Appendix B – Performance Standards

MONITORING AND PERFORMANCE STANDARDS

SEPTEMBER 2017

The following monitoring and performance standards are established to ensure that mitigation banks or in-lieu fee programs create aquatic resources (wetlands or other waters of the U.S.) which compare favorably with moderate to high quality natural aquatic resources/wetlands with respect to diversity, abundance and distribution of plant species, and also to ensure that the created aquatic resources/ wetlands exhibit the hydrologic regimes of natural wetlands and other waters. These standards will be used to measure the performance of mitigation banks unless otherwise stated in the banking instrument. Other standards may be proposed by the bank sponsor if native plant restoration is not the primary goal of the mitigation bank. Justification for alternative standards must be provided in the bank prospectus. The Chicago District (District), in consultation with the IRT, retains approval authority for any performance standards proposed which are different from those contained in this appendix.

The term plant community as used in this appendix refers to wetland and upland buffer plant communities.

MONITORING STANDARDS

Monitoring and data collection are intended to assess whether the mitigation bank has attained the following performance standards for full credit release and certification. Monitoring is required for a minimum of five (5) full growing seasons from the completion of planting activities of the wetland area(s). It must also be recognized that monitoring may need to continue beyond the minimum five (5) growing season period until all performance standards are met, especially for plant communities with woody components. This requirement also includes plant communities with woody components (i.e., forested wetland and/or scrub-shrub wetland).

A. Wetland Delineation

To meet full performance standards, a routine wetland delineation must be performed to verify the total acreage of aquatic resources that exist within bank property boundaries. The delineation must be conducted in accordance with the Corps of Engineers Wetland Delineation Manual (1987) and applicable Regional Supplement (Midwest Region or Northcentral and Northeast Region). Wetland boundaries must be flagged for verification by the IRT. Property boundaries for the bank site must be marked as well. A routine delineation should not be conducted and submitted to the IRT unless it has already been documented that the site is meeting all performance standards set forth in the banking instrument.

B. Monitoring Vegetation

Permanent straight line sampling transects must be established, plotted onto project drawings and a current aerial photograph of the site, across each proposed plant community of the mitigation bank site. Sufficient transects must be established to provide full representation of all plant communities within the site, which might include more than one of each type. Each transect must consist of a series of 1.0 square meter quadrats (no fewer than 10) at regular or random intervals (5-10m suggested interval). If smaller-sized quadrats (e.g., 0.25 square meter quadrats) are used for sampling then the number of quadrats will need to be increased to obtain the same sampling area that would be obtained using 1.0 square meter quadrats. The number of quadrats depends on system complexity and the size of each plant community for which credit is sought. A guideline is a minimum of 10 quadrats per each plant community. Vegetation monitoring must be done within the growing season each year following the initial planting until all vegetation performance standards are met. Data must be reported by plant community, and by transect. Data may be summarized by plant community for which credit is sought within the body of monitoring reports, however, the full sampling data should be provided in an appendix to the annual monitoring report.

C. Monitoring Hydrology[1]

Monitoring hydrology entails measuring the frequency, depth and duration of inundation and/or the water table in relation to the soil surface.

The Corps wetland hydrology technical standard for interpreting monitoring well data (U.S. Army Corps of Engineers 2005) specifies depth to the water table. Therefore, depth to the water table is applied by the target hydrology performance standards.

Installation of monitoring wells in accordance with the Corps technical standard for water table monitoring (U.S. Army Corps of Engineers 2005) is the recommended approach for monitoring the hydrology of compensation sites. Guidance developed by the Minnesota Board of Water and Soil Resources (2013) provides detailed instructions and excellent illustrations for this purpose. Monitoring wells can be read manually, but instrumentation with dataloggers (transducers that record changes in pressure within the PVC pipe; also called leveloggers) is typically necessary. Monitoring wells/dataloggers are employed to determine both the depth/duration of the water table below the soil surface as well as the depth/duration of inundation.

1. Number of Monitoring Wells per Site. The number of monitoring wells necessary for monitoring the hydrology of a compensation site varies with size and complexity of the site. In *Water Table Monitoring Project Design,* Noble (2006) lists the following factors: acreage, topography, plant communities, hydrogeomorphic (HGM) wetland classes, soil types, and disturbances (e.g., ditches, berms). A monitoring plan should account for each

[1] This appendix contains information adopted from St. Paul District Corps Regulatory Branch (POC: Steve Eggers, Senior Ecologist).

of these variables in terms of the number and locations of the monitoring wells. Where a particular plant community/HGM class/soil type is larger than a few acres, a transect(s) of monitoring wells is recommended to ensure that hydrology is adequately characterized. In cases where a particular plant community/HGM class/soil type exhibits microtopographic relief, locations of monitoring wells should include representative lower elevations (e.g., hollows) and representative higher elevations (e.g., hummocks).

2. Timing of Monitoring Well Installation. Monitoring wells should be installed and data collection begun as soon as frost is out of the ground. If this is not feasible, monitoring wells should be installed and data collection begun as early in the growing season as possible.

3. Frequency of Recording Data. The frequency of water level readings must be sufficient to determine whether performance standards are met. Those standards are based on inundation and/or a water table ≤12 inches below the soil surface for a consecutive number of days. Therefore, daily readings are necessary to track whether the consecutive day specification is met. Once weekly, or twice weekly, etc., readings are not suitable because they do not confirm whether the consecutive day requirement is met. The recommended approach is installation of monitoring wells with dataloggers programmed to record multiple readings/day (4 or more readings per day are recommended).

4. Duration of Monitoring. Duration of monitoring hydrology at compensation sites is typically 5 growing seasons, but can be increased due to site-specific conditions and goals/objectives.

5. Reference Wetlands. The ideal for evaluating the hydrology of compensation sites includes collecting data from reference wetlands. It is acknowledged that this approach may not be practicable in some or even many cases. Selection of reference wetlands is based on matching the proposed restored/enhanced/created wetlands with the least altered wetlands of the same type located on-site, or as close as possible to the compensation site. One way (of many) to define "wetland type" is to use the plant community + HGM class[2] + soil type for a simple yet reasonably comprehensive approach. If, for example, the compensation site consists of restoration of a fresh (wet) meadow community on mineral soil, the ideal would be to locate a monitoring well(s)/ datalogger(s) in a reference standard, fresh (wet) meadow community on mineral soils and in proximity to the compensation site. Depth and duration of the water table from the soil surface could then be compared between restored and reference fresh (wet) meadow communities. The hydrology performance standard would need to set criteria for the range of differences between restored/enhanced/created wetlands and reference standard wetlands that would still meet target hydrology. If use of a reference wetland is approved by the IRT, the hydrology at the reference wetland and at the proposed site must be monitored concurrently using monitoring wells for a minimum of one growing season prior to construction/planting activities at the proposed site. Duration of a water table ≤12 inches

[2] See Brinson (1993) for discussion of HGM classes.

below the soil surface that is plus or minus 20 percent of that of a reference standard wetland is one example.

Example: A reference wetland has a water table ≤12 inches below the soil surface for 50 consecutive days during a particular growing season. To be within the 20 percent variability range, a restored wetland would need to have a water table ≤12 inches below the soil surface for 40 to 60 consecutive days during that same growing season.

Simultaneous collection of hydrology data from both reference and restored/enhanced/created wetlands allows for direct comparisons across the entire range of normal, drier than normal, and wetter than normal, conditions that occur during a monitoring period. As a result, the subjectivity regarding the minimum number of consecutive days of inundation and/or a water table ≤12 inches below the soil surface can be avoided, and the evaluation of climatic conditions (See D. below) is less critical.

6. Other Sources of Hydrological Data. Hydrological data has been collected for some wetland types at various locations across the Midwest. Examples include data collected by watershed districts, monitoring of previously constructed compensation sites, research projects, stream gauging data, and baseline studies for proposed mining projects. These data can be useful if collected from wetlands that are of the same type and within the same region as wetlands proposed at a compensation site.

