US Army Corps
of Engineers ®
New England District

NEW ENGLAND DISTRICT COMPENSATORY MITIGATION GUIDANCE

INDEX

I. GENERAL GUIDANCE

1. Purpose and General Considerations

Applicants should contact the Corps prior to initiation of mitigation site selection and mitigation plan development because mitigation requirements are project-specific and appropriate site selection is critical to mitigation success. This New England District Guidance is for use when the Corps determines compensatory mitigation is appropriate for a particular project. This represents New England District policy and incorporates the requirements of the following documents:

1. Compensatory Mitigation for Losses of Aquatic Resources; Final Rule 4/10/08; 33 CFR Parts 325 and 332 ("Mitigation Rule") (**http://www.usace.army.mil/CECW/Pages/final_cmr.aspx**)
2. Regulatory Guidance Letter 08-03: Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources (**http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/rgl08_03.pdf**)

The Council on Environmental Quality (CEQ) has defined mitigation in its regulations at 40 CFR 1508.20 to include: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts. The Clean Water Act Section 404(b)(1) Guidelines establish environmental criteria which must be met for activities to be permitted under Section 404, including sequencing to reduce project impacts on the aquatic environment. This sequencing hierarchy starts with avoiding impacts to aquatic resources to the extent practicable, minimizing unavoidable impacts, and finally, compensating for any remaining impacts to aquatic resources. Both the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency have a national goal of no overall net loss of wetland functions, as explained in the agencies' 1990 Memorandum of Understanding (http://www.usace.army.mil/cw/cecwo/reg/mou/mitigate.htm) and the Mitigation Rule. This goal is achieved through compensatory mitigation of aquatic resource impacts. Compensatory mitigation may be accomplished via mitigation banks or in-lieu fee programs where they exist, or through permittee-responsible mitigation. These guidelines use the terms "mitigation" and "compensation" interchangeably to refer to compensatory mitigation.

The purpose of this document is twofold:

1. To provide guidance to the regulated community on the requirements for mitigation required by the Corps of Engineers, New England District, and
2. To provide a standardized format for the Corps to use in reviewing mitigation plans for their technical merit and ability to replace impacted functions.

It is important to note that there is flexibility in this guidance. When variances are necessary, the proposed mitigation plan should provide a simple explanation of the rationale. However, some items are required by regulation or policy and are indicated by use of the term "must." We acknowledge that absolutes are rare in mitigation design and that a successful site requires careful design, detailed review, commonsense oversight during construction by a person well versed in wetland or other applicable science (e.g., stream morphology, submerged aquatic vegetation ecology, vernal pool ecology), and effective and comprehensive problem resolution (e.g., invasive species removal).

The checklists and checklist directions are intended to help focus mitigation plans on the topics, items, and specific information needed for the Corps to perform a thorough review of proposed mitigation. The general checklist is intended for use with all projects, while the specific aquatic resource checklists are designed to note the required information unique to each resource.

2. Definitions

These definitions are for use with this document. Somewhat different definitions may exist in other documents.

Coastal ecologist: A biologist that studies the interaction of biological organisms with the coastal environment. The applicant should work with the Corps Project Manager to determine the appropriate expertise for the "coastal ecologist" needed to oversee a particular project. For example, they should have expertise and practical experience in subtidal habitats for projects involving subtidal habitats.

Compensatory mitigation: Action taken which provides some form of substitute aquatic resource for the impacted aquatic resource. It may include created, restored, enhanced wetlands, streams, mudflats, etc. and preserved wetlands, streams, and/or uplands provided by the permittee or a third party through a mitigation bank or in-lieu fee program.

Cultivars: Non-native species or varieties which are developed for cultivation (e.g., agriculture, landscaping).

Exotic species: Used in this context the same as non-native species - species not native to New England, and usually not native to North America.

Herbivore: Any animal that primarily feeds on living plants.

Hydrogeomorphic (HGM) Classification: The Hydrogeomorphic wetland classification system is based on geomorphic position and hydrologic characteristics to group wetlands into seven different wetland classes as defined by Brinson (1993).

Invasive species: Native and non-native species which aggressively move into areas, especially sites that are disturbed, and crowd out less aggressive native species. This often results in a monoculture of the invasive species.

Mitigation in relation to S.404: While federal mitigation includes sequencing from avoidance to minimization to, finally, compensation, the term is frequently used instead of "compensation," including in this document.

Secondary impacts: Secondary impacts are effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material (40 CFR 230.11(h)).

Temporal loss: The time lag between the loss of aquatic resource FUNCTIONS caused by the permitted impacts and the replacement of aquatic resource functions at the compensatory mitigation site(s) (33 CFR 332.2).

Wetlands creation: The transformation of upland or deepwater habitat to wetland at a site where there is no evidence that it was previously wetlands. It is sometimes referred to as "establishment." Wetlands creation results in a gain in wetland acreage, however, in the case of use of deepwater habitat, it is not a gain in waters of the U.S.

Wetlands enhancement: Restoring degraded FUNCTIONS of an existing wetland. Degradation may result from infestation by invasive species, partial filling that does not create upland, deliberate removal of woody species (natural changes such as flooding and subsequent demise of trees as a result of beaver activity is not degradation), partial draining, etc. Restoration of an existing wetland's natural functions is sometimes called "rehabilitation." Wetlands enhancement does not result in a gain in wetland acreage.

Wetlands restoration: Returning a former wetland area, which had been filled, drained, or excavated so that it no longer qualifies as a wetland, to wetland conditions. It is sometimes referred to as "re-establishment." Wetlands restoration results in a gain in wetland acreage.

Wetland scientist: The applicant should work with the Corps Project Manager to determine the appropriate expertise for the "wetland scientist" needed to oversee a particular project.

3. General Compensatory Mitigation Requirements

3.a. Temporal Losses

All projects which do not have mitigation in advance of impacts will result in temporal losses which occur as a result of the passage of time between the time when aquatic resource functions are lost to the project impact and when they exist to a similar degree in a compensatory aquatic resource. For example, the wildlife and ecosystem support functions of forested wetlands may take 30-50 years or more to develop and eelgrass habitats are variable by nature and their habitat functions may take 5 years or more to develop (Evans and Short, 2005). Applicants should be aware that additional compensation is likely to be required to offset temporal losses. Wetland functions which *may* not lag behind mitigation construction are flood storage and groundwater discharge and/or recharge. While sediment trapping may develop relatively quickly, water quality functions involving chemical transformation can take many years to develop as they depend upon the chemical and biological characteristics of the wetland soils. The amount of additional compensation will depend upon the nature of the functions impacted, the type of aquatic resource proposed, the functions intended, and pre-existing conditions that may influence the development of the desired aquatic resource(s). Such compensation may include increased area for aquatic resource creation, restoration, or enhancement or it may be solely additional preservation.

Aquatic resource mitigation is not an exact science; an adaptive management approach is a necessity. If appropriate, trial plots might compare different controls and treatments to help determine the most favorable mitigation strategy. This approach requires detailed planning, effective implementation of the plan, close monitoring, adjusting to intermediate results, and making additional modifications when needed to reach the long-term goals.

3.b. General Compensatory Mitigation Concepts

In order to more closely replace impacted functions, in-kind mitigation is generally preferred to out-of-kind mitigation for impacted resources that are not heavily degraded, provided this is appropriate in the landscape. It is important that mitigation be functionally and geographically appropriate in the overall service area - watershed or embayment context, so in-kind mitigation may not be preferred in some situations. Out-of-kind mitigation may be preferred for heavily degraded systems or where it would be more beneficial to the overall watershed (at the U.S.G.S. Hydrologic Unit Code Level 8 or 10) or other appropriate project-specific boundary. Compensation should generally be located where it is most likely to be successful in providing the desired aquatic resource functions, taking into account aquatic habitat diversity, connectivity, and, for wetlands and streams, a natural balance of wetlands and uplands. Compensation should not be located in positions that will be detrimental to the compensation site (e.g., some on-site compensatory mitigation functions may be degraded by proximity to the project). Some functions (e.g., floodflow alteration) may need to be mitigated on-site, while others (e.g., wildlife and/or fisheries habitat) should be mitigated off-site in most cases. If more than one compensation site is to be used, they do not need to be contiguous with each other. Again, overall watershed or embayment concerns may affect location of compensatory mitigation projects.

Restoration is the preferred form of compensatory mitigation, but good restoration sites can be hard to find in New England. Restoration, provided there have been no irreversible changes to the hydrology (for wetlands and streams) or water quality (eelgrass), generally has the greatest likelihood of success. It is usually appropriately situated within the landscape. Successful aquatic resource restoration and creation efforts replace impacted aquatic resource acreage/linear feet and function. Enhancement yields some replacement of function based on types of functions enhanced and/or degree of functional enhancement, but it does not result in the replacement of aquatic resource amount (acreage or linear feet). Since this form of mitigation increases levels of functions in existing aquatic systems, a higher ratio is typically required than is required for mitigation involving restoration or creation.

For additional information on planning and implementing successful compensatory mitigation projects, see the National Research Council's "Operational Guidelines for Creating or Restoring Wetlands that are Ecologically Self-Sustaining" (2001). They may be found as Appendix B in the Corps' Regulatory Guidance Letter 02-02 "Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899" at http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/RGL2-02.pdf

3.c. Preservation as Mitigation

Preservation is an important element of every compensatory mitigation project (please see Section I.3.h. on preservation documentation). The created, restored, and enhanced sites should be preserved in perpetuity, along with an appropriate buffer, to ensure the long term viability of these compensatory mitigation sites. In order to meet the goal of no net loss of wetland functions, the Corps expects mitigation comprised solely of preservation to be acceptable in rare circumstances. While preservation does not replace wetland functions, it does reduce future impacts and degradation to existing wetland functions. For this reason, appropriate preservation-only may be a suitable means of compensatory mitigation in situations where meaningful wetland restoration, creation, and/or enhancement opportunities have been exhaustively explored and do not exist, or are not practicable or ecologically desirable. When looking for mitigation opportunities, the geographic area of consideration is expected to be broad. If an exhaustive search of other conventional mitigation options yields a lack of additional mitigation opportunities, an applicant should work with the Corps and other agencies to develop a suitable preservation package.

In its discussion of preservation, the Mitigation Rule states (at 33 CFR 332.3(h)) that:

> (1) Preservation may be used to provide compensatory mitigation for activities authorized by DA [Department of Army] permits when all the following criteria are met:
>
> (i) The resources to be preserved provide important physical, chemical, or biological functions for the watershed;
>
> (ii) The resources to be preserved contribute significantly to the ecological sustainability of the watershed. In determining the contribution of those resources to the ecological sustainability of the watershed, the district engineer must use appropriate quantitative assessment tools, where available;
>
> (iii) Preservation is determined by the district engineer to be appropriate and practicable;
>
> (iv) The resources are under threat of destruction or adverse modifications; and
>
> (v) The preserved site will be permanently protected through an appropriate real estate or other legal instrument (e.g., easement, title transfer to state resource agency or land trust).
>
> (2) Where preservation is used to provide compensatory mitigation, to the extent appropriate and practicable the preservation shall be done in conjunction with aquatic resource restoration, establishment, and/or enhancement activities. This requirement may be waived by the district engineer where preservation has been identified as a high priority using a watershed approach described in paragraph (c) of this section, but compensation ratios shall be higher.

Following this guidance, suitable preservation as compensatory mitigation should make sense in the watershed context, provide protection of important aquatic resources, and be sustainable in the long-term (e.g., be near other protected resources to provide appropriate ecological continuities). Due to wetlands laws in all of the New England states that reduce development pressure on wetlands, New England District encourages upland preservation that protects aquatic functions over wetlands-only preservation.

3.d. Effective Replacement of Functions

Applicants should expect that more than 1:1 acreage replacement will usually be deemed appropriate. The replacement ratio is based on several factors, including: the aquatic resource functions that are impacted, the reasonably likely functions to be established, the temporal loss of functions, and a "safety factor." The baseline included in the New England District ratios (see I.3.g. below) addresses the expected reduction in specific functions (fish and/or wildlife habitat, water quality functions performed by soils, etc.) of created or restored aquatic resources in comparison with naturally occurring aquatic resources. It also includes a safety factor to allow for some degree of failure. Our experience shows that some portions of most mitigation sites fail to establish the required aquatic resource features or, in the case of wetlands, fail to develop the appropriate hydrology which diminishes many resulting wetland functions.

