on site-specific conditions/goals.

Successful forested restorations have used various specifications for number of live stems/acre, with the goal of establishing PSs that will ensure if the final PS is met, usually at year 7 or 10, that the site will continue to successful maturity – meaning trees greater than 30 years old. As one example, the goal for past restoration projects for floodplain forests in the Upper Mississippi River system ranged from 108 to 180 live stems/acre at 30 years. Corps and WDNR foresters, who reviewed and commented on these PSs, noted that 300 live, NNI seedlings/saplings per acre is a minimum starting point for forested restorations. This starting point could vary based on landscape position and soil types, for example frequently flooded alluvial soils in floodplain forests, saturated mineral soils in hardwood swamps and saturated *Sphagnum* peat in coniferous bogs may dictate different starting points, as well as interim and final PSs.

In Example 8, a minimum of seven growing seasons are required to meet all components of the PS: (1) Interim 1 is met after the first three growing seasons; (2) Interim 2 is met the following three growing seasons; and (3) the Final PS is met one growing season after Interim 2 is met.

[6] Volunteer NNI tree and shrub species can be a major factor. If seed sources are adjacent and/or upstream, and soils and hydrology are suitable, numerous NNI tree and shrub species are adept at naturally colonizing compensation sites.

Example 8—Proposed restoration of a hardwood swamp community (note that PS would also be needed for establishing the shrub layer and ground layer):

1. Interim1: There shall be >70% survival of planted tree seedlings, OR >300* live, NNI tree seedlings/acre for ≥2 consecutive growing seasons
2. Interim 2: There shall be >250* live, NNI tree seedlings/acre with a height of ≥4.0 feet for ≥3 consecutive growing seasons after Interim 1 is met
3. Final: There shall be >200* live NNI tree seedlings/saplings per acre with a height of ≥6.0 feet comprised of ≥4 NNI tree species for ≥2 consecutive growing seasons after Interim 2 is met

*Higher densities may be appropriate depending on site-specific conditions/goals.
"Trees/acre" includes shrub- and sapling-size individuals.

F. Floristic Quality Assessment

The Floristic Quality Assessment (FQA) is a vegetation-based, ecological condition assessment. The Corps may require sponsors to use the FQA in PS development for enhancement or preservation sites. FQA metrics have been found to be responsive and reliable indicators of overall wetland condition (e.g., Mack and Kentula 2010). In the FQA, a Coefficient of Conservatism value (*C*-value) ranging from 0 to 10 is assigned to an individual plant species reflecting its conservatism, or fidelity, to natural habitats as well as its tolerance to natural or anthropogenic disturbance (Milburn et al. 2007, MCPA 2014). The Corps recommends that Sponsors use the weighted *C*-value (*wC*) for PSs because weighting *C*-values by percent relative areal cover of each plant species provides a simple yet comprehensive evaluation of that community (MPCA 2014). Sponsors should also include invasive species in the calculation of *wC* (subscript $_i$ = wC_i) when using FQA for PSs. The Corps has developed a national FQA database and calculator that can assist Sponsors and practitioners in evaluating FQA metrics. The tool is available at: https://fqacalc.erdc.dren.mil/fqacalc/.

The MPCA (2015) analyzed Minnesota vegetation data for each Eggers and Reed (2015) plant community along a Biological Condition Gradient (Table 1). Four Condition Categories, exceptional, good, fair, and poor (see full descriptions on page 4), were developed for the plant communities shown in Table 1. Sponsors may develop PSs using these Condition Categories for sites in Minnesota. Using shrub-carr communities as an example, a Final PS could specify a wC_i of 3.2-4.5, which corresponds to the "Fair" condition category (red box in Table 1).