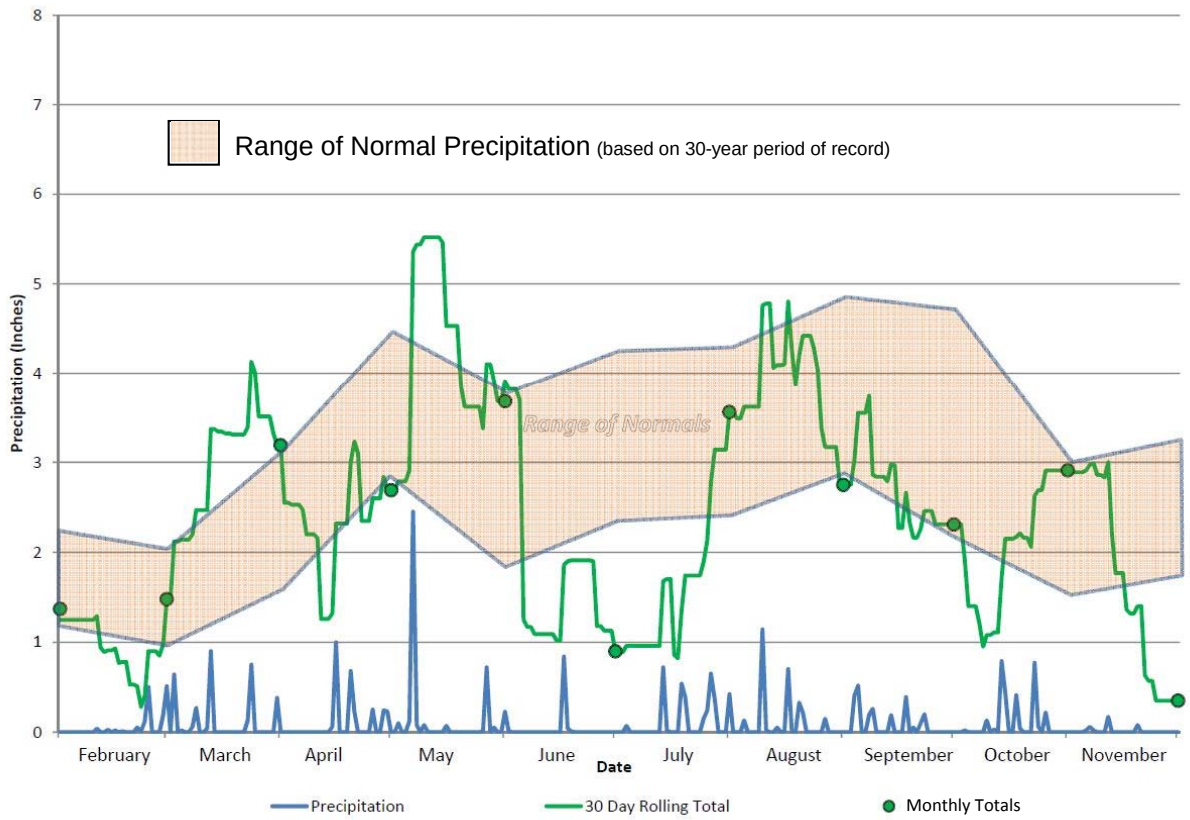
7. Alternative Approach to Determining Growing Season. An alternative accepted approach to determine growing season follows: For purposes of this document, the required methodology is to immediately insert a soil thermometer into the wall of a freshly dug soil pit 12 inches (30 cm) below the soil surface. The soil temperature must be documented with a date stamped photograph showing the temperature on the soil thermometer immediately upon removal from the wall of the soil pit. Date stamped photographs of the area surrounding the soil pit where the soil temperature is measured must also be provided. A minimum of one soil temperature measurement per hydrology monitoring well must be collected and provided to the IRT. The growing season is considered to have begun when all soil temperature measurements collected are 41° F (5° C) or higher. The IRT must be informed at least one week prior to visit made to measure soil temperature so they have the opportunity to be present when soil temperature is measured. The IRT retains the ability to visit the site within 5 business days of the initial visit in order to ensure that the soil temperature remains continuously at or above 41° F (5° C).

D. Placing Hydrology Data in the Context of Antecedent Precipitation

An essential component of evaluating water level data is placing those data in the context of antecedent precipitation. In *Accessing and Using Meteorological Data to Evaluate Wetland Hydrology*, Sprecher and Warne (2000) recommend three approaches to categorize precipitation as normal, wetter than normal, or drier than normal, for a particular monitoring

period: (1) *Hydrology Tools for Wetland Determination* (Woodward 1997), the same approach used by the state off-site methods for wetland determinations on agricultural lands; (2) the method of 30-day rolling totals of precipitation (Figure 1); or (3) a combination of (1) and (2). All of these are thoroughly addressed by Sprecher and Warne (2000). *Evaluating Antecedent Precipitation Conditions* (Minnesota Board of Water and Soil Resources 2015) provides an excellent step-by-step guide for applying these methods. The recommended approach for evaluating hydrology performance standards is to graph 30-day rolling totals for each growing season and include this information in monitoring reports submitted to the Corps.

Figure 1 – Example of 30-day Rolling Totals



Source: Stantec

Data generated by the weather station closest to the compensation site is used to determine whether antecedent precipitation was normal, wetter than normal, or drier than normal, based on the most recent 30-year period of record. These data are used to generate a bell-shaped curve where the middle 40 percent of monthly precipitation is considered "normal" while the 30 percent of precipitation amounts on either side of the bell curve are considered "wetter than normal" and "drier than normal."

Many types of reference wetlands can be dry during drier than normal conditions that require a minimum duration of inundation and/or a water table ≤12 inches below the soil surface

during normal and wetter than normal hydrological conditions, but not drier than normal conditions. Lack of inundation and/or a water table ≤12 inches below the soil surface during drier than normal conditions is not necessarily a negative indicator in these cases, i.e., indicating that hydrology is not on the correct trajectory for success. It also does not inform us of whether the requirements for inundation and/or depth to the water table would be met during normal and wetter than normal conditions. The key is to continue monitoring and base the decision on whether target hydrology performance standards are met using data collected during normal and wetter than normal hydrological conditions.

If the duration of inundation and/or a water table ≤12 inches below the soil surface specified for normal and wetter than normal hydrological conditions is met during drier than normal conditions, those reviewing/managing the site can evaluate this fact in context with the specific characteristics of that site. In some cases, meeting inundation and/or water table depth requirements during drier than normal conditions would be a positive indicator. Conversely, in the case of a depressional wetland fed solely by surface water inputs, it may indicate that the compensation site would be too wet during normal and wetter than normal conditions and as a result would not support the target vegetation.

A subset of drier than normal conditions – the extreme dry end – consists of "drought" conditions. For purposes of the target hydrology performance standards, drought conditions refer to Categories D0-D4 as determined by the U.S. Drought Monitor (Attachment A).

Some of the performance standards specify a precipitation event, e.g., the 10-year, 24-hour storm event.

These data are available on-line using latitude/longitude or nearest weather station:

http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=il (or =in for Indiana)

PERFORMANCE STANDARDS

If a portion of the bank has met a particular performance standard, the standard must be maintained in that portion until all portions of the bank meet their performance standards.