3.e. **Mitigation Site Selection**

The Mitigation Rule includes the following requirements for site selection (33 CFR 332.3(d)):

> (1) The compensatory mitigation project site must be ecologically suitable for providing the desired aquatic resource functions. In determining the ecological suitability of the compensatory mitigation project site, the district engineer must consider, to the extent practicable, the following factors:
>
> (i) Hydrological conditions, soil characteristics, and other physical and chemical characteristics;
>
> (ii) Watershed-scale features, such as aquatic habitat diversity, habitat connectivity, and other landscape scale functions;
>
> (iii) The size and location of the compensatory mitigation site relative to hydrologic sources (including the availability of water rights) and other ecological features;
>
> (iv) Compatibility with adjacent land uses and watershed management plans;
>
> (v) Reasonably foreseeable effects the compensatory mitigation project will have on ecologically important aquatic or terrestrial resources (e.g., shallow sub-tidal habitat, mature forests), cultural sites, or habitat for federally- or state-listed threatened and endangered species; and
>
> (vi) Other relevant factors including, but not limited to, development trends, anticipated land use changes, habitat status and trends, the relative locations of the impact and mitigation sites in the stream network, local or regional goals for the restoration or protection of particular habitat types or functions (e.g., re-establishment of habitat corridors or habitat for species of concern), water quality goals, floodplain management goals, and the relative potential for chemical contamination of the aquatic resources.

Whenever possible, locate the mitigation site in a setting of comparable landscape position and hydrogeomorphic (HGM) class (riverine, depressional, lacustrine fringe, tidal fringe, mineral flats, organic flats, and slopes) and subclass as the impacted aquatic resource. The HGM classification relates to the landscape position and water source of the aquatic resource. These features affect the functions that the aquatic resource performs and should therefore be used as a guide for developing compensatory aquatic resources intended to duplicate the impacted functions. Slope discharge wetlands will function very differently than precipitation-driven depressional wetlands. Functions relating to groundwater recharge/discharge, water quantity attenuation, nutrient/sediment/ toxicant retention, and even fish and wildlife habitat are affected by the location in the landscape of the aquatic resource and the way the water moves into and out of the site.

Seek to duplicate the features of reference wetlands or enhance connectivity with adjacent natural upland and wetland landscape elements. Select sites that are, and will continue to be, resistant to disturbance from the surrounding landscape, by locating the mitigation site to take advantage of refuges, buffers, green spaces, and other preserved elements of the landscape.

Long-term sustainability is a key feature of successful wetland mitigation and thus, protecting the site from degradation. Wherever possible, select sites where wetlands previously existed and/or where nearby wetlands currently exist. Restoration is frequently more feasible and sustainable than creation of wetlands. However, in some cases, long-term sustainability of restored functions is not feasible due to degradation of the overall landscape. In such cases, out of kind mitigation may be appropriate to achieve long-term sustainability. Applicants should consider both current and expected future hydrology (including effects of any proposed manipulations and sea level rise), sediment transport, locations of water resources, and overall watershed functional goals before choosing a mitigation site. This is extremely critical in watersheds that are rapidly urbanizing. Changing infiltration rates can modify runoff profiles substantially, with associated changes in sediment transport, flooding frequency, and water quality. More importantly, applicants must plan for long-term survival by placing mitigation in areas that will remain as open space and not be severely impacted by clearly predictable development. Consideration of the landscape perspective requires evaluation of buffers and connectivity (both hydrologic- and habitat-related). Buffers are particularly important to insure that changing conditions are ameliorated, especially in watersheds that have been, or are in the process of being, heavily developed.

Degraded habitats are favored compensation locations; however, the potential for invasive species establishment should be taken into consideration when evaluating appropriateness for mitigation. Also, habitat degradation varies over a wide range, and so must flexibility in developing mitigation at such sites. Creation and restoration sites should not result in the degradation or destruction of valuable uplands. For example, mature forested uplands and other non-degraded uplands are generally inappropriate for use as wetland creation sites. Likewise, creation and restoration of eelgrass habitats should avoid bottom habitats that already have valuable aquatic functions. In addition, the presence of nearby eelgrass habitat actually argues against creating new habitat in that location as the expectation is that the eelgrass would spread to the adjacent unvegetated bottom anyway.

<u>Surrounding land use/plans, including probable future land use</u> - Consider current and future landscape features or public issues that may control or influence design.

Consider the effect of the mitigation site on roads, rights-of-way, site access, and utilities, as well as on drainage, including the potential for flooding both upstream and downstream of the site. Also consider the potential effect of adjoining land uses, including agriculture, residential, and industrial uses, roads, rights-of-way, utilities, and drainage easements on the mitigation site and its success and functions. Urbanization of the watershed may increase runoff and nutrient inputs from stormwater and septic systems. Both sources can degrade water clarity and quality, impacting submerged aquatic vegetation habitats. Identify the location and approximate extent of any existing, adjacent special aquatic sites. Consider whether there are riparian areas along waterways where water quality may be enhanced, or whether there are adjacent woodlands that may buffer aquatic resources from less compatible land uses.

Stormwater Basins - Typically, detention/retention basins are not appropriate for use as compensatory mitigation. Their construction results from requirements of the constructed project to mitigate stormwater concerns for the project itself, not address the lost functions of the impacted wetlands. In addition, they often require frequent maintenance to retain functionality, decreasing their ability to develop a full suite of wetland functions. However, detention/retention basins can serve to minimize the adverse effects of a project on nearby wetlands and waters, provided that the stormwater management system will be maintained for the life of the project.

Other Site Selection Considerations

There are a variety of other considerations which should be taken into account in mitigation site selection. These include watershed-scale features, size and location of sites relative to water sources, compatibility with adjacent land uses and watershed plans, foreseeable effects of mitigation on ecologically important resources, and development trends and anticipated land use changes.

3.f. Difficult to Replace Aquatic Resources

Some types of aquatic resources are “difficult-to-replace.” They include, but are not limited to: bogs, fens, springs, streams, and Atlantic white cedar swamps. Impacts to such resources should generally not be compensated for by using in-kind creation as success is too uncertain.

3.g. Amount of Compensatory Mitigation

Like many Corps districts around the country, New England District has developed standard compensatory mitigation ratios to serve as a starting point for developing adequate compensatory mitigation. These ratios provide guidance for all compensatory aquatic resource mitigation required by New England District. They are particularly designed for direct permanent impacts, with additional mitigation required to address temporary fill impacts and secondary impacts (effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material, e.g., fragmenting wildlife habitat, alteration of hydrology, removal of vegetation, degraded water quality, increased turbidity, increased biological stressors, etc.) on another scale. The ratios are based on:

- Complexity of system impacted,
- Likelihood of mitigation success,
- Degree to which functions are replaced, and
- Temporal losses for certain functions (e.g., water quality renovation, wildlife habitat).

These guidelines represent policy guidance for the New England District. As such, they are not intended to represent a binding regulation, and are not intended to be enforceable against the Army Corps of Engineers by third parties. While these ratios are the starting point for developing appropriate compensatory mitigation, there continues to be flexibility on a project-by-project basis in order to achieve the most appropriate mitigation for a specific project and, based on the facts of a particular situation, permit decisions may result in different requirements than the ratios set forth in this document. The functions and levels of functions impacted are important in determining adequate and appropriate compensation. Some of the factors to be considered in developing the project-specific compensation include:

- The functions provided by the proposed impact site (including the level of those functions).
- The functions provided by the proposed compensatory mitigation project (including the estimated level of those functions upon completion of construction and completion of the monitoring period – as opposed to the level of functions at the site's "maturity" which may be decades in the future).
- Temporal losses of aquatic resource functions.
- The method of compensatory mitigation (e.g., restoration, creation).
- The likelihood that the compensatory mitigation project will attain the performance goals.
- Any risks and/or uncertainties associated with the proposed compensatory mitigation project.
- The distance between the impact site and the compensatory mitigation project site, particularly if they are in different HUC-8 watersheds or ecoregions.
- The relationship between the impacted watershed and the watershed served by the mitigation project.

This flexibility may lead to compensatory mitigation deemed adequate and appropriate which is at different ratios than included here. Project-specific ratios may be lower than depicted here, or they may be higher so that unavoidable impacts to high quality wetlands may be adequately mitigated and/or secondary impacts may be addressed. Proven mitigation methods and confidence that the proposed plan substantially reduces the risks inherent in wetland construction may also be considered in determining the appropriate ratios for a specific project. The New England District will also work closely with state regulatory agencies to achieve as much consistency as possible, given differing state and federal legislative and program requirements; however, these guidelines are designed to meet the federal compensation requirements and may not meet state requirements.

Recommended Ratios for Direct Permanent Impacts (Table 1)

It is extremely important to mitigate for affected functions, generally by replacing the same type of system impacted. This will vary with watershed and landscape considerations; the mitigation should be functionally and geographically appropriate. The ratios are based on the type of aquatic resource impacted, not the type of aquatic resource proposed for compensation. They were developed with the presumption of in-kind compensation (which will not always be appropriate) and ranges are meant to reflect the quality of aquatic resource and the level of functions impacted. In cases where out-of-kind compensation is performed, project-specific ratios will be developed.

Several specific types of systems (e.g., vernal pools, riffle and pool complexes) are not specified here as they will generally require resource-specific and project-specific compensation.

The proximity of impaired waters will be considered. Greater mitigation ratios may be needed for projects near impaired waters to protect water quality. Impaired waters are those waters which do not meet state water quality standards (even after point sources of pollution have installed the minimum required levels of pollution control technology). It is the responsibility of the applicant to identify whether a project is in the vicinity of a designated impaired water by referring to a state's or tribe's Clean Water Act Section 303(d) list and/or maps of impaired waters.

In the case of eelgrass habitat, degraded water quality will be a major determining factor in whether a mitigation project achieves success. When an applicant proposes a mitigation project in designated impaired waters, the expected lower success rate will be considered. Hence, locating eelgrass mitigation in impaired waters should be contemplated only after all other alternative sites have been ruled out.

Recommended Mitigation for Temporary and/or Secondary Impacts (Table 2)

Impacts to aquatic resource functions resulting from temporary placement of fill or as a secondary impact of the permanent or temporary placement of fill can be substantial. In most cases, it will be necessary to compensate for such temporary and secondary impacts to prevent a net loss in aquatic resource functions. Corps regulations published in the March 12, 2007 Federal Register state in C.20(h): "Where certain functions and services of waters of the United States are permanently affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project…." In temporary fill situations, although the fill remains in place only temporarily, impacts typically remain after the fill is removed. For example, there may be shearing caused by pressure on organic or fine-grained soils which presses the soil outward, causing upheaval. There may also be compaction which can result in changes to movement of subsurface and/or surface water and conversion of wetland type within and/or adjacent to the temporary fill area. There may be conversion to upland in upheaval areas. If an applicant feels they can avoid these impacts, they can elect to refute the presumption of impacts requiring compensation by performing monitoring. This would involve collecting data on pre-construction conditions (elevations to 0.5', vegetative community composition and type, hydrologic regime such as saturated to surface or inundated) within the footprint and 25' on each side and then repeating that annually during the growing season for five years after the temporary fill is removed. If, after five years (or less), the data show long-term or permanent impacts, compensation will be required. Funds should be held in escrow for this possibility. NOTE: The monitoring may only obviate the need for compensation for the impacts of the temporary fill; any temporary conversion of forest will still require compensation.

Recommendations for mitigation for temporary (in addition to restoration in place) and secondary impacts are expressed as ranges of percentages of the mitigation recommended for direct, permanent impacts. There are several factors to consider when applying the ranges to determine the appropriate level of mitigation for a specific project. Factors to consider for:

- Removal of forested wetland vegetation include density and diversity of original woody vegetation, soil type (organic or mineral), effects of substrate compression, work during frozen conditions only, original aerial cover, presence/absence of exemplary vegetative community, threatened and endangered species habitat, length of time fill will be in place, likelihood of shearing causing upheaval, etc. Habitat is presumed to be the principal function affected but there may also be changes in soil temperature, a window of opportunity for invasion by exotic species, temporary reduction in biomass and carbon sequestration, and changes to hydrology as a result of reductions in evapotranspiration. Compensatory mitigation addresses temporal impacts during the time temporary fill is in place and during forest re-establishment.
- Temporary and secondary impacts to scrub-shrub and emergent wetlands, factors to consider include soil type, effects of substrate compression, work during frozen conditions only, presence/absence of exemplary vegetative community, threatened and endangered species habitat, length of time fill will be in place, likelihood of shearing causing upheaval, etc.
- Vernal pool buffer impacts, factors to consider include original aerial cover, relationship to other vernal pools, etc.