Table 1: **Minnesota Biological Condition Gradient Assessment**				
Plant Community	**Condition Category**			
	Exceptional	**Good**	**Fair**	**Poor**
Shallow, Open Water		>5.0	<5.0	
Deep Marsh		>4.1	<4.1	
Shallow Marsh	>4.9*	>4.2	1.9-4.2	<1.9
Fresh Meadow	>4.2*	>4.2	1.4-4.2	<1.4
Wet Prairie	>4.8*	>4.1	1.4-4.1	<1.4
Calcareous Fen	>7.0*	>6.4	5.2-6.4	<5.2
Sedge Mat	>6.4*	>5.9	1.8-5.9	<1.8
Open Bog	>7.4*	>7.0	5.4-7.0	<5.4
Coniferous Bog	>7.3*	>7.1	5.9-7.1	<5.9
Shrub-Carr	>4.5*	>4.5	3.2-4.5	<3.2
Alder Thicket	>4.2*	>3.9	2.3-3.9	<2.3
Hardwood Swamp	>4.6*	>4.2	2.5-4.2	<2.5
Coniferous Swamp	>5.8*	>5.6	3.8-5.6	<3.8
Floodplain Forest	>4.2*	>2.7	2.1-2.7	<2.1
*Total non-native species cover <1%				From MPCA 2015

A rapid FQA is available in Minnesota (MPCA 2014) that uses an abbreviated list of relatively easy to identify plant species. However, for purposes of PSs, a full FQA is warranted because a full species list is more informative as it more accurately reflects the condition of a plant community.

Hlina et al. (2015) evaluated wetlands in the Wisconsin Northern Lakes and Forests Ecoregion and proposed condition tier benchmarks (Table 2). Sponsors may apply the benchmarks to PSs for mitigation sites in the Northern Lakes and Forests Ecoregion of Wisconsin or use the benchmarks as a starting point for use in other similar ecoregions. However, future efforts and research are needed to develop benchmarks applicable to wetlands within more urban and agricultural landscapes of southern Wisconsin. This is in concert with some wetland practitioners who suggest that FQA is best applied on an ecoregion basis rather than state boundaries (Bourdaghs et al. 2006; DeBerry et al. 2015).

LSB + NFL	Condition Tiers Defined by 2012-2014 Disturbance Factor Checklist				
Plant community type	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Alder Thicket	>5.3	4.5-5.3	4.1-4.5	3.8-4.1	<3.8
Northern Hardwood Swamp	>6.2	5.7-6.2	3.9-5.7	2.5-3.9	<2.5
Black Spruce Swamp	>7.9	7.4-7.9	6.7-7.4	5.7-6.7	<5.7
Cedar Swamp	>7.4	6.9-7.4	<6.9		
Muskeg	>8.5	7.9-8.5	<7.9		
Northern Sedge Meadow	>7.1	5.2-7.1	3.5-5.2	<3.5	
Open Bog	>8.9	8.0-8.9	<8.0		
Shallow Water Marsh	>7.1	5.2-7.1	2.8-5.2	<2.8	<.71
Shrub Carr			>5.1	3.9-5.1	<3.9

TABLE 2: wC_i benchmarks for condition tiers in northern Wisconsin

V. Examples of Performance Standards for Target Plant Communities

Example formats to summarize PSs for target plant communities are shown by Tables 3 through 6. Sponsors may use other formats. Table 3 includes PSs where all strata are lumped in some cases (e.g., species richness). As an option, sponsors can develop PSs specific to each stratum.

Table 3: **Forested Communities** (e.g., Hardwood Swamp, Floodplain Forest)			
Performance Standard	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species Cumulatively Across all Strata (tree, shrub, woody vine, herbaceous)	≥50% NNI; <50% InNN[1]	≥70% NNI; <30% InNN[2]	≥80% NNI; <20% InNN[3]
Establishment of Tree Species	>70% survival of planted woody stock, OR >300 live, NNI tree seedlings/acre for ≥2 consecutive growing seasons	>250 live, NNI tree seedlings/ acre ≥4.0 feet in height for ≥3 consecutive growing seasons after Interim 1 is met	>200 live, NNI tree seedlings/ saplings ≥6.0 feet in height comprised of ≥4 NNI tree species for ≥2 consecutive growing seasons after Interim 2 is met
Species Richness (all strata cumulatively)	≥30 NNI[1]	≥35 NNI[2]	≥45 NNI[3]
Number of Perennial NNI Species with ≥5% Relative Areal Cover in Groundlayer	≥4[1]	≥5[2]	≥6[3]
Relative Areal Cover by Hydrophytes (all strata cumulatively)	>70%[1]	>75%[2]	>85%[3]
Maximum Allowance for Unvegetated Areas	≤10%/acre[1]	≤8%/acre[2]	≤5%/acre[3]
Minimum Height	TBD	TBD	TBD
Floristic Quality Assessment (wC_i)	TBD	TBD	TBD