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 SOP:

***(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

(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

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

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

***Open water*:** lacking aquatic emergent vegetation but supporting floating, floating-leaved and/or submergent vegetation (Figure 2)

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

Species richness: number of plant species

***Unvegetated*:** lacking vegetation of any kind (contrast with Figure 2)

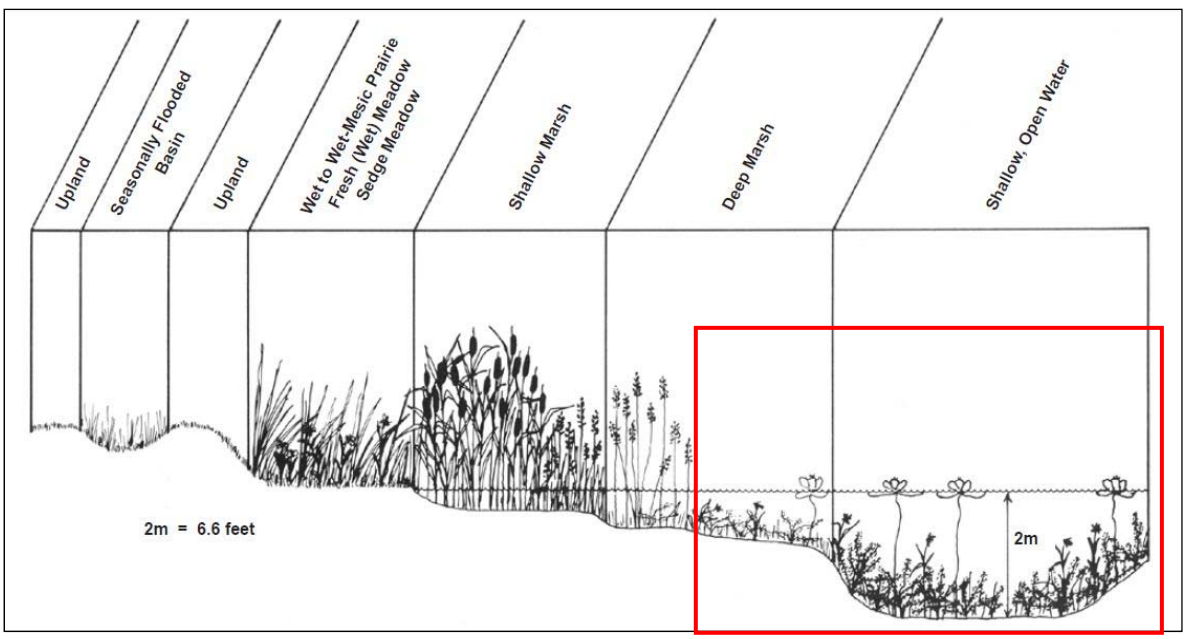


Figure 2: Red box illustrates "open water" – defined as a lack of aquatic emergent vegetation but supporting floating, floating-leaved and/or submergent vegetation. From Eggers and Reed (2015)

A. Vegetation Performance Standards

1. Tiered Approach to Vegetation Performance Standards and Credit Releases
Performance standards (PS) are broken out by plant communities.[3] A compensation site with three plant communities would have three sets of PS, for example. Each PS applies a tiered approach consisting of progressively higher standards (tiers) for vegetation. Credits are released incrementally as each tier is met. Two to four tiers for each vegetation PS can be used with three tiers being the most commonly applied approach in the Chicago District. Full credit for the vegetation PS would be achieved if all tiers are met. Meeting at least one, but not all, tiers would typically result in a partial credit release.

2. Components of Performance Standards for Vegetation
Vegetation PS primarily involve seven components. All seven are not necessarily applied to each compensation site:

a) Relative Areal Cover by NNI Species versus InNN Species
b) Species Richness
c) Number of Dominant Species
d) Relative Areal Cover by Hydrophytes
e) Maximum Allowance for Unvegetated Areas
f) Survival of Planted Woody Stock/Establishment of Woody Vegetation
g) Floristic Quality Assessment

a. Relative Areal Cover by Native, Non-Invasive Species (NNI) v. Invasive and/or Non-Native (InNN) Species
Requirements for this PS vary depending upon the goals/objectives for a particular compensation site. In most cases, the goal is to establish the highest functioning/highest condition plant communities to the extent practicable. Exceptions are few and include cases where the focus is on wetland/aquatic resource functions other than vegetative diversity/integrity. Examples include a wetland compensation site that filters runoff from row-cropped fields prior to that runoff reaching a trout stream or recreational lake. High relative areal cover by InNN species could be acceptable in that case. Another example is a compensation site with a goal of restoring habitat for northern pike spawning if that goal could be achieved in spite of high relative areal cover by InNN species.

[3] Plant communities are based on *Wetland Plants and Plant Communities of Minnesota and Wisconsin – Version 3.2* (Eggers and Reed 2015).
http://cdm16021.contentdm.oclc.org/cdm/compoundobject/collection/p266001coll1/id/2801/rec/1

The following formulas are used to determine the relative proportion of absolute areal cover by NNI species versus that by InNN species:

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

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

***Example*:** A three-tier approach to this PS could consist of the following:

1. Interim1: ≥50% relative areal cover by NNI species;<50% by InNN species
2. Interim 2: ≥70% relative areal cover by NNI species; <30% by InNN species for ≥2 consecutive growing seasons after Interim 1 is met
3. Final: ≥90% relative areal cover by NNI species; <10% by InNN species

At a minimum, three growing seasons are required for a credit release based on Interim 2: (1) Interim 1 is met the first growing season post-restoration; and (2) the ratio of NNI/InNN relative cover specified by Interim 2 is met the following two growing seasons.

Calculation of relative areal cover excludes unvegetated areas within a reference area or plot. Unvegetated areas are addressed by a separate PS.

b. Species Richness

A PS specifying a minimum number of NNI species establishes a baseline for floristic diversity. Otherwise, a plant community consisting of a monotype of a NNI hydrophytic species would meet most of the vegetation PS.

Counting only perennial species for purposes of species richness—thereby excluding annual and biennial species—has been evaluated. Metrics for the Floristic Quality Assessment (FQA), for example, make no distinction between annual, biennial and perennial species. In sum, annual and biennial species are natural components of native plant communities including reference standard wetlands; therefore, all plant species – annual, biennial and perennial – are counted for purposes of the species richness PS.

No formula has been developed to determine a minimum number of NNI species for each plant community and for each tier of a PS. Numerous variables need to be considered on a case-by-case basis:

1) Species richness varies considerably among wetland, as well as upland buffer, plant communities. For example, relatively few plant species thrive in the semi-permanently inundated conditions of deep marshes while many species thrive in

the saturated soil conditions that characterize other wetland communities. Reference wetlands can provide a species list to set goals for compensation sites.

2) Number of strata is a factor. Forested wetlands have at least three strata—tree, shrub, and herbaceous—compared to a single stratum for herbaceous communities.

3) The starting point for a compensation site, as indicated by the method of compensation proposed, is a key factor. The starting point may contain 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 the starting point is a wetland creation site with no hydric soils and no wetland seedbank (establishment). Both cases mean starting from scratch in establishing diverse, native, hydrophytic plant communities. In contrast, perhaps the compensation site composed of existing but degraded wetlands with a viable native seedbank (restoration via rehabilitation). Or the compensation site is predominately composed of native, hydrophytic communities but invasive species are present and spreading (enhancement). PS need to be adjusted based on what is practicable to achieve within a particular compensation site.

4) Seed mixtures for fresh (wet) meadow, sedge meadow, wet prairie, and upland prairie plantings should typically consist of 25-35 NNI species while those for shallow marsh plantings include 15-20 NNI species. A common occurrence is that not all species establish and persist for the typical five-year monitoring period. An acceptable or expected result in terms of establishing a seed mixture within a particular site could be – 80%, 60%, or some other percentage of the planted species.

5) Adjacent and/or upstream sources of native plant propagules could supplement the applied seed mixture/planting.

Example: Proposed restoration of a wet prairie; starting point is exposed soils; seed mixture/cover crop with 30 NNI species would be applied; no viable native seedbank (site was drained and cultivated for decades); some natural influx of NNI plant propagules expected:

1. Interim1: None specified because vegetation is in the initial stages of establishment
2. Interim 2: ≥10 NNI species
3. Final: ≥15 NNI species

The above example is conservative. Fifteen species is half the number in the seed mixture, plus some influx of NNI propagules from off-site is expected. But consider that the starting point is a site that was effectively drained and cultivated

for decades leaving no viable native seedbank. Establishing ≥15 NNI species could be considered a reasonable goal, particularly after only five growing seasons—the typical monitoring period for herbaceous wetland restorations.