TABLE 1 - RECOMMENDED COMPENSATORY MITIGATION RATIOS FOR DIRECT PERMANENT IMPACTS

Mitigation / Impacts	Restoration[1] (re-establishment)	Creation (establishment)	Enhancement (rehabilitation)	Preservation (protection/ management)
Emergent Wetlands (ac)	2:1	2:1 to 3:1	3:1 to 10:1[2]	15:1
Scrub-shrub Wetlands (ac)	2:1	2:1 to 3:1	3:1 to 10:1[2]	15:1
Forested Wetlands (ac)	2:1 to 3:1	3:1 to 4:1	5:1 to 10:1[2]	15:1
Open Water (ac)	1:1	1:1	project specific[3]	project specific
Submerged Aquatic Vegetation (ac)	5:1	project specific[4]	project specific[5]	N/A
Streams[6] (lf)	2:1[7]	N/A	3:1 to 5:1[8]	10:1 to 15:1[9]
Mudflat (ac)	2:1 to 3:1	2:1 to 3:1	project specific	project specific
***Upland*[10] (ac)**	≥10:1[11]	N/A	project specific	15:1[12]

[1] Assumes no irreversible change has occurred to the hydrology. If there has been such a change, then the corresponding creation ratio should be used.
[2] Based on types of functions enhanced and/or degree of functional enhancement.
[3] Might include planting submerged and/or floating aquatics and/or removal of invasive species.
[4] Rare cases, e.g., removal of uplands, old fill, etc.
[5] E.g., remove pollutant source such as an outfall, remove moorings.
[6] Note that this assumes both banks will be restored/enhanced/protected. If only one bank will be restored/ enhanced/protected, use half the linear foot credit.
[7] E.g., daylighting stream, elimination of concrete channel.
[8] Enhancement of denuded banks and channelized streams = 3:1.
Enhancement of denuded banks when there is a natural channel = 4:1.
Enhancement when there are vegetated banks but the stream has been channelized = 5:1.
[9] Preserving buffer within the 100-foot minimum from channel = 10:1.
Preserving additional buffer 100 to 250 feet from channel = 15:1.
[10] This is when upland is used for wetland mitigation, NOT mitigation for upland impacts, which are not regulated.
[11] Only applies if existing condition is pavement or structure AND should complement aquatic functions.
[12] 100' upland buffer recommended for restoration, creation, and enhancement sites would be credited here.

TABLE 2 - RECOMMENDED COMPENSATORY MITIGATION FOR TEMPORARY AND/OR SECONDARY IMPACTS

IMPACT	**% OF STANDARD[13] AMOUNT[14]**
Temporary fill (swamp mats, fill over membrane) in forested wetlands; area to revegetate to forest.	10-25%
Temporary fill in emergent or scrub-shrub; area to revert to previous condition.	5-20%
Temporary fill in forest and will be permanently converted to scrub-shrub or emergent	15-45%[15]
Permanent conversion of forested wetlands to other cover types	15-40%
Removal of forested wetland cover for new corridor	Project specific
Removal of forested cover of vernal pool buffer (w/in 250' of pool) when percentage of disturbance exceeds 25% of the total VP buffer area	Project specific[16]
Streams – clearing of upland forest and/or scrub-shrub vegetation within 100' of stream bank or outermost channel of braided stream	Project specific[17]
Wetlands within subdivisions	Project specific

[13] "Standard" refers to amount of compensation that would be recommended under either the Corps' mitigation ratios for permanent fill (TABLE 1) or that required in In-lieu fee payments using the standard calculation.
[14] Percentages may be reduced if appropriate project-specific BMPs are incorporated into the project.
[15] For widening existing corridors only, not new. This does not take into account fragmentation impacts.
[16] Considerations in determining appropriate mitigation for secondary impacts to vernal pools should be on overall impact to the upland vernal pool buffer and how this affects the functions of the pool.
[17] Considerations in determining appropriate mitigation for secondary impacts to streams from loss of upland buffer should be on overall impact to the upland stream buffer and how this affects the functions of the stream.

- Stream buffer impacts include distance of impact from stream, width of impact, original aerial cover, etc. Secondary impacts may include water temperature, water quality, fish and wildlife habitat (including travel corridors), production export, and streambank stabilization.

A sample hypothetical calculation of appropriate mitigation using the ratio guidance is posted on the New England District website: http://www.nae.usace.army.mil/reg/index.htm under "Mitigation."

3.h. Preservation Documentation

There are numerous forms of preservation documents. They include fee transfer to another entity such as a non-profit conservation organization or public agency with a conservation mandate, easement given to a non-profit conservation organization or public agency with a conservation mandate, deed restriction, or restrictive covenant. The form should be specified in the text and a copy of the draft document(s) included. Fee transfer with third party enforced conservation covenants or conservation easements is preferred. Deed restrictions are discouraged as they are difficult to enforce and may be easily changed.

3.i. Buffers

In most cases, a protected (preserved) buffer will be required around creation, restoration, and enhancement sites, including stream mitigation, as this is of benefit on a local and watershed scale throughout New England. The extent of the buffer will depend upon the landscape position of the site(s) and current and potential surrounding land uses but it will be rare that a buffer less than 100 feet in width will be adequate. Buffers greater than 100 feet in width are generally encouraged. Usually buffers will consist of uplands but wetlands also may serve that function in some situations. Vernal pools require a substantial area of adjacent forested terrestrial habitat (both upland and wetland) in order to adequately support vernal pool dependent wildlife. The buffer requirements for projects involving vernal pools may be greater than 100 feet in width.

Compensatory mitigation that involves restoration, creation, and enhancement benefits greatly from the presence of upland buffer to prevent site degradation resulting from nearby activities and enhances long-term sustainability. This buffer area would count toward upland preservation mitigation credit. A preserved buffer of a minimum of 100' from each bank is recommended for stream restoration and enhancement projects, but may be smaller based on landscape features. Eelgrass also benefits from the protection of headwater streams, nearby lands, and adjacent bottom habitat but the potential for compensation credit will be dependent upon site and project-specific circumstances.

3.j. Relationship to Other Federal, Tribal, State, and Local Programs

Occasionally there are conflicts between requirements of the Corps and those of state and/or local agencies. Applicants should notify the Corps when this situation arises and the Corps will work with all parties to avoid or minimize duplication of effort and meet agency requirements. Normally, use of the most rigorous standard has been acceptable to all agencies. However, the amount, type, and location of compensatory mitigation required by the Corps can differ substantially from that required by other federal, tribal, state, and local programs.

3.k. Party(ies) Responsible for Compensatory Mitigation

The Mitigation Rule requires that the entities responsible for the implementation, performance, and long-term management of the mitigation project be listed.

3.l. Timing

Whenever feasible, mitigation construction should be in advance of or concurrent with the authorized impacts.

3.m. Financial Assurances

Financial assurances are to ensure a high level of confidence that the project will be completed and achieve the goals intended. Depending on the timing, certainty (or lack of same), difficulty of the compensation, and the track record of the applicant, financial assurances, particularly performance bonds, letters of credits, or escrow accounts, may be required for all aspects of the mitigation (acquisition, construction, and monitoring—including remediation).

In addition, endowments to provide a funding source in perpetuity to long-term stewards are generally encouraged.

Government entities which are unable to provide performance bonds, or similar assurances, should provide a formal, documented commitment that covers all aspects of the mitigation, especially monitoring and remedial activities.

Financial assurances may be phased out, with written approval by the Corps, as various stages of the project are deemed complete and successful according to specified conditions linked to performance standards, adaptive management, or compliance with special conditions.

4. Planning and Documentation – Mitigation Plan

The Mitigation Rule requires that the public notice for an individual permit contain a statement explaining how impacts associated with the proposed activity are proposed to be avoided, minimized, and compensated for. This would include the amount, type, and location of proposed compensatory mitigation, including if any is out-of-kind.

The Mitigation Rule requires that the following items be incorporated into final mitigation plans:

- Objectives
- Site Selection
- Site protection instrument
- Baseline information
- Determination of credits (how the project will provide the required compensation for unavoidable impacts)
- Mitigation work plan
- Maintenance plan
- Performance standards
- Monitoring requirements
- Long-term management plan
- Adaptive management plan
- Financial assurances

See Section IV for specific mitigation plan data needs.

4.a. Data Presentation

The use of charts, tables, and plan overlays to present data for impact and mitigation areas is encouraged. They are often the most concise method of conveying information and make comparison easier. Appendices B and C are examples of useful presentations of data. Submissions in portable document format (pdf) and GIS polygon files (shapefile, geodatabase, or other GIS format) are strongly encouraged.

4.b. Hydrological Considerations

The emphasis should be on establishing naturally variable hydrology. This includes fluctuations in water flow, depth, duration, and/or frequency. Hydrology within the mitigation site should be comparable to a reference aquatic resource within the same landscape setting (HGM type). Reestablishment of natural hydrology is encouraged; active engineered devices are discouraged. When natural hydrology is not feasible, consider passive structures to sustain the desired hydroperiod over the long term. Avoid designing a system that depends on water-control structures or other infrastructure that must be maintained in perpetuity in order to provide the necessary hydrology. In situations where direct or in-kind replacement is desired, mitigation sites should have the same basic hydrological attributes as the impacted site.

Essential hydrology may not be immediately available. For example, a stream diversion portion of a project may be completed after the mitigation grading construction, thus the portion of the stream diversion intended to flow to the mitigation site will not be directed there immediately. It is appropriate to factor the availability of that water in the timing of any plantings.

Monitoring Wells - Note that monitoring wells may not be necessary if other data are adequate. If you are considering monitoring wells, you should discuss this issue with Corps staff to clarify the need and nature of the data prior to installation.

Note that there is an important difference between monitoring wells and piezometers, both of which provide useful information. Since accurate placement and installation of monitoring wells and/or piezometers affects the accuracy and usefulness of the data, details on the uses for and installation of both of these types of wells are available in two documents prepared by the Engineers Research and Development Center's (ERDC) Environmental Lab, previously known as the Waterways Experiment Station (WES):

- "Installing Monitoring Wells/Piezometers in Wetlands", ERDC TN-WRAP-00-02, can be found at: **http://el.erdc.usace.army.mil/wrap/pdf/tnwrap00-2.pdf**,
- "Technical Standard for Water-Table Monitoring of Potential Wetland Sites", ERDC TN-WRAP-05-02, can be found at: **http://el.erdc.usace.army.mil/wrap/pdf/tnwrap05-2.pdf** .

If monitoring wells are used and the site is adjacent to a wetland system, installation of at least one well in the adjacent system may provide useful information on the relationship of the water table in the wetland to the one in the proposed mitigation site.

Precipitation data is available on the Internet. Sites include **http://water.weather.gov** under the appropriate Eastern Region Weather Forecast Office and the Northeast Regional Climate Center (**http://www.nrcc.cornell.edu**).

4.c. Microtopography

Note that natural wetland systems, particularly those with trees and/or shrubs, typically have an intricate pattern of topographic relief. Created or restored areas should have variability (elevational and size) similar to the impacted resource or a suitable reference area.

4.d. Soil

Manmade topsoil shall consist of a mixture of equal volumes of organic and mineral materials. Well-decomposed clean leaf compost is the preferred soil amendment to achieve these standards. Note that "clean" refers both to a negligible amount of physical contaminants such as plastic and to the lack of chemical contaminants that might pose a hazard to plants or animals. If other soil amendments are more readily available than clean leaf compost, they can be used to meet the requirement for the appropriate percent organic carbon content. Note, however, that compost or other organic matter should be clean and free of weed seeds, specifically the seeds of the species listed in Appendix D. Commercial peat is not recommended for soil amendments as its harvesting methods are generally destructive to wetlands. Caution should be used when using non-commercial peat salvaged from project impact sites as the chemical composition of that material may not be adequately buffered against phytotoxic levels of pH.