TBD = to be determined on a case-by-case basis as an optional PS

[1] For ≥2 consecutive growing seasons (MN); for ≥1 growing season (WI)

[2] For ≥1 growing season after Interim 1 is met (MN); for ≥2 consecutive growing seasons after Interim 1 is met (WI)

[3] For ≥1 growing season after Interim 2 is met (both MN and WI)

Table 4: **Herbaceous Communities** (e.g., Fresh Wet Meadow, Wet Prairie)			
Performance Standard	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species	≥50% NNI; <50% InNN[1]	≥70% NNI; <30% InNN[2]	≥80% NNI; <20% InNN[3]
Species Richness	≥20 NNI[1]	≥25 NNI[2]	≥30 NNI[3]
Number of NNI Perennial Species With ≥5% Relative Areal Cover	≥3[1]	≥4[2]	≥5[3]
Relative Areal Cover by Hydrophytes	>70%[1]	>75%[2]	>80%[3]
Maximum Allowance for Unvegetated Areas	≤5%/acre[1]	≤2%/acre[2]	≤1%/acre[3]
Floristic Quality Assessment (wC_i)	TBD	TBD	TBD

TBD = To be determined on a case-by-case basis as an optional PS

[1] For ≥2 consecutive growing seasons (MN); for ≥1 growing season (WI)

[2] For ≥1 growing season after Interim 1 is met (MN); for ≥2 consecutive growing seasons after Interim 1 is met (WI)

[3] For ≥1 growing season after Interim 2 is met (both MN and WI)

Table 5: **Shrub Communities** (e.g., Shrub-Carr, Alder Thicket)			
Performance Standard	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species			
• Shrub Stratum	≥50% NNI; <50% InNN[1]	≥70% NNI; <30% InNN[2]	≥80% NNI; <20% InNN[3]
• Herbaceous Stratum	≥50% NNI; <50% InNN[1]	≥70% NNI; <30% InNN[2]	≥80% NNI; <20% InNN[3]
Establishment of Shrub Species	>70% survival of planted shrub seedlings, OR >400 live, NNI shrub seedlings/ acre for ≥3 growing seasons	>300 shrubs/ acre ≥2.0 feet in height by ≥4 NNI species for ≥1 growing season after Interim 1 is met	>250 shrubs/ acre ≥4.0 feet in height by ≥6 NNI species for ≥1 growing season after Interim 2 is met
Species Richness			
• Shrub Stratum	≥4 NNI[1]	≥5 NNI[2]	≥6 NNI[3]
• Herbaceous Stratum	≥20 NNI[1]	≥25 NNI[2]	≥30 NNI[3]
Number of Perennial NNI Species with >5% Relative Areal Cover in Groundlayer	≥3[1]	≥4[2]	≥5[3]
Relative Areal Cover by Hydrophytes (all strata cumulatively)	>70%[1]	>75%[2]	>85%[3]
Maximum Allowance for Unvegetated Areas	≤10%/acre[1]	≤8%/acre[2]	≤5%/acre[3]
Floristic Quality Assessment (wC_i)	TBD	TBD	TBD

TBD = to be determined on a case-by-case basis as an optional PS

[1] For ≥2 consecutive growing seasons (MN); for ≥1 growing season (WI)

[2] For ≥1 growing season after Interim 1 is met (MN); for ≥2 consecutive growing seasons after Interim 1 is met (WI)