With regard to tree and shrub species, a Final PS specifying a minimum of three or four NNI species for each is suitable in most cases.

c. Number of Dominant Species

A minimum number of NNI dominant plant species can be specified to address the situation where a PS for species richness is met, but one NNI species comprises the majority of areal cover. Multiple NNI dominant species is the preferred condition for restored/enhanced/created plant communities with few exceptions.

Most wetland, as well as upland buffer, plant communities in the Midwest are dominated by perennial species; therefore, "perennial" is specified by this PS.[4] Exceptions are few and 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 groundlayer of floodplain forests (e.g., jewelweed (*Impatiens capensis*), Canadian clearweed (*Pilea pumila*)).

The Dominance Test ("50/20 Rule") is the recommended approach for determining dominant species. Two to four NNI dominants are typically specified for each vegetative stratum (tree, shrub and herbaceous).

A variation of this PS involves specifying a minimum number of species that meet a certain areal cover requirement. This approach addresses the same goal of requiring higher floristic diversity as opposed to a community where one species comprises a majority of the areal cover.

***Example*:** For an herbaceous community, the following PS could be applied:

1. Interim1: None specified because vegetation is in the initial stages of establishment
2. Interim 2: ≥2 NNI, perennial, dominant species [Alternative: ≥8 NNI species with ≥5% areal cover]
3. Final: ≥4 NNI, perennial, dominant species [Alternative: ≥10 NNI species with ≥5% areal cover]

[4] If annual species dominate a compensation site after two or more growing seasons, it may indicate major problems such as: (1) erosion; (2) incorrect hydrologic regime; (3) unsuitable substrate; (4) excessive herbivory; (5) improper seed installation/planting; and (6) drought. Adaptive measures and/or corrective actions may be necessary.

d. Relative Areal Cover by Hydrophytes

Specifying a PS for relative areal cover by hydrophytes (OBL, FACW and FAC) is important to set a target for predominately hydrophytic plant communities. The following formula is applied:

$$\text{Relative Areal Cover by Hydrophytes (\%)} = \left[\frac{\text{Sum of areal cover by OBL, FACW and FAC species}}{\text{Sum of areal cover by OBL, FACW, FAC, FACU and UPL species}}\right] x\ 100$$

While 51% relative areal cover by hydrophytes would minimally meet the criterion for a hydrophytic plant community,[5] this minimum is not the optimum for establishing targeted wetland plant communities. Instead, a Final PS specifying >75% relative areal cover by hydrophytes is recommended for most cases. One hundred percent relative areal cover by hydrophytes is not necessary nor recommended because NNI FACU species are a natural component of many wetland communities. Exceptions include deep marsh and shallow, open water communities where specifying 100% areal cover by hydrophytes could be appropriate given that species composition is entirely OBL-FACW species.[6]

***Example*:**

1. Interim1: None specified because vegetation is in the initial stages of establishment
2. Interim 2: >60% relative areal cover by hydrophytes
3. Final: >75% relative areal cover by hydrophytes

e. Maximum Allowance for Unvegetated Areas

A compensation site with large patches of unvegetated areas could potentially meet the PS discussed in A.-D. above because those PS focus exclusively on vegetated areas. A PS specifying the maximum allowable extent of unvegetated areas for each tier can be advisable. Variables include whether: (1) the starting point for the compensation site is exposed soils (e.g., row-cropped fields, graded sites) versus a wetland enhancement site that is fully vegetated; (2) a seed mix/plugs (rhizomes)/woody seedlings/cover crop would be planted; and (3) a viable native seedbank is present.

[5] Using the Hydrophytic Cover Index (Lichvar, R. and J. Gillrich. 2014. *Examining Discrepancies Among Three Methods Used to Make Hydrophytic Vegetation Determinations for Wetland Delineation Purposes*. ERDC/CRREL TR-14-2.)

[6] With the possible exception of drought periods when the substrate is exposed allowing FACU and even UPL species to establish, albeit temporarily.

Seed mixtures 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. Therefore, areas of exposed soils should be minor in extent at the close of the first growing season and nearly absent by the close of the second growing season. If this is not the case, it may indicate problems including: (1) erosion; (2) incorrect hydrologic regime; (3) unsuitable substrate; (4) excessive herbivory; (5) improper seed installation/planting; and/or (6) drought. Adaptive management and/or corrective actions may be warranted.

Example: Proposed restoration of a wet prairie; starting point is exposed soils; seed mixture/cover crop with 30 NNI species would be applied; Interim 1 should be achieved by the close of the first growing season and Interim 2 by the close of the second growing season:

1. Interim 1: No unvegetated areas >400 ft2
2. Interim 2: No unvegetated areas >100 ft2
3. Final: No unvegetated areas >10 ft2

***Exceptions*:** Shallow marshes, vernal pools, and drainage channels in floodplain forests, 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. PS specific to these types of wetlands should include some allowance for unvegetated areas as a long-term, natural condition.

f. Survival of Planted Woody Stock/Establishment of Woody Vegetation

PS addressing plantings and establishment of forested and shrub wetland communities include survival of planted woody stock, number of live stems per acre, basal diameter, and areal cover.

Survival of planted woody stock is the focus of the initial growing seasons (1st and 2nd). It subsequently becomes obsolete, in most cases, due to the typical situation where NNI tree and/or shrub species naturally supplement a planting.[7] At that point, the number of live stems/acre of NNI tree and/or shrub species (both planted and volunteer) becomes the optimal metric. Basal diameter is an option for PS as well. A switch to PS using areal cover can typically be made during the latter half of monitoring periods (typically 8 years for shrub-dominated wetland communities and 10 years for forested wetland communities). Areal cover becomes the preferred method once woody vegetation has sufficiently established not only because it is the

[7] 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, willows (*Salix* spp.) and red-osier dogwood (*Cornus alba*) can rapidly colonize a compensation site (e.g., 2 to 4 growing seasons). Numerous NNI tree species are adept at naturally colonizing restoration sites as well.

standard for most applications of the vegetation PS,[8] but also because counting live stems/acre and measuring basal diameter are more difficult and time consuming approaches.

A goal for forested wetlands is generally 108 trees/acre, an average of one tree for each 20 foot x 20 foot area. Tree size (≥3 inches dbh) may or may not be attained by planted tree seedlings during the typical 10-year monitoring period. What is important is that the Final PS confirm that the site is on the correct trajectory for success.

g. Floristic Quality Assessment (FQA)
A useful FQA metric for PS is the mean (average) *C*-value. C-values are designated in *Flora of the Chicago Region: A Floristic and Ecological Synthesis* (Wilhelm & Rericha, 2017). To account for differences in species richness, a Floristic Quality Assessment Index (FQAI) may also be useful. In all cases, invasive species (e.g., mean C (all species) and FQAI (all species) must be included for purposes of PS.

3. Examples of Combining PS for a Specific Plant Community
PS for a specific community can be combined and summarized as shown by Tables 1 through 3.
Table 2 lists PS for a planned forested wetland community where all strata (tree, shrub, herbaceous) are lumped under some of the PS. As an option, PS specific to the shrub layer and/or herbaceous layer of a planned forested community can be made.

Table 1: Fresh (Wet) Meadows, Sedge Meadows and Wet to Wet-Mesic Prairie Communities

Category	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species	≥50% NNI; <50% InNN	≥70% NNI; <30% InNN	≥80% NNI; <20% InNN
Species Richness	N/A	≥10 NNI	≥15 NNI
Number of Dominant Species ("50/20 Rule")	N/A	≥2 NNI	≥4 NNI
Number of Species With ≥5% areal cover	N/A	≥8 NNI	≥10 NNI
Relative Areal Cover by Hydrophytes	N/A	>60%	>75%
Maximum Unvegetated Areas	<400 ft^2	<100 ft^2	<10 ft^2
Floristic Quality Assessment	N/A	TBD	TBD

N/A = none specified because vegetation is in initial stages of establishment
TBD = To be determined on a case-by-case basis as an optional PS

[8] And wetland delineations.