It is important to keep in mind the difference between organic *matter* and organic *carbon* both for meeting regulatory guidelines and when classifying the surface horizons in soils as histic (organic soils), mucky modified, or mineral. The organic *carbon* content of most upland topsoil is between 1 and 6 percent of dry weight. Soils with more than 20 to 30 percent organic *matter* (12 to 17 percent organic *carbon* content) are known as organic soils or Histosols if in a layer of adequate thickness. The Field Indicators for Identifying Hydric Soils in New England (New England Hydric Soils Technical Committee, 2004, 3rd ed.) glossary defines the criteria for these classifications based on their organic *carbon* contents. A minimum organic *carbon* content of 4-12% (7 to 21 percent organic *matter*) on a dry weight basis for soils should be used in wetland replication areas. The rule of thumb for conversion is to divide percent organic *matter* by 1.72 to get percent organic *carbon* content and multiply percent organic *carbon* by 1.72 to get percent organic *matter* content[18]:

$$\%O_m/1.72 = \%O_c \quad \text{and} \quad \%O_c \times 1.72 = \%O_m$$

Scrub-shrub and forested wetlands should have about 12% organic carbon; emergent wetlands in permanently or semi-permanently inundated areas may only need 4-6%. Under certain circumstances, increased organic matter can lead to acidification of the soil, which damages the soil microbial community and the vegetation. Care should be taken to properly evaluate the soil and hydrology proposed for a site to prevent this from occurring.

Note that the term "loam" that is frequently used for the material spread on a mitigation site after subsoil grading is a landscaping term. In soil science, the term refers to a specific texture of soil comprised of specific amounts of sand, silt, and clay particles. The landscaping term is not a scientific term and should be avoided.

When topsoil must be stockpiled on site, the plan should include plans for maintaining moisture in the soil. The following measures are suggested for the contractor doing the work:

[18] Excerpted from Allen, Art, "Organic Matters", *AMWS Newsletter*, December 2001.

- Soil should not be stockpiled in wetlands or waters
- Seek approval for location of stockpiled materials (from owner/engineer);
- Avoid stockpiling compost organics in piles over 4 feet in height;
- Protect stockpiles from surface water flow and contain them with hay bales and/or silt fence;
- Cover stockpiles with a material that prevents erosion (tarps, erosion control mat, straw and temporary seed, depending on size and duration of storage)
- Inspect and repair protection measures listed above regularly (weekly), as well as prior to (to the extent possible) and after storm events.
- Maintain moisture in the soils during droughty periods.

Soil Compaction - Soil compaction by heavy machinery may adversely affect plantings and/or may result in perching of water. Therefore, efforts should be made to minimize soil compaction area during grading of the mitigation site. If use of heavy machinery cannot be avoided, compaction must be addressed by disking or some other treatment to loosen the soil surface. Finer grained soils are more susceptible to compaction than more coarsely grained soils, so clayey soils should not be worked at all except in extremely dry condition. Similar consideration should be given while spreading the topsoil.

4.e. Planting (for Wetlands, Vernal Pools, and Stream Riparian Areas)

Planting and/or seeding are generally appropriate for a mitigation site, as determined through consultation with the Corps. When planting is proposed as part of the plan, the guidelines noted below should be followed.

Irrigation - Note that irrigation is solely a temporary measure to enhance the success of vegetation establishment, not to provide hydrology. The use of irrigation for woody plantings should be considered for the first one or two growing seasons after planting due to the unpredictability of short-term local hydrologic conditions and the need for additional care to establish new plantings. Equipment (e.g., pipes, pumps, sprinklers) must be removed and irrigation discontinued no later than the end of the second growing season unless the Corps concurs with extended irrigation. In this situation, the monitoring period shall be extended an equivalent time period.

Two methods have been used successfully: water trucks and installation of irrigation systems. The former is limited by accessibility for the truck(s), a likely problem on large sites. The latter tends to be less expensive and may be more effective for large projects.

Use of Mulch - The use of mulch around woody plantings is strongly encouraged, and may be required, to reduce the need for irrigation and to keep down herbaceous vegetation in the immediate vicinity of each plant for a couple of years. There are at least two methods available: biodegradable plastic or fiber (which should be stapled or staked to the ground) or organic mulch. Note that organic mulch is not considered to be part of the organic content of the topsoil and it should not be used in locations that will be inundated as it may float away. Suggested specifications for organic mulching are as follows:

- Mulch balled and burlaped or container-grown trees and shrubs in a 3' diameter circle approximately 2" deep.

- Mulch bare-root woody planting in an 18" diameter circle approximately 2" deep.

Planting Density - Woody planting densities may require adjustment depending upon the goals of the mitigation plan and the 'reference wetland' used to develop the habitat goals. For example, if the primary goal for a particular creation site is flood storage and there is minimal need for wildlife habitat but there is interest in developing a woody component in the flood storage area, the density may be reduced. Also, if the wetland type desired is a dense thicket, the density may need to be increased.

Plant Species - Native planting stock scavenged from the immediate vicinity of the project is ideal as it minimizes the threat to native diversity. Salvaging native plants from wetlands and uplands cleared by the project is strongly encouraged. Transplanting entire blocks of vegetation with several inches of the original wetland soil substrate from the impact areas has been found effective in establishing mitigation wetlands. However, beware of the potential for transplanting invasive species.

Although the use of non-native species is typically discouraged, there are situations where such use may be appropriate such as using *Secale cereale* (Annual Rye) to quickly stabilize a site. The species should be noted and the reason for their use explained.

No cultivars shall be used. Beware of stock identified as a native species which is actually a cultivar or non-native species (e.g., there have been numerous instances around New England of *Alnus incana* or *Alnus rugosa* labels appearing on seedlings of non-native *Alnus glutinosa*).

Non-native or otherwise unacceptable species are listed in Appendix D[19] and are not to be included as seed or planting stock in the overall project. Many of these species may not need to be actively removed from the site. Exceptions are included below in the discussion of invasive species. More may be added by the Corps on a case-by-case basis.

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[19] This list is a compilation of state lists from New England and additional species recommended by regional botanical experts.

The Emerald Ash-Borer (http://www.emeraldashborer.info/), an insect species that is damaging to ashes, especially green ash (*Fraxinus pennsylvanicus*), is moving toward New England. Therefore, consideration of this should be made before incorporating ash (*Fraxinus* spp.) into planting plans. The Asian Longhorned Beetle (http://www.ct.gov/dep/cwp/view.asp?a=2697&q=421754&depNAV_GID=1631&pp=12&n=1) and other invertebrate pests may be problems in certain areas and/or on specific species.

Herbivory - Herbivory by white tailed deer, rodents (e.g., meadow voles, beaver), and rabbits can adversely impact forest stand development. Rodents frequently girdle seedlings, increasing mortality of plantings. Herbivory by Canada geese has impaired establishment of both herbaceous and woody communities in agricultural and old field settings, as well as in salt marshes. Mute swans (*Cygnus alor*) cause significant damage to submerged aquatic beds throughout Long Island Sound. Herbivory from invasive species like the green crab (*Carcinus maenas*) has been shown to extirpate naturally occurring or created eelgrass beds (Williams 2007). Measures that have been used to address herbivory, with mixed success, include the use of tree tubes, fencing, nurse crops, trapping, hunting, chemical deterrents, attracting predators, removing cover for herbivores, planting browse-tolerant coppicing shrubs (e.g., willows and alders), etc.

4.f. Invasive Species

There is growing recognition of the negative impact that invasive species have on the environment, economy, and health of the United States[20]. Projects should avoid introducing or increasing the risk of invasion by unwanted plants (such as those species listed below) or animals (such as zebra mussels). Soils disturbed by projects are very susceptible to invasion by undesirable species. Be particularly alert to the risk of invasion on exposed mineral soils; these may result from excavation or filling. In addition, construction equipment can be a source of contamination and should be thoroughly cleaned prior to arrival on the project site (http://www.usbr.gov/pps/EquipmentInspectionandCleaningManual_Sept09.pdf). Invasive species often get a foothold along project drainage features where the dynamics of erosion and accretion prevail. Along salt marshes, be especially alert to the project's influence on freshwater runoff. Frequently, *Phragmites australis* invasion is an unanticipated consequence of freshwater intrusion into the salt marsh. Information from the Invasive Plants Atlas of New England is available at: http://nbii-nin.ciesin.columbia.edu/ipane/. It should also be noted that, although relatively rare, there are populations of native *Phragmites australis* (*P.a.* ssp. *americanus*) throughout New England and these plants should be conserved, rather than controlled (http://ian.umces.edu/pdfs/iannewsletter7.pdf, http://www.invasiveplants.net/phragmites/phrag/morph.htm).

[20] U.S. Army Corps of Engineers Invasive Species Policy (2 June 2009)

In the case of eelgrass habitat, non-native species can negatively impact the establishment and persistence of mitigation beds through herbivory, encrusting growth on shoots, physical disturbance, etc. Common invasive species in these habitats include green crabs, mute swans, colonial tunicates, and bryozoans (Williams 2007).

Because of the pervasiveness of invasive species in New England and the damage they do to aquatic resources, the Mitigation Plan must include an Invasive Species Control Plan (ISCP). The ISCP should:

- Discuss the risk of colonization by invasive species (plant and/or animal). The discussion of risk should include an assessment of the potential for invasion of the wetland by the species listed below or other identified problematic species specific to this project or site. The assessment of risk should consider the local and regional backdrop of invasive species, the potential mechanisms for the spread of invasives (e.g., contaminated equipment and machinery), the potential virulence and responsiveness to control of the species.

- Identify regulatory and ecological constraints that influence the design of any plan to control invasive plants and animals by biological, mechanical, or chemical measures. For example, if a state requires a permit for use of herbicide, this will be a factor in developing a plan to control an invasive plant species. If there are no constraints, this should be stated.

- Describe the strategies to prevent the introduction of invasives and to recognize and eradicate or control the degradation of the mitigation site by invasive or non-native plant species. The invasion by the following invasive species, and any other species identified as a problem at the project or mitigation sites, should be controlled. See the Corps website http://www.nae.usace.army.mil/reg under "Invasive Species" for some websites providing information on controlling these species. The ISCP should address a full range of practicable measures to minimize threats to wetlands as well as all associated buffers or other habitats that are factored in project impact mitigation. The ISCP should consider traditional control methods including: mechanical (pulling, mowing, or excavating on-site), chemical (herbiciding), and biological (planting fast-growing trees and shrubs for shading or releasing herbivorous insects).

    - Common reed (*Phragmites australis*)
    - Purple loosestrife (*Lythrum salicaria*)
    - Smooth and Common buckthorns (*Frangula alnus*, *Rhamnus cathartica*)
    - Russian and Autumn olives (*Elaeagnus angustifolia* and *E. umbellata*)
    - Multiflora rose (*Rosa multiflora*)
    - Reed canary-grass (*Phalaris arundinacea*)
    - Japanese knotweed (*Fallopia japonica*)

- other species identified as a current or likely problem at the site

In addition to these species, none of the species listed in the "Invasive and Other Unacceptable Plant Species" (Appendix D) should be planted anywhere on the project site. For more information on ISCPs, please see additional guidance (http://www.nae.usace.army.mil/reg/Mitigation/ISCP_Guidance.pdf) on New England District's Regulatory webpage.

4.g. Coarse Woody Debris

Coarse woody debris includes such materials as logs (ideally, a mix of hardwoods for longevity and softwoods), stumps, smaller branches, and standing snags but not woodchips or mulch made from wood. Placement of this material is generally inappropriate in tidal or frequently flooded environments, and may not be appropriate for some herbaceous systems. As much as possible, these materials will be in various stages of decomposition and salvaged from natural areas cleared for the other elements of the project. Where floodwaters are a factor, it may be practical to anchor or partially bury snags and other larger components of woody debris.

When mitigation requires a component of forest or scrub-shrub habitat, the design should include plans for a continuum of coarse woody debris, including snags (standing dead trees). This continuum should include a full range of sizes, including small twigs and brush, not merely larger logs, stumps, and snags. Woody debris also plays an important role in vernal pool habitat by providing egg mass attachment sites in the pool basin and terrestrial refuges in the adjacent terrestrial habitat.

When a tree dies, it may continue to provide habitat for another century or longer. The speed of the recycling processes depends on many factors, but the main point is that coarse woody materials are relatively durable and remain as important ecological features both below- and above-ground for a long time. Long after the last needles or leaves fall to the forest floor, a tree persists, parceling itself out in bits and pieces.

In the first years, if a tree remains upright, the greatest volume of its litter may consist of bark, twigs, and small branches. Later, as insects and fungus weaken the aerial framework, larger limbs and sections of the trunk tumble to the ground where decay occurs under quite different conditions. On the forest floor, well-decomposed logs may sustain greater faunal richness. In an ideal situation, there is an uninterrupted supply of woody litter in various sizes and stages of decay providing a diverse range of habitats. Decomposition is one of the natural processes in a healthy forest. If one link of the chain is lacking, the process falters. Wetland builders should factor coarse woody debris into most habitat mitigation strategies.