[3] For ≥1 growing season after Interim 2 is met (both MN and WI)

Table 6: **Upland Buffer** (e.g., Mesic Prairie)			
Performance Standard	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species	≥50% NNI; <50% InNN[1]	≥70% NNI; <30% InNN[2]	≥80% NNI; <20% InNN[3]
Species Richness	≥15 NNI[1]	>20 NNI[2]	≥25 NNI[3]
Number of Perennial NNI Species With ≥5% Relative Areal Cover	≥3[1]	≥4[2]	≥5[3]
Maximum Allowance for Unvegetated Areas	≤5%/acre[1]	≤2%/acre[2]	≤1%/acre[3]
Floristic Quality Assessment (wC_i)	TBD	TBD	TBD

TBD = *C*-values for UPL species have not been published for MN and WI. Once those are published, the option to use FQA metrics as a performance standard would become viable.

[1] For ≥2 consecutive growing seasons (MN); for ≥1 growing season (WI)

[2] For ≥1 growing season after Interim 1 is met (MN); for ≥2 consecutive growing seasons after Interim 1 is met (WI)

[3] For ≥1 growing season after Interim 2 is met (both MN and WI)

VI. Conclusion

This guidance document aims to assist sponsors in developing appropriate vegetation PSs for wetland mitigation sites in Minnesota and Wisconsin. Sponsors should design, construct and monitor mitigation sites to ensure successful establishment of the highest functioning/highest condition plant communities practicable, as determined with consideration for hydrologic restoration goals of the site, site-specific considerations, and based on feedback from the IRT. Well-developed vegetation PSs are essential for determining whether a wetland mitigation site has met objectives or is on a trajectory to meeting those objectives. Successful mitigation sites are essential to Regulatory Program integrity, as these sites are utilized to offset losses of aquatic resource functions due to impacts authorized under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.

The Corps expresses gratitude to Steve Eggers, retired ecologist, who offered his expertise during the drafting of this document. Point of Contact: Marissa Merriman, Regulatory Ecologist, marissa.v.merriman@usace.army.mil or 651-290-5362.

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VIII. Definitions and Abbreviations

***Aerial*:** occurring in or performed in the air, e.g., aerial photograph

***Areal*:** adjective of area; relating to or involving an area.

***Areal cover*:** a measure of the above ground portions of plants based on the percentage of the ground surface covered by stems and leaves when viewed from directly above. Two categories are applied for purposes of this guidance document:

(1) ***Absolute areal cover*:** actual cover by an individual plant species, or group of plant species (e.g., hydrophytes), expressed as a percentage of a reference area or plot; sum of absolute areal cover within a reference area or plot can exceed 100 percent due to overlapping layers of vegetation, or can be less than 100 percent due to gaps/unvegetated areas.

(2) ***Relative areal cover*:** the proportion (percentage) of the total absolute areal cover by an individual plant species, or group of plant species (e.g., hydrophytes), within a reference area or plot; sum of all proportions equals 100 percent.

Effectively drained: refers to a condition where artificial drainage (e.g., ditches, drain tile) has eliminated wetland hydrology.

***InNN*:** invasive and/or non-native plant species

***NNI*:** native, non-invasive plant species

Partially drained: refers to a condition where hydrology has been altered by artificial drainage (e.g., ditches, drain tile) but wetland hydrology persists.

***Performance standards* (PSs):** observable or measurable attributes used to determine if compensatory mitigation meets functional objectives and goals in relation to a baseline condition.

Reference standard wetlands: Reference standard wetlands are the least impacted examples of a wetland type within the least impacted landscapes of a reference domain (e.g., watershed, ecoregion). They possess the highest level of functioning across the suite of functions for that wetland type within that reference domain (i.e., regional subclass) [Noble et al. 2015].

Species richness: number of plant species

***Unvegetated areas*:** bare ground, exposed soils, rock, and open water with <5% vegetative areal cover.

IX. Appendices

Appendix A: Summary of Revisions [Reserved for future versions]