Table 2: Floodplain Forest Community			
Category	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species cumulatively across all strata (tree, shrub, herbaceous)	≥50% NNI; <50% InNN	≥70% NNI; <30% InNN	≥80% NNI; <20% InNN
Establishment of Tree Species	>70% survival of planted woody stock; or >200 live, NNI seedlings/acre for ≥3 growing seasons	>150 live, NNI tree seedlings/ acre with a basal diameter of ≥1.0 inch for ≥3 subsequent growing seasons	>50% relative areal cover by ≥4 NNI tree species
Species Richness (all strata cumulatively)	N/A	≥15 NNI	≥20 NNI
Number of Dominant Species (“)	N/A	≥4 NNI	≥6 NNI
Relative Areal Cover by Hydrophytes (“)	N/A	>60%	>75%
Maximum Unvegetated Areas	<400 ft^2	<100 ft^2	<10 ft^2
Floristic Quality Assessment	N/A	TBD	TBD
N/A = none specified because vegetation is in initial stages of establishment TBD = to be determined on a case-by-case basis as an optional PS			

Table 3: Mesic Prairie Communities (Upland Buffer)			
Category	Interim 1	Interim 2	Final
Relative Areal Cover by NNI Species versus InNN Species	≥50% NNI; <50% InNN	≥70% NNI; <30% InNN	≥90% NNI; <10% InNN
Species Richness	N/A	≥10 NNI	≥15 NNI
Number of Dominant Species (“50/20 Rule”)	N/A	≥2 NNI	≥4 NNI
Number of Species With ≥5% Areal Cover	N/A	≥8 NNI	≥10 NNI
Maximum Unvegetated Areas	<400 ft^2	<100 ft^2	<10 ft^2
Floristic Quality Assessment	N/A	TBD	TBD
N/A = none specified because vegetation is in initial stages of establishment TBD = To be determined on a case-by-case basis as an optional PS; note, C-values not yet published for UPL species in MN and WI			

REQUISITE PERFORMANCE STANDARDS

A. A temporary cover crop must be planted immediately upon completion of any earthwork in order to prevent soil erosion. Erosion control blanket or other soil erosion and sediment control measures may be necessary depending on site conditions and season of planting. Soil erosion and sediment control measures must be in place before, during, and after all construction work. Within three (3) months, at least 90% of this area, as measured by areal coverage, will be vegetated. If the desired long-term vegetation is not planted with a temporary cover crop, it must be planted in the first available growing season appropriate for each plant community. All cover crop species must be non-persistent and non-allelopathic or native.

B. ≤ 10% cumulative average cover by exotic and invasive species including but not limited to the following species:

American Silver-Berry (*Elaeagnus commutata*)
Ash-Leaf Maple (*Acer negundo*)
Asian Bittersweet (*Celastrus orbiculatus*)
Black Swallow-Wort (*Vincetoxicum nigrum*)
Garden Bird's-Foot-Trefoil (*Lotus corniculatus*)
Black Locust (*Robinia pseudoacacia*)
Bradford Pear (*Pyrus calleryana*)
Brittle Waternymph (*Najas minor*)
Bull Thistle (*Cirsium vulgare*)
Lesser Burrdock (*Arctium minus*)
Canadian Goldenrod (*Solidago canadensis*)
Canadian Thistle (*Cirsium arvense*)
Cat-Tail (*Typha spp*.)
Chinese Yam (*Discorea oppositifolia*)
Chinese Silver Grass (*Miscanthus sinensis*)
Common Reed (*Phragmites australis*)
Common Water-Hyacinth (*Eichhornia crassipes*)
Crack Willow (*Salix fragilis*)
Creeping-Jenny (*Lysimachia nummularia*)
Crownvetch (*Securigera varia*)
Curly Pondweed (*Potamageton crispus*)
Eurasian-Buttercup (*Ficaria verna*)
Eurasian Water-Milfoil (*Myriophyllum spicatum*)
European Barberry (*Berberis vulgaris*)
European Buckthorn (*Rhamnus cathartica*)
Garlic-Mustard (*Alliaria petiolata*)
Giant Hogweed (*Heracleum mantegazzianum*)
Glossy False Buckthorn (*Frangula alnus*)
Greater Flowering-Rush (*Butomus umbellatus*)
Hedge-Parsley (*Torilis* spp.)
Japanese Barberry (*Berberis thunbergii*)

Japanese Bristle Grass (*Setaria faberi*) Japanese Honeysuckle (*Lonicera japonica*) Japanese Hop (*Humulus japonica*) Japanese-Knotweed (*Reynoutria japonica*) Japanese Stilt Grass (*Microstegium vimineum*) Jetbead (*Rhodotypos scandens*) Kudzu (*Puereria montana*) Leafy Spurge (*Euphorbia esula*) Littleleaf Linden (*Tilia cordata*) Morrow's Honeysuckle (*Lonicera morrowii*) Mother-of-the-Evening (*Hesperis matronalis*) Nodding Plumeless-Thistle (*Carduus nutans*) Privet (*Ligustrum* spp.) Purple Loosestrife (*Lythrum salicaria*) Ragweed (*Ambrosia* spp.) Rambler Rose (*Rosa multiflora*) Reed Canary Grass (*Phalaris arundinacea*) Reed Manna Grass (*Glyceria maxima*) Russian Olive (*Elaeagnus angustifolia*) Sandbar Willow (*Salix interior*) Seaside Goldenrod (*Solidago sempevirens*) Showy Fly-Honeysuckle (*Lonicera x bella*) Spotted knapweed (*Centaurea stoebe* subsp. *micranthos*) Tall Goldenrod (*Solidago altissima*) Teasel (*Dipsacus* spp.) Tree-of-Heaven (*Ailanthus altissima*) Twinsisters (*Lonicera tatarica*) Watercress (*Nasturtium officinale*) Water-lettuce (*Pistia stratiotes*) Wild Parsnip (*Pastinaca sativa*) Winged Spindletree (*Euonymus alatus*) Yellow Sweet-Clover (*Melilotus officinalis*)

C. A vegetation map of the bank site based on as-built drawings developed at the completion of implementation must be submitted. This information must be descriptive and define the limits of all vegetation areas by community type, based on field observations. The permanent transects must be shown on this map. Representative photographs of each vegetation area by general community zone must be submitted to the IRT.

INTERIM VEGETATION PERFORMANCE STANDARDS

The Interim Vegetation Performance Standards, as defined by the approved MBI, must be met for additional release of credits. The Interim vegetation release may occur only after the 15% credit release for demonstration of hydrology has been granted, as defined below.

HYDROLOGY PERFORMANCE STANDARDS

The following specifications for target hydrology have two purposes. They provide a guide for design of a compensation site so that target plant communities are matched with the appropriate target hydrology, and, they provide performance standards to evaluate the success or failure of establishing target hydrology at compensation sites.

The target hydrology performance standard for each plant community is listed below followed by user notes.

A. Target Hydrology Performance Standards

The hydrology standard(s) must be met for ≥ (greater than or equal to) 2 consecutive growing seasons in order to qualify for credit release and/or final release from maintenance and monitoring.

On a project-specific basis, the target hydrology performance standards may be met by matching, or being within an IRT-approved variability range of the hydrologic regime of an IRT-approved reference wetland.

1. Seasonally Flooded Basins. Hydrology shall consist of inundation up to 36 inches in depth for a minimum of 14 consecutive days during the growing season under normal and wetter than normal hydrological conditions (per Sprecher and Warne 2000). Inundation shall be absent following the first 6 weeks of the growing season except during wetter than normal hydrological conditions (per Sprecher and Warne 2000).