Frequently the inclusion of scattered various sized boulders, as well as woody debris, is an appropriate method of increasing structure and habitat in a site. NOTE: if not properly screened by a wetland scientist, such debris can be a source of invasive species.

4.h. Erosion Controls

Cordoning off of an entire site with erosion controls is discouraged as it impedes animal movement. If circling of an entire site is needed, either gaps or overlaps with intervening space should be provided. Silt fences should be removed or cut to ground level when no longer needed.

5. Ecological Performance Standards

In consultation with the Corps, the applicant will develop clear and concise ecological performance standards to be used to assess whether the mitigation project is achieving its objectives. The standards must be based on attributes that are objective and verifiable.

Performance standards may be based on variables or measures of functional capacity, measurements of hydrology, vegetative diversity or physical characteristic (e.g., height, aerial cover, stem counts per specified area) or other aquatic resource characteristics. Another option is to provide comparisons to reference aquatic resources of similar type and landscape position. When practicable, they should take into account the expected stages of aquatic resource development.

6. Monitoring

A thorough monitoring plan is part of an adaptive management program that provides an early indication of potential problems and possible correction actions and is used to determine if the project is meeting its performance standards. Monitoring of aquatic resource structure, processes, and function from the onset of restoration, creation, or enhancement can indicate potential problems. Process monitoring (e.g., water-level fluctuations, sediment accretion and erosion, plant flowering, and bird nesting) is particularly important because it may identify the source of a problem and remedial measures, as well as identifying functional development. Monitoring and control of non-native species should be a part of any effective adaptive management program. Assessment of aquatic resource performance must be integrated with adaptive management. Both require understanding the processes that drive the structure and characteristics of a developing the desired aquatic resource. Simply documenting the structure (i.e., vegetation, sediments, fauna, and nutrients) will not provide the knowledge and guidance required to make adaptive “corrections” when adverse conditions are discovered. Although the full maturation of a compensatory aquatic resource may take many years or even decades, process-based monitoring facilitates adaptive management to insure that the mitigation site is developing along an appropriate trajectory.

Once the final mitigation plan is incorporated into the permit, the permit will require full implementation of the mitigation plan, including remedial measures, during the first five or more growing seasons (monitoring period) to ensure success. Typically, sites proposed to be emergent-only wetlands or submerged aquatic vegetation will be monitored for five years and sites proposed to be scrub-shrub and/or forested wetlands will be monitored for five to ten years (years 1, 2, 3, 5, 7, and 10 for the latter), as extended periods for monitoring will be appropriate in some cases. While formal monitoring and submission of reports may not be required every year, some remediation activities (e.g., invasive species control efforts) should continue.

Permit non-compliance can include:

- failure to implement the plan and/or remedial measures;
- failure to achieve the designed aquatic resource types (HGM and/or Cowardin for wetlands);
- failure to submit copies of financial assurances and/or preservation documents;
- failure to submit required monitoring reports, transmittal, and self-certification documents; and
- failure to submit the final assessment document.

If all or part of the mitigation is still deemed unsuccessful at the end of the monitoring period, or recognized during the monitoring period as unlikely to ever succeed, alternative mitigation must be developed to fully compensate for the authorized impacts.

Electronic submission of monitoring reports is strongly encouraged. Portable Document Format is preferred (e.g., Adobe PDF). When submitted in electronic format, there is no restriction for using standard paper sizes. These monitoring reports should be concise and effectively provide the information necessary to assess the status of the compensatory mitigation project. Large, bulky reports containing general information are contrary to national mitigation policy. The concise format for monitoring reports is included in Section IV: Directions for Completing Mitigation Plans, with Checklist. Additional monitoring guidance for specific habitat types is provided in several of the specific aquatic resource type modules.

7. Management

Site Protection

Management includes real estate instruments such as conservation easements (see I.3.h.) held by third parties, generally government agencies with a conservation mission or non-profit conservation organizations. If the site is on federal government land, long-term protection may be provided through federal facility management plans or integrated natural resources management plans. The third party shall have the right to enforce site protections. An endowment shall be provided for the third party to provide the resources needed to monitor the site and enforce the site protections.

The site protection document shall prohibit incompatible uses that would jeopardize the objectives of the mitigation project.

The document must also contain a provision requiring 60-day advance notification to the Corps before any action is taken to void or modify the instrument, including transfer of title to or establishment of other legal claims to the site(s).

Real estate instruments, management plans, or other long-term protection must be approved by the Corps in advance of, or concurrent with, the authorized impacts.

Adaptive Management

If the project cannot be constructed substantially in accordance with the approved mitigation plan, the permittee must notify the Corps and obtain written approval for changes.

Should a site not meet the ecological performance objectives of the project, the Corps will work with the permittee to determine appropriate measures to remedy the deficiencies. This may include site modifications, design changes, revisions to maintenance requirements, revised monitoring requirements, or use of a different site. Performance standards may be revised in accordance with adaptive management to account for measures taken to address deficiencies. They may also be revised to reflect changes in management strategies and objectives if the new standards provide ecological benefits that are comparable or superior to those originally approved. No other revisions to performance standards will be allowed except in the case of natural disasters.

Long-Term Management/Stewardship

Compensation sites are expected to mitigate impacts "in perpetuity." Since monitoring has a limited timeframe, a willing entity must be found to receive responsibility for the mitigation site(s) associated with a permit. That entity must have the resources and expertise in the long-term management and stewardship of mitigation properties. The final mitigation plan must identify the party responsible for long-term management of the project and should include a long-term management plan. This plan should include a description of long-term management needs (e.g., ATV problems, littering, encroachment, boat damage), the annual cost estimates to address them, and a funding mechanism to meet those needs.

To ensure the entity has adequate funding to do annual inspections, perform needed maintenance, and deal with problems, a financing mechanism (e.g., endowment, trust, or long-term financing plan for a public entity) should be provided. If an endowment is used, it should be sufficient that the needed stewardship activities can be covered by 3 to 4.5% of the principal. This should generally allow the principal to continue to grow and cover inflation. The long-term steward/manager and the particulars of the endowment should be included in the mitigation plan and may also be included as a special permit condition.

II. GUIDELINES FOR SPECIFIC RESOURCE TYPES

The majority of compensatory mitigation in New England is for impacts to non-tidal wetlands and much of this guidance reflects that. However, there are a variety of other types of aquatic resources which are impacted and for which compensatory mitigation is required. Below are some of the more common of these other aquatic resources and special concerns noted for developing compensatory mitigation for each.

1. Tidal Wetland Establishment:

Planting zones should be based on species requirements and a tidal datum. Each species must be planted at the appropriate elevation for that species and at the proper depth. Following grading, a survey shall be conducted to determine if supplemental backfill materials need to be placed to achieve required elevations for planting. If necessary, supplemental backfill shall be applied and then allowed to settle for a minimum of six tidal cycles prior to planting.

The potential for establishment of *Phragmites australis* is an important consideration in the design of tidal wetlands. Selected backfill material should be free of seed and vegetative propagules of *Phragmites*. For freshwater tidal wetlands, *Lythrum salicaria* may also be a species of concern.

The elevation of low marsh should be identified and considered in the design and should be provided in the plan. Low marsh plants should be planted between mean tide level and mean high water. High marsh plants should be planted between mean high water and spring high water. Salt hardened plants are most likely to survive. Plant storage on site should be kept short (less than 2 weeks). Planting densely (i.e., on 12 inch centers) will encourage the site to provide habitat and some water quality functions more quickly. A nitrogen-rich slow-release fertilizer may be added to each planting hole prior to closing. Salt marsh cordgrass (*Spartina alterniflora*) is shade intolerant, so it should not be planted in shady areas or, if a mitigation plan involves planting a riparian buffer, trees should not be planted within 20 feet of a salt marsh mitigation area. Additionally, salt marsh cordgrass is recommended to be planted on 18-inch centers, 2 culms per hole. Also, in areas with geese, a goose exclusion system is very important during the plant establishment period.

2. Vernal Pool Establishment:

Definitions:

Adjacent Terrestrial Habitat: Uplands and wetlands associated with vernal pools used by pool-breeding amphibians for migration, feeding, and hibernation. Typically, includes all land within 750 feet of the pool depression edge.

Breeding Season: The period of time during which amphibians begin migrating to pools to breed and lay eggs. For the purposes of this document, the breeding season also refers to the entire period of time necessary to complete the amphibian cycle from egg-laying through metamorphosis and emergence from the pool. The breeding season may vary regionally and annually, but generally begins between early to mid March (southern New England) and mid to late April (northern Maine). The breeding season ends when the pool dries in the summer months. It should be noted that, in areas with marbled salamander activity (a fall breeder), breeding season observations should also be made in the fall (September to October).

Facultative Species: Vertebrate and invertebrate species that frequently use vernal pools for all or a portion of their life cycle, but frequently successfully complete their life cycle in other types of wetlands and/or waters.

Hydroperiod: Timing and duration of seasonal inundation and drying in a typical year.

Indicator Species: Vertebrate and invertebrate species that depend upon vernal pool habitat for all or a portion of their life cycle. These species serve as direct indicators of the presence of a vernal pool. May also be referred to as obligate or vernal pool-dependent species.

Metamorph: Name for a young amphibian that has just completed, or is close to completing metamorphosis. Metamorphosis is the process of growth and development of an amphibian (or other animal) from an egg through larval stages to become an adult.

Pool depression edge: The maximum observed or recorded extent of inundation. May be determined by a distinct and clear topographic break at the edge of a pool or by evidence of high water marks or other physical data.

Reference pool: A minimally impaired vernal pool that is representative of the expected ecological conditions. Reference pools serve as a measuring stick to determine the health and integrity of other vernal pools.

Target Species: The target species is/are the species used to define the mitigation plan habitat goals. It may be appropriate to design different parts of the plan to address each target species' habitat requirements, for example multiple pools with different hydroperiods.

Documenting Impacted Vernal Pools: The seasonal timing and duration of inundation determines whether a pool will provide sufficient habitat for vernal pool-dependent species. Hydroperiod also influences predator composition and abundance. In order to determine appropriate compensation, detailed documentation of the hydroperiod for every pool which may be impacted either directly or indirectly should be provided.
Although the pool depression may contain limited or no woody vegetation, a surrounding intact forested canopy cover provides shading, leaf litter for nutrients, and woody debris for protection and egg attachment sites within the pool. Removing the shade of the tree canopy can heat up the air, soil, and water in the pool, change the period of time that water remains in the pool, and influence which species can survive there. Any impacts to the canopy cover should be considered impacts to the vernal pool and documented.

Mitigation Type: Created pools often fail to replicate vernal pool hydrology, and may lure breeding amphibians away from more appropriate breeding areas. Replacement of natural invertebrate communities is even more difficult. If loss is unavoidable, mitigation should focus on preservation of lands with existing natural vernal pool habitat (off-site or on-site), and restoration or enhancement of existing vernal pools and adjacent terrestrial habitat. Any creation projects will require a detailed adaptive management and contingency plan. All creation projects will also require the preservation of appropriate adjacent undeveloped terrestrial habitat.

Wildlife Habitat Function: There are a variety of species which are dependent on or utilize vernal pools as habitat for one or more critical life-cycle needs. For example, several species of amphibians are dependent on vernal pools to provide breeding habitat in order to ensure successful reproduction. The ability of a pool to adequately provide safe and productive breeding habitat is dependent on a number of physical and biological characteristics. Although in nature we often find vernal pool amphibians breeding successfully in pools lacking one or more of these features, it is not possible to accurately predict the circumstances under which apparently marginal habitat will effectively provide habitat needs. Therefore, a mitigation plan must aim towards providing vernal pool habitat under the most pristine conditions in order to offer the best opportunity to compensate for lost wildlife habitat functionality.

- The expected hydroperiod for each pool at the mitigation area must be specified. A mitigation plan which includes vernal pool creation should attempt to replicate the hydroperiod of the impacted pool(s) as closely as possible. Groundwater modelling, water budget calculations, and detailed soil descriptions should be used to demonstrate the ability of the site to provide the desired hydrology. If the mitigation plan includes vernal pool creation as part of a larger compensation package, multiple pools with a variety of hydroperiods should be constructed in order to provide the best chance of success. The hydroperiod should also be described for all pool(s) for which enhancement or restoration is proposed. Because hydroperiod can vary annually, multiple years of data should be provided if available.

- Fishless environment: Vernal pools provide breeding habitat for amphibians whose tadpoles and larvae are especially vulnerable to fish predation. Not all vernal pools go dry every year, but they generally have some feature that excludes fish such as annual drying, low oxygen concentrations in the summer, or shallow conditions that permit winter freezing to the pool bottom. Pools which are truly isolated, having no permanent inlet or outlet, are not susceptible to the establishment of a predatory fish population during ponding. Although there are pools in nature where fish and amphibians coexist, due to the presence of microtopographical barriers, mitigation plans should specify how the pool(s) will maintain a fish-free environment. Signage reminding people not to stock ponds with fish may also be required.

- Microtopography: Natural vernal pool depressions often have varied microtopography throughout the pool basin. The basin of many pools is extremely heterogeneous, offering varied moisture and temperature conditions including the development of hummock topography, hardwood leaf litter wells, sphagnum moss, and accumulations of woody debris. Creating pool bottoms with microtopography that will enhance plant distribution and invertebrate habitat will add to the functionality of the mitigation.

- Substrate: The substrate of a natural vernal pool bottom often consists of a thick layer of leaves and other decaying organic materials, which provides a valuable food source for vernal pool species. Mitigation projects involving the creation of vernal pools should consider the addition of such a natural substrate. Salvaging organic layers of lost pools may help "seal" the bottom and colonize the new pools with an invertebrate food base and seeds from native plants. However, be alert to the potential for transplanting invasive species.

- Canopy cover – mitigation: All pools at the mitigation site should have at least 75 percent canopy cover of trees in the area immediately adjacent to the pool (up to 100 feet from the pool edge). The remaining adjacent terrestrial habitat (up to 750 feet from the pool edge, should maintain at least 50 percent canopy cover. Enhancement and restoration projects should consider reforestation of areas without intact canopy; however, it important to realize that increases in woody vegetation immediately adjacent to the pool may alter the hydroperiod due to increased evapotranspiration.

- Adjacent terrestrial habitat: Habitat for many vernal pool species consists not only of the pool basin, but also of the adjacent terrestrial habitat. Because studies have shown that pool-breeding amphibians can migrate significant distances during the non-breeding season, all land within 750 feet of the pool depression edge should be considered part of the vernal pool habitat.

- In order to provide compensation for the wildlife habitat functions of an impacted vernal pool, adequate terrestrial habitat must be included in the compensation plan. At least 75 percent of the adjacent terrestrial habitat should be undeveloped. Appropriately designed and located tunnel crossings and drift fencing should be incorporated along any existing roads within this area to minimize deaths during amphibian migration. A complete mitigation package must include preservation of as much undeveloped adjacent terrestrial habitat as possible.

- Small mammal burrows: Research has shown that amphibians are dependent on small mammal burrows and other terrestrial refuges to prevent desiccation during migration. Documentation of the existence of small mammal populations in the adjacent terrestrial habitat will add to the value of a mitigation plan.

- Clusters of pools: Clusters of vernal pools that vary in size, hydroperiod, and spatial proximity, provide each resident species with a variety of potential breeding sites and allow adults to seek out high quality habitat with low densities of predators. Protecting existing clusters is encouraged. If creation is proposed, developing a cluster is encouraged.

Location: Priority will be given to sites that historically supported vernal pools or have appropriate soil type and will be adequately buffered. Agricultural fields, clearcuts, pasture, and other lands lacking impermeable surfaces, but that have historically supported pools and can be reforested, are good options for mitigation, assuming that there is suitable adjacent habitat.

- Resident population: Existing resident population(s) of the target species may improve the likelihood that the mitigation pool(s) will be colonized. Mitigation sites should be surveyed for evidence of existing source populations and estimates of population size should be documented, if possible.

- Inoculation: Transplantation of vernal pool organisms from sites impacted by the construction project may be warranted. There is limited data on successful methodology for this process. It is important that any inoculation plan is well documented and monitored in order to further understanding on appropriate applications of this technique.

Monitoring: Investigators should be familiar with the various types of amphibian monitoring techniques that are available. Specific methods are appropriate for particular species and life stages but not for others. Previous studies of vernal pool establishment attempts have shown limited success in replication of lost habitat functionality. Past projects have also often failed to provide the kind of long-term monitoring data necessary to advance our understanding of successful methodologies for vernal pool establishment and restoration. All vernal pool mitigation plans must include systematic and documented monitoring for hydroperiod and presence of indicator species. Additional guidance documents on some of these methods are listed in the reference section.

- Hydroperiod: Depth, area, and duration of inundation must be recorded weekly throughout the entire monitoring period. Pool depth should be monitored in all constructed and reference pools using hydrology staff gauges or some other documented method. The date on which each pool floods and dries should be recorded annually. Pool hydrology should also be documented using hydrographs and photographs.

- Egg mass counts: Egg mass counts provide an index to population size for several indicator species, including wood frogs and spotted salamanders, and are required for all vernal pool mitigation projects. Egg mass counts should be conducted during daylight hours (not within 2.5 hours of sunrise or sunset) on sunny days. Observers should wear polarized sunglasses to reduce glare.

- Other aquatic survey techniques: Egg mass counts should be combined with larval sampling (such as larval dip-netting) to ensure that eggs are developing successfully. Other methods which may be incorporated into the monitoring plan, depending on the site requirements, include anuran call surveys, road surveys, walking transects, pitfall traps, and dip-netting. For example, anuran call surveys may be used to monitor predatory green frog populations. Dip-netting may be used to document establishment of invertebrate populations. All species observed should be documented including insect taxa and estimates of population size should be included when possible.

- Other: Monitoring plans should also include standard water quality measures (e.g., pH, conductivity, nitrogen, phosphorus, BOD, temperature, DOC), contaminant levels, plant species in and around the pool perimeter, and canopy closure. Presence of fish and other predators or invasive species should be documented.

Performance Standard Examples: Measures of success could include the following criteria:

1) Use of the pools by vernal pool indicator species.
2) Maintenance of viable populations of target amphibians.
3) Maintaining a fish-free environment.
4) Maintenance or establishment of closed canopy cover.
5) Hydroperiod replication within project-specific percentage of reference pool.
6) Availability and use of egg mass attachment sites.
7) Establishment of biological viability by comparing specific parameters **[specify]** of constructed pools with those of reference vernal pools from the same immediate areas.

Indicator species found in New England: Wood Frog (*Rana sylvatica)*, Spotted Salamander *(Ambystoma maculatum)*, Marbled Salamander *(A. opacum)*, Jefferson Salamander *(A. jeffersonianum)*, Blue-Spotted Salamander *(A. laterale)*, Spade-Foot Toad (*Scaphiopus holbrookii)*, and Fairy Shrimp (Order: Anostraca).

Facultative species found in New England: include Fingernail Clams, Caddis Flies, Four-Toed Salamander, Eastern Newt, Spring Peeper, American Toad, Green Frog, Gray Treefrog, Spotted Turtle, Blanding's Turtle, Wood Turtle, Painted Turtle, Snapping Turtle, Fowler's Toad.

Additional guidance on vernal pool conservation, restoration, and creation is included in an excerpt from Science and Conservation of Vernal Pools in Northeastern North America, which is posted on our website at: http://www.nae.usace.army.mil/reg/Science%20and%20Conservation%20of%20VPs%20-%20Chapter%2012.pdf .

3. Stream Restoration:
Guidance on developing stream restoration projects is available on our website, including:

- a national Stream Mitigation Compendium (http://www.nae.usace.army.mil/reg/PhysicalStreamAssessment.pdf),
- two documents developed for New Hampshire, (http://www.nae.usace.army.mil/reg/River%20Restoration%20and%20Fluvial%20Geomorphology.pdf and
- http://www.nae.usace.army.mil/reg/Guidelines%20for%20Naturalized%20River%20Channel%20Design%20and.pdf), and
- Natural Resources Conservation Service's Stream Restoration Design Handbook (http://www.nae.usace.army.mil/reg/nrrbs/MAIN-MENU.pdf).

For projects involving removal of dams, ideas for project goals and monitoring may be found in this document: http://www.gulfofmaine.org/streambarrierremoval/, with additional resources:

- http://www.bae.ncsu.edu/programs/extension/wqg/srp/pdfs/tullos.pdf
- http://www.greatlakeswiki.org/index.php/Stronach_Dam_removal_provides_model_for_monitoring
- http://tbabs.org/OWEB/MONITOR/docs/SmallDams/StatementofWork_SavageRapids.pdf
- http://h2o.enr.state.nc.us/ncwetlands/documents/DamRemovalGuidanceFinal061908.doc
- http://www.pc.ctc.edu/coe/pdfs/ERC/05Woodward2008.pdf

Details of each stream restoration are project-specific and should be discussed with the Corps at the earliest opportunity. Such projects include restoration of natural streams, removal of channelization, dam removal, and other such work. When doing stream restoration work or considering preservation of a riparian area, it is important to look at the whole stream system bandwidth, not merely the bank-to-bank area.

4. Submerged Aquatic Vegetation (SAV):

The majority of SAV projects in New England involve eelgrass (Zostera marina) and this guidance reflects that. For projects involving other species of SAV, this guidance may need to be modified.

Definitions:

Eelgrass enhancement: Restoring degraded FUNCTIONS of an existing eelgrass habitat. Degradation may result from infestation by herbivores, decreased water quality or a change in substrate composition. Restoration of previous natural functions but not acreage is sometimes called "rehabilitation." Eelgrass habitat enhancement does **not** result in a gain in vegetated aquatic resource acreage.

Eelgrass habitat creation: The transformation of subtidal habitat to eelgrass beds at a site where it did not previously exist, so far as is known. It is sometimes referred to as "establishment." Eelgrass bed creation results in a gain in vegetated aquatic resource acreage.

Eelgrass restoration: Returning a former eelgrass habitat area, which had been altered or disturbed to the extent that it was no longer functioning as eelgrass habitat, to viable eelgrass habitat. It is sometimes referred to as "re-establishment." Eelgrass restoration results in a gain in vegetated aquatic resource acreage.

Embayment: Portions of open water or marsh defined by natural topographical features such as points or islands, or by human structures such as dikes or channels. In the context of eelgrass mitigation, it is assumed that these semienclosed basins, due to their sheltered nature, provide a preferred growing environment for submerged aquatic vegetation (SAV).

Epiphyte (in the context of SAV): A plant or animal (e.g., macroalgae or colonial tunicates) that grows on the surface of another plant, usually for the purposes of physical support and exposure to currents that enhance nutrient exchange.

Long-term sustainability of conditions suitable for SAV is key to successful eelgrass mitigation. Success is largely a factor of the site selection, timing, and method used.

Low success rates in the past have been primarily attributed to poor site selection. Wherever possible, select sites where eelgrass previously existed and/or where potentially optimum environmental conditions for eelgrass currently exist. The environmental factors evaluated should include light attenuation, exposure and wave energy regimes, substrate quality, historical distribution, temperature, salinity, epiphyte presence, incidence of herbivory, near shore assessment, and some discussion of the likelihood of wasting disease.

A number of research efforts have been conducted to quantify and standardize the establishment and monitoring of eelgrass mitigation projects. The applicant is urged to consult one of the guidance documents to get practical knowledge for designing successful eelgrass mitigation projects. An example of a comprehensive and useful effort can be seen in the guidance documents promulgated by the Massachusetts Division of Marine Fisheries (Evans and Leschen 2010) http://www.mass.gov/dfwele/dmf/publications/tr_43.pdf .

There are a number of steps to initiating an eelgrass restoration project. These are:

- Find areas with optimum growth conditions using Eelgrass Site Selection (ESS) software and environmental criteria from previously chosen preliminary test sites
- Characterize the site using the ESS software
- Create a 100-meter buffer around existing beds to minimize impacts from mitigation work, provide the opportunity for the beds to expand naturally, and to simplify post-construction monitoring
- Choose a preferred mitigation site from among the candidate test sites
- Select a minimum of three vegetated reference sites
- Find a donor site (the preferred donor source would be shoots harvested from the impacted site)
- Harvest eelgrass shoots from donor site
- Replant shoots or, alternatively, broadcast seeds (reportedly this method has a low success rate in New England)
- Monitor establishment and success rate using appropriate indices at both the mitigation and all of the reference sites

Each of these steps is designed to maximize the probable success of the proposed area of eelgrass habitat. The logistics of harvesting shoots or collecting seeds, then transplanting or seeding mitigation areas must be carefully developed beforehand.