2. Floodplain Forests. Hydrology shall consist of inundation for a minimum of 14 consecutive days during the growing season under normal and wetter than normal hydrological conditions (per Sprecher and Warne 2000). Depth of inundation shall range up to _____ feet {specify maximum depth based on site-specific conditions}. Duration of inundation during the growing season shall not exceed 28 consecutive days for a single flood event {see user notes} except: (1) during wetter than normal hydrological conditions (per Sprecher and Warne 2000); and (2) channels and other depressional areas can have standing water for extended duration.

3. Fresh (Wet) Meadows, Sedge Meadows and Wet Prairies (Mineral Soils). Hydrology shall consist of a water table 12 inches or less below the soil surface for a minimum of 28 consecutive days, or two periods of 14 or more consecutive days, during the growing season under normal and wetter than normal hydrological conditions (per Sprecher and Warne 2000). Inundation during the growing season shall not occur except: (1) at the start of the growing season (due to snowmelt/precipitation); and (2) following the 10-year, 24-hour – or greater – precipitation events. Depth of inundation during the growing season shall be 6 inches or less with duration of less than 14 consecutive days. An exception can be made for sites with hummocky microtopography – hollows between hummocks can have standing water depths up to 6 inches for extended duration.

4. Fresh (Wet) Meadows and Sedge Meadows (Organic Soils)

   a. Performance Standard 1 (Typical): Hydrology shall consist of a water table 12 inches or less below the soil surface from the start of the growing season to at least July 1st, with the exception of drought conditions (Categories D0-D4, Attachment A). The water table shall not drop more than ____ inches below the soil surface {see user notes for guidance on specifying maximum depths to the water table} during the remainder of the growing season. Inundation during the growing season shall not occur except: (1) at the start of the growing season (due to snowmelt/precipitation); and (2) following the 10-year, 24-hour – or greater – precipitation events. Depth of inundation shall be 6 inches or less with duration of less than 14 consecutive days. An exception can be made for sites with hummocky microtopography – hollows between hummocks can have extended durations of standing water depths up to: (1) 6 inches for fresh (wet) meadow and, sedge meadows

   b. Performance Standard 2 (For Predominantly Groundwater-Fed or Lacustrine Fringe Sites): Hydrology shall consist of a water table 12 inches or less below the soil surface throughout the growing season with the exception of drought conditions (Categories D0-D4, Attachment A). Inundation during the growing season shall not occur except: (1) at the start of the growing season (due to snowmelt/ precipitation); and (2) following the 10-year, 24-hour – or greater – precipitation events. Depth of inundation shall be 6 inches or less with duration of less than 14 consecutive days. An exception can be made for sites with hummocky microtopography – hollows between hummocks can have extended durations of standing water depths up to: (1) 6 inches for fresh (wet) meadows and sedge meadows.

5. Shallow Marshes. Hydrology shall consist of inundation up to 6 inches in depth for at least 50 percent of the growing season under normal and wetter than normal hydrological conditions (per Sprecher and Warne 2000). During the growing season, inundation up to 18 inches in depth following the 2-year, 24-hour – or greater – precipitation events is permissible provided that the duration does not exceed 28 consecutive days (i.e., water depth drops from 18 inches to 6 inches within 28 days).

B. User Notes For Hydrology Performance Standards:

1. Seasonally Flooded Basins. User Notes: This hydrologic regime fits "temporarily flooded" described by Cowardin et al. (1979)[e.g., PEMA](Table 4). Floodplain wetlands are characterized by temporary inundation during the growing season changing to mudflats that are subsequently colonized primarily by annual plant species. More frequent and/or longer periods of inundation would trend towards establishing marsh communities dominated by perennial, emergent aquatics, while longer-term soil saturation would trend towards wet/sedge meadows dominated by perennial grass/sedge/forb mixtures.

Table 4 – Cowardin Hydrologic Regimes

A = Temporarily Flooded: *Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season.*

B = Saturated: *The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.*

C = Seasonally Flooded: *Surface water is present for extended periods especially early in the growing season, but is absent by the end of the growing season in most years. When surface water is absent, the water table is often near the soil surface.*

F = Semi-Permanently Flooded: *Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the soil surface.*

G = Intermittently Exposed: *Surface water is present throughout the year except in years of extreme drought.*

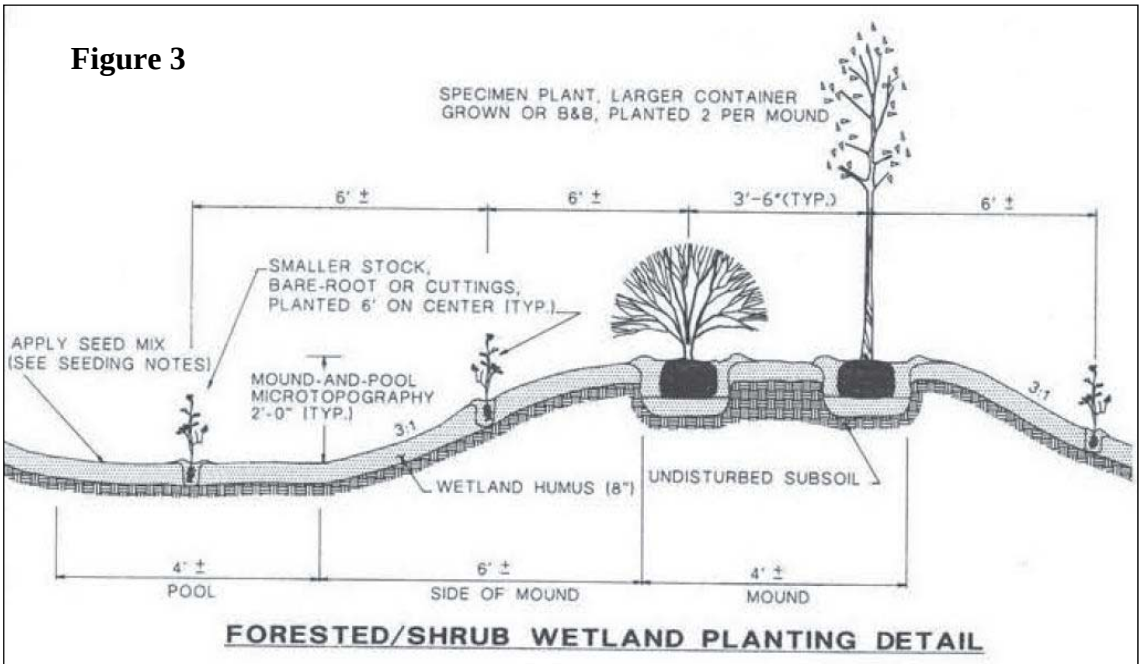
2. Floodplain Forests. User Notes: This hydrologic regime fits "temporarily flooded" described by Cowardin et al. (1979) [e.g., PFOA](Table 4). Note that 14 consecutive days of inundation would typically result in an additional number of days with a water table ≤12 inches below the soil surface depending upon soil texture. This is incorporated into the subject performance standard by virtue of specifying a minimum of 14 consecutive days of inundation. Less frequent and/or shorter-term inundation would be less likely to support the target floodplain forest community as it would be conducive for competition and colonization by non-hydrophytic species, which could result in an upland community.

   An alternative approach, if stream gauging data and one-foot contour interval mapping of the compensation site are available, would be to specify frequency and duration of inundation by elevation. For example, the performance standard could specify that ≥14 consecutive days of inundation during the growing season shall occur at the following annual frequencies: (1) ≥90 percent for the lowest elevation; (2) ≥70 percent for elevations one foot higher; and (3) ≥50 percent for elevations two feet higher.

   More than one flood event within a single growing season can occur in floodplain forests of the Midwest, e.g., a flood event in April due to snowmelt/precipitation and a second flood event in July due to heavy precipitation events. Target hydrology is met as long as the duration of inundation for each flood event does not exceed 28 consecutive days and the exceptions listed in the performance standard do not apply.