When planning eelgrass mitigation projects, it is vital to choose locations with optimum environmental conditions before the project is started. A number of test sites should be selected and subjected to rigorous evaluation before a final mitigation site is selected. To this end, eelgrass mitigation projects usually employ the ESS software, an example of which is described in Short, et al. (2002). This software uses long-term, tidally averaged environmental data to rate potential mitigation sites.

In order to have long-term sustainability, sites must be protected from degradation. Applicants should consider both current and expected future environmental conditions (including effects of any proposed manipulations) and evaluate long-term trends in water quality, sediment transport, maritime activities in the vicinity, locations of contributing water resources, and overall watershed functional goals before choosing a mitigation site. This is extremely critical in watersheds that are rapidly urbanizing; changing watershed development rates can modify runoff and nutrient loading profiles substantially, with associated changes in sediment transport, flooding frequency, and water quality. Water quality problems, such as increased nutrient loading and sedimentation, lead to degraded eelgrass habitat in the form of lower light attenuation, increased epiphytic growth on the eelgrass shoots and increased water column turbidity.

Water quality is critical. Every effort must be made to maintain or increase water quality long term. More importantly, applicants must plan for long-term survival by placing mitigation in areas that will not be severely impacted by clearly predictable water quality degradation factors. During the first few years while the designed eelgrass beds become established, they are susceptible to degraded water quality, herbivory, temperature extremes and physical disturbance. Buffers are particularly important to insure that changing conditions are ameliorated, especially in watersheds and embayments that have been, or are in the process of being, heavily developed. In addition, because eelgrass habitats are so dynamic, adequate buffers and unvegetated subtidal areas are vital to allowing for eelgrass beds to expand and/or decrease in size and function and migrate within the embayment, particularly in coastal areas under natural and/or man-made pressures.

Eelgrass planting methods can contribute greatly to potential success rates. Care should be taken to select a technique that is most likely to succeed in a particular location. A detailed discussion of planting methods (rhizomes, seedcasting, Transplanting Eelgrass Remotely with Frame Systems (TERFS) http://marine.unh.edu/jel/seagrass_ecology/communityeelgrassrestoration/commeelgrassrestor2002.pdf , etc.) along with proposed planting densities and grid arrays should be provided. Site bathymetry maps should also be included. Test plantings may be necessary to fully evaluate proposed site alternatives.

III. ADDITIONAL GUIDANCE FOR CORPS PROJECT MANAGERS

Information on the Mitigation Rule and New England District Guidance should be provided to applicants as early as possible.

Special Conditions

Four mitigation-related items must be in the permit special conditions for any permit requiring compensatory mitigation. They may be stated as four separate special conditions or combined into two or three conditions. The items include:

- identifying the specific mitigation proposed,
- referencing the mitigation plan,
- stating the ecologically-based performance standards, and
- stating the implications should the proposed mitigation fail.

Examples:

- Mitigation shall consist of the restoration of 3.3 acres of button-bush and alder shrub swamp and preservation of the 3.3 acres plus 5.2 acres of wetland and upland adjacent to this restoration area located off Kensington Road in Concord, Massachusetts.

- This work shall be performed in accordance with the attached mitigation plan entitled, "Lower Bonneville Road Mitigation Plan" and dated "6 May 2009."

- The performance standards for this project are: a) documented presence of wetland hydrology appropriate for forested wetlands (soil saturation to the surface a minimum of two consecutive weeks during the growing season with no extended inundation of greater than two weeks, other than by greater than 10 year storms, between 30 April and 1 November), b) 75% cover by native hydrophytes, including 50% aerial cover by native wetland tree species, including red maple, (*Acer rubrum*), green ash (*Fraxinus pennsylvanicus*), and yellow birch (*Betula alleghaniensis*), at least 75% of which are over 2 meters tall, c) documented usage of the site by forested wetland-dwelling reptiles, d) control of non-native species with less than 10% total areal coverage by the end of the monitoring period, and e) all slopes stabilized and any silt fencing removed no later than the end of the third growing season.

- Mitigation shall consist of the restoration of 0.6 acres of non-degraded eelgrass habitat in Scituate, Massachusetts. The performance standards for density can be assessed using quadrat sampling methods. Final estimates of shoot density should be at least equal to that of the original impacted eelgrass bed which is 15 stems/sq. meter.

- Your responsibility to complete the required compensatory mitigation as set forth in Special Condition X will not be considered fulfilled until you have demonstrated mitigation success and have received written verification from the U.S. Army Corps of Engineers. The term 'mitigation success' means success as defined in the mitigation plan this permit requires you to implement. Demonstration of success under this permit shall consist of meeting the performance standards listed in Special Condition X plus the required mitigation monitoring, corrective measures, submittal of mitigation monitoring reports, and a final wetland assessment. Should the mitigation not meet the performance standards in Special Condition X by the end of the monitoring period, you will be required to provide alternative compensation for the impacts authorized with this permit.

Financial Assurances

See 33 CFR 332.3(n) for requirements on financial assurances.

Original performance bonds, letters of credit, documentation of escrow accounts, insurance policies, etc. are now kept in the Resource Management (RM) safe in an envelope marked "REGULATORY" (see the RM Chief to access them). The Policy Analysis and Technical Support (PATS) Chief will also keep a file of copies and there should be a copy in the official project file.

Procedurally, if you have a project involving a financial assurance document, please provide the original (we will only get the original if we are the 'obligee') to the Chief, PATS Branch, to add it to the envelope in the RM safe. If you need to retrieve a document because the work is complete and the Corps has verified completion or satisfaction with the appropriate stage of work, contact the PATS chief.

These documents are very important and ORIGINALS SHOULD NEVER BE KEPT IN THE PERMIT FILE since eventually the file will be scanned and the original tossed.

IV. DIRECTIONS FOR COMPLETING MITIGATION PLAN (WITH CHECKLIST)

1. **Overall Mitigation Plan**
2. **Nontidal Wetland Module**
3. **Tidal Wetland Module**
4. **Vernal Pool Module**
5. **Submerged Aquatic Vegetation Module**
6. **Stream Module**

1. OVERALL MITIGATION PLAN CHECKLIST

Project: __
File No: __
City: _____
State: ____
Plan Title: ______
Plan Preparer: ________
Plan Date: ______
Corps Project Manager: ____

TABLE OF CONTENTS

A. General Information

1. [ ] Mitigation plan and documentation submitted as one complete package.
2. Site location:
   a. [ ] Locus map(s)
   b. [ ] Aerial photo(s)
   c. [ ] Latitude/Longitude of mitigation site(s) in decimal format.
   d. [ ] 8-digit Hydrologic Unit Code(s) for impact area(s) and mitigation area(s).

B. Impact area(s)

1. [ ] Wetland acreage at each impact site.
2. [ ] Cowardin classifications at each impact site.
3. [ ] HGM classifications at each impact site.
4. [ ] Other aquatic resources at each impact site.
   a. [ ] Vernal pools
   b. [ ] Streams
   c. [ ] Submerged Aquatic Vegetation

d. [ ] Mudflats

5. [ ] Describe both site specific and landscape level wetland and stream functions and values at each impact site.
6. [ ] Describe type and purpose of work at each impact site.
7. [ ] Relationship of impact area(s) to watershed or regional plans for the area discussed.

C. Mitigation area(s)

1. Background information
   a. [ ] Mitigation alternatives.
   b. [ ] Existing wildlife use.
   c. [ ] Existing soil.
   d. [ ] Existing vegetation.
   e. [ ] Surrounding land uses.
   f. [ ] USFWS and/or NOAA Clearance Letter or Biological Opinion.
   g. [ ] SHPO/THPO Cultural Resource Clearance Letter.
2. Mitigation proposed
   a. [ ] Wetland acreage proposed at each site.
   b. [ ] Cowardin classifications proposed at each site.
   c. [ ] HGM classifications proposed at each site.
   d. [ ] Other aquatic resources proposed at each site.
      i. [ ] Vernal pools
      ii. [ ] Streams
      iii. [ ] Submerged Aquatic Vegetation
      iv. [ ] Mudflats
   e. [ ] Site-specific and landscape-level functions and values proposed at each site.
   f. [ ] Target fish and/or wildlife species.
   g. [ ] Reference site(s).
   h. [ ] Design Constraints.
   i. [ ] Construction oversight.
   j. [ ] Project construction timing.
   k. [ ] Responsible parties for all aspects of project.
   l. [ ] Potential to attract waterfowl and other bird species that might pose a threat to aircraft?
3. Specific Aquatic Resource Checklist Information Appended
   a. [ ] Non-tidal wetlands
   b. [ ] Tidal wetlands
   c. [ ] Vernal pools
   d. [ ] Streams
   e. [ ] Submerged aquatic vegetation

D. Grading Plan

1. Plan View
   a. [ ] Existing and proposed grading plans.
   b. [ ] Microtopography

c. [ ] Scale is in the range of 1”=20’ to 1”=100’.
d. [ ] All items on the plan are legible. Electronic documents are encouraged (e.g., PDF); otherwise plans should be on 8 ½ x 11” sheets.
e. [ ] Plans have a bar scale.
f. [ ] The drawings show the access for maintenance and monitoring.

2. [ ] Representative cross-sections.
3. [ ] Other - Specific staff recommendations related to grading.

E. Erosion Controls

[ ] Erosion control removal deadline is included.

F. Invasive Species

[ ] Invasive Species Control Plan (ISCP) is included.
a. [ ] Risks – includes evaluation of the potential for unwanted species or varieties.
b. [ ] Constraints – regulatory or environmental factors affecting control strategies.
c. [ ] Addresses a scope commensurate with risk & constraints.

G. Off-Road Vehicle Use

1. [ ] No off-road vehicle use in immediate vicinity, or if so, control measures addressed.
2. [ ] Control plan, if appropriate.

H. Preservation

1. [ ] Adequate buffers.
2. [ ] Wetlands within subdivisions are protected along with appropriate buffers.
3. [ ] Required preservation language is included.
4. [ ] Plans of preservation area(s).
5. [ ] Form of legal means of preservation.
6. [ ] Documentation of acceptance by receiving agency (if applicable).

I. Monitoring

[ ] Appropriate monitoring is proposed and language included.
[ ] Project Overview Form will be included with each Annual Monitoring Report.
[ ] Transmittal and Self-Certification Form will be included with each Annual Monitoring Report.

J. Assessment

[ ] An appropriate final assessment is proposed and language included.

K. Contingency

[ ] Plan for dealing with unanticipated site conditions or changes.

L. Long-term Stewardship

[ ] Plan for long-term stewardship is included.

[ ] Documentation of acceptance by the receiving steward (if applicable).

M. Financial Assurances

[ ] Appropriate financial assurances in place:

a. [ ] Construction
b. [ ] Monitoring and remediation
c. [ ] Contingency
d. [ ] Long-term stewardship (endowment)

N. Other Comments

<u>OVERALL MITIGATION PLAN CHECKLIST DIRECTIONS</u>

A. General Information
B. Impact Area(s)
C. Mitigation Area(s)
D. Grading Plans
E. Erosion Controls
F. Invasive Species
G. Off-Road Vehicle Use
H. Preservation
I. Monitoring
J. Assessment
K. Contingency
L. Long Term Stewardship
M. Financial Assurances
N. Other Comments

All checklist items should be included in the mitigation plan or there should be an explanation as to why they are not appropriate. While most of these items will be needed for most mitigation plans, a few items included here will need to be modified for specific resource types (see following guidance).

After Corps review, items <u>not</u> marked with X (included), N/A (Not Applicable), or NONE should be addressed by the applicant, as well as any comments under any item.

The ➡ used throughout this document indicates text which should typically be included in the mitigation plan.

Many items on the checklist are self-explanatory. Those which require specific guidance or clarification are noted below. Basic project information as noted in the main portion of the checklist should be included in every mitigation plan. Information noted in specific resource modules should be submitted for any project which includes mitigation involving the specific resource(s), e.g., nontidal wetlands, vernal pools, SAV, etc.

A. GENERAL INFORMATION

1. To avoid confusion, all mitigation proposal materials should be submitted as a single package without extraneous information that is needed for the permit evaluation but is not pertinent to the mitigation itself. A complete mitigation plan is important so that it may be cited in the permit and be easily used for permit compliance.