For floodplain forest compensation sites that are to be planted with woody stock, note that woody seedlings/saplings – including those of hydrophytic species – are sensitive to anaerobic conditions in the root zone and could be stressed or drowned out by inundation/soil saturation. Seedlings/saplings typically need to be planted on mounded soils (hummocks) to promote initial root system development (Figure 3). Or, if feasible, hydrologic restoration can be delayed for 2-3 growing seasons to allow for initial root system development.

Figure 3



From Barry et al. (1996)

For additional information, Matthews and Pociask (2015) provide an in-depth analysis of tree survival within floodplain forest compensatory mitigation sites in Illinois.

3. Fresh (Wet) Meadows, Sedge Meadows and Wet Prairies (Mineral Soils). User Notes: This hydrologic regime fits "saturated" described by Cowardin et al. (1979)[e.g., PEMB] (Table 4). If the water table within the upper 12 inches is of a shorter duration or less frequent occurrence, it would reduce the competitive advantage of hydrophytic species versus non-hydrophytic species. Specifically, a drier regime would be more conducive to colonization and competition by undesirable and/or invasive FAC and FACU species including Canada goldenrod, Canada thistle, common ragweed, giant ragweed, stinging nettle, common buckthorn, common cocklebur and garlic mustard.

4. Fresh (Wet) Meadows and Sedge Meadows (Organic Soils).

   a. User Notes for Performance Standard 1 (Typical): A water table 12 inches or less below the soil surface is specified from the start of the growing season to at least July 1st—with an exception for drought conditions—due to snowmelt, spring rains and lower evapotranspiration rates of the early growing season compared to mid- and late-summer, coupled with the water retention capacity of organic soils. A maximum depth to the water table during the remaining portion of the growing season is not specified herein for Performance Standard 1 because numerous variables are involved. Monitoring well data from reference standard wetlands would be ideal for determining an appropriate maximum depth to the water table for a specific compensation site.

   b. User Notes for Both Performance Standards 1 and 2: These hydrologic regimes fit within "saturated" described by Cowardin et al. (1979)[e.g., PSSB, PMLB](Table 4).

      Continuous or nearly continuous saturation to the soil surface during the growing season is necessary to prevent oxidation and subsidence of organic (peat/muck) soils. A characteristic of organic soils is their high water retention capacity. With regard to the capillary fringe, saturation in organic soils can extend well above the water table.[9] For example, a water table 14-18 inches below the soil surface can result in soil saturation within the upper 12 inches. Layering within organic soils due to differing degrees of decomposition/plant materials can create "perched" conditions and horizontal flows, which can be important factors to consider in restoring hydrology.

      Restoring hydrology to pre-disturbance (e.g., pre-ditching) conditions is not practicable for some compensation sites due to irreversible changes in the contributing watershed, or that not all ditches can be legally filled/blocked, or other factors. If Performance Standard 1 is not practicable, it is recommended that: (1) a soil scientist provides an analysis of the depth/composition/structure of the organic soils; and (2) hydrologic inputs/outputs of the site are quantified to the extent practicable. This information can then be factored into developing a site-specific hydrology performance standard that would meet the goals/objectives for restoration of that site.

      For compensation sites that are to be planted with woody stock, note that woody seedlings/saplings— including those of hydrophytic species—are sensitive to anaerobic conditions in the root zone and could be stressed or drowned out by inundation/soil saturation. Seedlings/saplings typically need to be planted on mounded soils (hummocks) to promote initial root system development. Or, if feasible, hydrologic restoration can be delayed for 2-3 growing seasons to allow for initial root system development.

[9] Varies considerably due to different degrees of decomposition (sapric vs. hemic vs. fibric), source of plant material (woody vs. sedge vs. *Sphagnum*), and overall heterogeneity of the organic layers.

5. Shallow Marshes. User Notes: Depth of inundation is from Shaw and Fredine (1971) and duration reflects the "seasonally flooded" hydrologic regime described by Cowardin et al. (1979)[e.g., PEMC](Table 4). However, inundation can be semi-permanent for shallow marshes in riverine or lacustrine fringe settings [e.g., PEMF](Table 4) especially where water levels are maintained by control structures. Therefore, the specification for duration of inundation should be based on site-specific conditions (28 consecutive days during the growing season, used above, is a starting point). Long-term inundation by water depths greater than 6 inches would establish deep marsh communities while even deeper, nearly permanent water depths would establish shallow, open water communities. Excessive "bounce" in water levels that can result in unvegetated open water or mudflats, or at best monotypes or mixed stands of reed canary grass, cattails and/or *Phragmites*.

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Attachment A

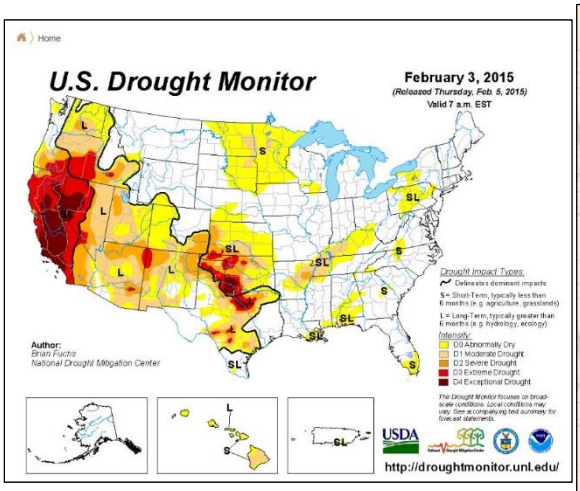
Drought Severity Classification

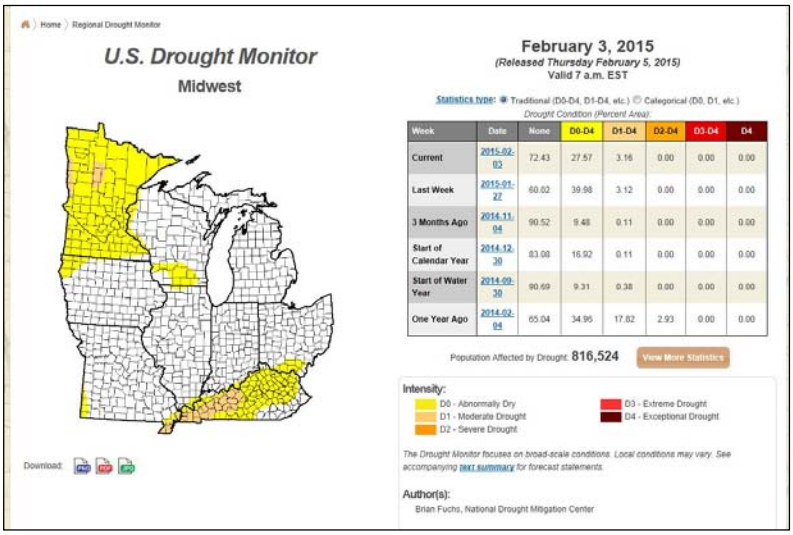
Drought Severity Classification

Category	Description	Possible Impacts	Ranges: Palmer Drought Index	CPC Soil Moisture Model (Percentiles)	USGS Weekly Streamflow (Percentiles)	Standardized Precipitation Index (SPI)	Objective Short and Long-term Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7	21-30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2	11-20
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5	6-10
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9	3-5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less	0-2

Source: National Drought Mitigation Center
http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx

Example graphics

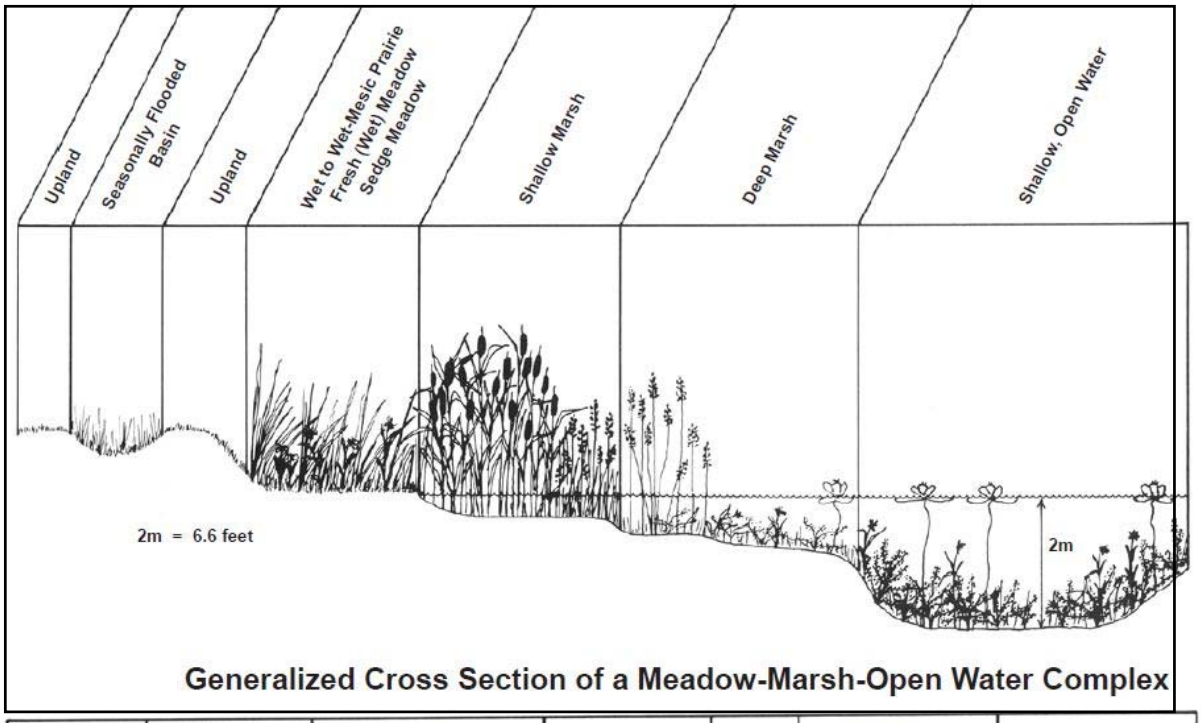




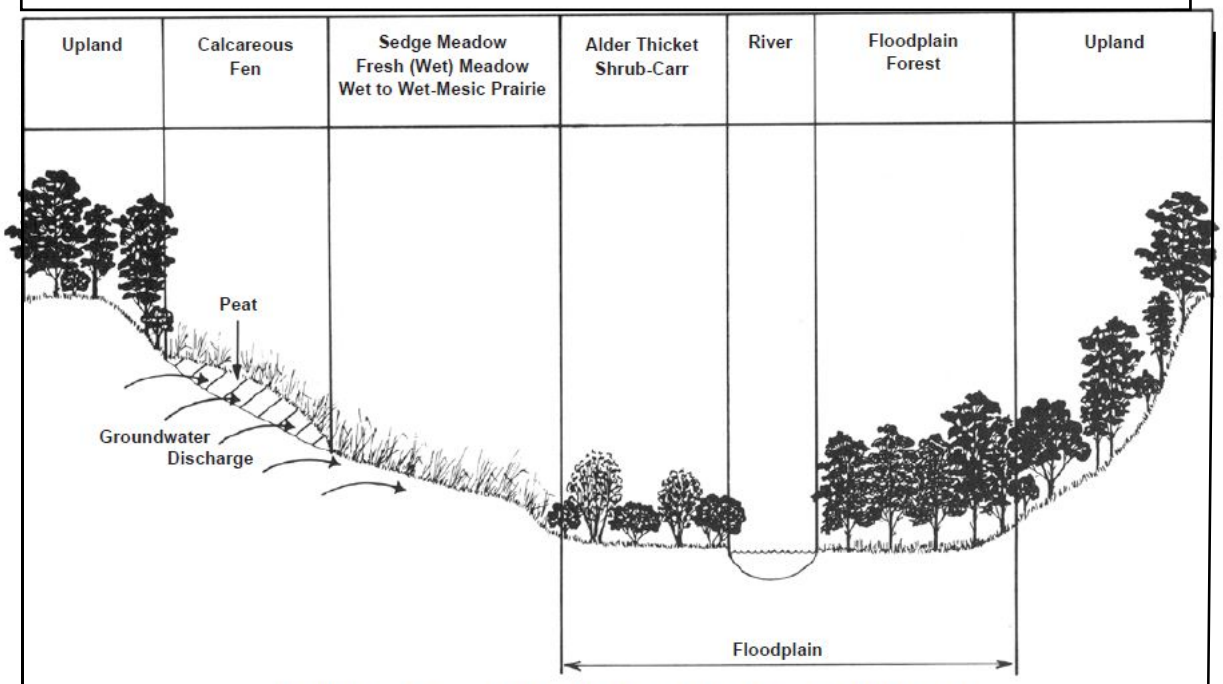
Attachment B

Generalized Cross Sections Illustrating Wetland Plant Communities Cited in the Text

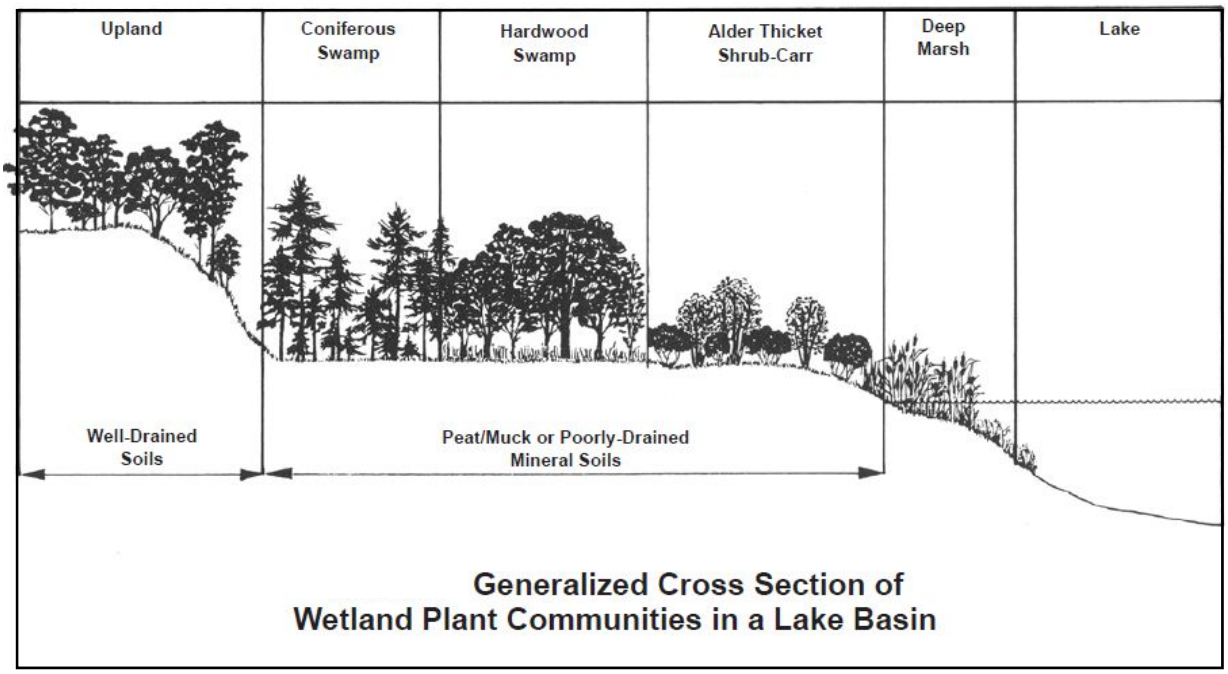
(From Eggers and Reed 2015)



Generalized Cross Section of a Meadow-Marsh-Open Water Complex



Generalized Cross Section of Wetland
. ..nt Communities in a River Valley



Generalized Cross Section of Wetland Plant Communities in a Lake Basin