2. a. Locus maps that show the location of the impact area and the location of mitigation sites – including preservation areas – are critical components of the plan. They should depict the geographic relationship between the impacted site(s) and the proposed mitigation site(s) and include a vicinity map of approximately 1 inch equals 2,000 feet. For sites where the relationship between the impacted site(s) and proposed mitigation site(s) is not clear at USGS quadrangle scale, an additional plan should be provided at an appropriate scale.

2.b. Aerial photographs, if available, should be included. There are several on-line sources available. Recent photographs are preferred.

2.c. Longitude and latitude of the mitigation site(s), including preservation areas, should be given in decimal format, rather than degrees and minutes or UTMs.

2.d. Watershed(s) must be identified using the USGS 8-digit Hydrologic Unit Code(s) for each impact and mitigation site (See Item A.2 on the Checklist), including preservation sites. One source of these codes is an EPA website at: **http://cfpub.epa.gov/surf/locate/index.cfm**.

B. IMPACT AREA(S)

Impact areas include both wetlands and waters. Most of the checklist items are self-explanatory but clarification is provided for stream information, functions and values assessment, and watershed plans.

2. Wetlands and/or waters at each impact site should be described using Cowardin, et al.[21]

3. Wetlands at each site should be described using the hydrogeomorphic[22] classification system.

4.a. Descriptions of the vernal pool(s) should include species use and approximate numbers of egg masses.

4.b. If any streams will be impacted, information needed includes length of stream to be impacted, nature of banks, normal seasonal flows, gradient, sinuosity, bed

[21] Cowardin, et. al. (1979) "Classification of wetlands and deepwater habitats of the United States," Office of Biological Services, FWS/OBS-79/31, December 1979. http://www.wbdg.org/ccb/ENVREG/habitat.pdf , http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm

[22] Brinson, M. M. (1993). "A hydrogeomorphic classification for wetlands," Technical Report WRP-DE-4 <http://www.wes.army.mil/el/wetlands/pdfs/wrpde4.pdf>, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A270 053.

load, lengths of riffles and pools, and adjacent landscape. Note that the Mitigation Rule references the need for mitigation of impacts to all aquatic resources.

4.c. Include information on variability and extent of bed size.

5. When performing functions and values assessments, simply stating "wildlife habitat" or "fishery habitat" is inadequate. Additional information needs to be provided. Provide indicator species for the habitat type such as forest-dwelling migratory birds or mole salamanders and/or woodfrogs for a vernal pool. The more specific the information, the more confidence the Corps will have in the evaluation.

7. Watershed and/or regional plans that describe aquatic resource objectives should be discussed if such plans are available for the impact area(s). If no such plans exist, this should be stated.

C. MITIGATION AREA(S)

1.a. Provide an explanation of sites and methodologies considered for mitigation activities and the rationale for selection or rejection. The Mitigation Rule discusses when use of a potential mitigation site is practicable, whether on-site or off-site mitigation is appropriate, and whether out-of-kind mitigation is appropriate instead of in-kind. In order to replace the impacted functions, in-kind mitigation is strongly preferred unless the impacted site is heavily degraded.

1.b. – e. Information on the selected site(s)'s existing wildlife usage, soils, vegetation, and surrounding land use are needed. **Wildlife usage** should include information on any probable state and federal threatened and endangered species habitat. Subsurface **soil conditions** have a critical role in mitigation design, whether the substrate is sand, loam, silt, clay, and/or bedrock. Therefore, soil profiles should be provided that extend down to at least two feet below the proposed new soil surface. Since much of New England has been and continues to be heavily developed, there is a potential for industrial and agricultural contaminants in the soil. Although contamination does not necessarily preclude the use of a site, testing that is commensurate with the risk may be needed. Describe the existing **vegetation** on the site including a list of species, dominant species, density, community types, and community structure. **Surrounding land use** should be described within at least 500 feet of the site(s) and include a discussion of likely future land uses. Include a discussion of how the site(s) plans fit into the watershed context and the proximity of the site to public and private protected lands.

1.f. USFWS and/or NOAA Clearance Letter or Biological Opinion is for the mitigation site(s) and necessary to ensure that threatened or endangered species will not be impacted by the mitigation. This is not necessarily addressed in those agencies' comments on the proposed project that requires the mitigation.

1.g. SHPO/THPO letters on the proposed project also may not address potential concerns at the mitigation site, so these must be provided for the mitigation site(s).

2.a. – d. Similar information is required for the mitigation area(s) as for the impacted area(s). Along with mitigation acreage at each site, the type of mitigation (i.e., creation, restoration, enhancement, preservation) should be identified. A single mitigation site may not be able to provide the full range of functions desired because some functions are incompatible. For example, some wildlife habitat may not be compatible with flood storage.

2.h. Frequently mitigation designs are constrained by the project itself, landscape features, or public issues that control or otherwise influence the design and/or monitoring and remediation of the mitigation area. Such constraints need to be explained in detail. If there are no constraints (rare), that should be stated in the plan.

2.i. To ensure that someone with expertise in the specific aquatic resource(s) being mitigated provides construction oversight for the mitigation project, the following language should be included in the narrative portion of the mitigation plan:

➡ A wetland scientist/coastal habitat scientist/stream scientist **[choose appropriate for project]** shall be on-site to monitor construction of the wetland mitigation area(s) to ensure compliance with the mitigation plan and to make adjustments when appropriate to meet mitigation goals.

2.j. Construction timing of the mitigation and the proposed wetland impacts affects temporal impacts. Therefore, the following language should be included in the narrative portion of the mitigation plan:

➡ Compensatory mitigation shall be initiated not later than 90 days after initiation of project construction and completed not later than one year after the permitted wetland impacts occur.

2.k. All parties responsible for the implementation, performance, and long-term management of the mitigation project are identified.

2.l. Wildlife can pose serious threats to aircraft and therefore mitigation sites near airports are of concern to the Federal Aviation Administration. Indicate how far the nearest airport is from the site. See Federal Aviation Administration Advisory Circular AC No: 150/5200-33B Hazardous Wildlife Attractants on or Near Airports, 8/28/2007:
http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/532dcafa8349a872862573540068c023/$FILE/150_5200_33b.pdf

For a search of nearby airports, see:

https://www.oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showCircleSearchAirportsForm

3. Identify what specific aquatic resource checklist information is included.

D. GRADING PLANS

1. a. Plan provides existing and proposed grading plans for mitigation area. Existing contours should be no greater than 2' intervals. Proposed contours should be to 1' intervals in the wetlands portion of the mitigation with spot elevations for intermediate elevations. All other areas should be shown at 2' contour intervals.

1.b. Where microtopographic variation is planned, the proposed maximum differences in elevation should be specified. The plan does not need to show the locations of each pit and mound as long as a typical cross-section and approximate number of pits and mounds is given for each zone.

1.d. Plans should be in black and white on 8 ½ x 11" sheets. Large format sheets are encouraged for clarity, but only as a supplement to the letter-sized sheets. Color reproductions of large format sheets should also be submitted in electronic form but should not be part of the formal plan as the color is lost during digitization of files.

1.f. The drawings should show the access for maintenance and monitoring.

2. Plan provides representative cross sections showing the existing and proposed grading plan, expected range of shallow groundwater table elevations or surface water level consistently expected. Cross-sections should include key features such as upland islands and pools. They should extend beyond the mitigation site into adjacent wetlands and uplands.

E. EROSION CONTROLS

The following language is included in the mitigation plan, either in the drawings or in the narrative portion of the plan:

➡ Temporary devices and structures to control erosion and sedimentation in and around mitigation sites shall be properly maintained at all times. The devices and structures shall be disassembled and properly disposed of as soon as the site is stable but no later than November 1, three full growing seasons after planting. Sediment collected by these devices will be removed and placed upland in a manner that prevents its erosion and transport to a waterway or wetland.

F. INVASIVE AND NON-NATIVE SPECIES

The mitigation plan should include an Invasive Species Control Plan (ISCP).

a. The discussion of risk should include an assessment of the potential for invasion of the wetland by Common reed (*Phragmites australis*), Purple loosestrife (*Lythrum salicaria*), Smooth and Common buckthorns (*Frangula alnus* and *Rhamnus cathartica*), Russian and Autumn olives (*Elaeagnus angustifolia* and *E. umbellata*), Multiflora rose (*Rosa multiflora*), Reed canary-grass (*Phalaris arundinacea*), Japanese knotweed (*Fallopia japonica*), or other identified problematic species specific to this project or site.

b. The plan should identify regulatory and ecological constraints that influence the design of any plan to control invasive plants and animals by biological, mechanical, or chemical measures. For example, if a state requires a permit for use of herbicide, this may constrain attempts to control an invasive plant species. If there are no constraints, this should be stated.

c. The plan should describe the strategy to control, or recognize and respond to, the degradation of the mitigation site by invasive or non-native plants, particularly those listed in F.a. above.

G. OFF-ROAD VEHICLE USE

If there is a potential for off-road vehicle access at the site, including snowmobile usage, the mitigation plan shall include a strategy to minimize impacts. Plans should illustrate locations of any necessary barriers placed at access points to the mitigation sites to prevent vehicles from damaging the sites.

H. PRESERVATION

1. Adequate buffers must be proposed to protect the ecological integrity of creation, restoration, and/or enhancement areas.

2. Wetlands within subdivisions, golf courses, etc. should generally be protected along with adequate buffers. This is part of the avoidance and minimization steps of mitigation, not part of compensation.

3. Preservation should be part of every mitigation package as preservation of a creation, restoration, or enhancement area, and buffer; the remaining unimpacted wetlands on-site as part of avoidance and minimization; as a stand-alone form of mitigation; or as any combination of these. Ideally the preservation document will be prepared, then reviewed and approved by the Corps prior to submission of the final mitigation plan and permit issuance. If this is not possible, the following language should be included in the plan[23]:

➡ Compensatory mitigation sites and on-site unimpacted wetlands (and buffers) to be set aside for conservation shall be protected in perpetuity from future development. Within 90 days of the date this permit is issued and prior to initiation of permitted work in aquatic resources, the permittee shall submit to the Corps of Engineers a draft of the conservation easement or deed restriction. Within 30 days of the date the Corps approves this draft document in writing, the permittee shall execute and record it with the Registry of Deeds for the Town of __________ and the State of _________. A copy of the executed and recorded document must then be sent to the Corps of Engineers within 120 days of the date the Corps approves it. The conservation easement or deed restriction shall enable the site or sites to be protected in perpetuity from any future development. For preservation as part of compensation, the conservation easement or deed restriction shall expressly allow for the creation, restoration, remediation and monitoring activities required by this permit on the site or sites. It shall prohibit all other filling, clearing and other disturbances (including vehicle access) on these sites except for activities explicitly authorized by the Corps of Engineers in these approved documents.

If it is possible to have the document prepared and approved prior to final mitigation plan submission and permit issuance, only the following needs to be included:

➡ Within 30 days of the date of permit issuance and prior to initiation of permitted work in aquatic resources, the permittee shall execute and record the preservation document with the Registry of Deeds for the Town of -__________ and the State of _________. A copy of the executed and recorded document must then be sent to the Corps of Engineers within 120 days of the date the Corps approves it.

4. Plans showing the location of all sites to be preserved are required. In addition to a locus, they must be sufficiently detailed to determine relationships to adjacent development and/or properties as these adjacent areas affect the long term sustainability of the site. In some cases it may be appropriate to have signs at the boundaries of the preservation area(s). The sign design should be noted in the documentation.

5. The form should be specified or a copy of the document(s) included.

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[23] Departments of Transportation, in particular, may need to have the timing requirements modified. This will be addressed on a case-by-case basis.

I. MONITORING

The following language, through performance standards (specific to the project), should be included in the narrative portion of the mitigation plan:

→ **MONITORING**

<u>Notification of Construction Completion</u>

Within 60 days of completing a mitigation project that includes restoration, creation, and/or enhancement, the applicant will submit a signed letter to the Corps, Policy Analysis and Technical Support Branch, specifying the date of completion of the mitigation work and the Corps permit number.

If mitigation construction is initiated in, or continues throughout the year, but is not completed by December 31 of any given year, the permittee will provide the Corps, Policy Analysis and Technical Support Branch, a letter providing the date mitigation work began and the work completed as of December 31. The letter will be sent no later than January 31 of the next year. The letter will include the Corps permit number.

<u>Monitoring Report Guidance</u>

For each of the first **[specify number]** full growing seasons following construction of the mitigation site(s), the site(s) will be monitored and annual monitoring reports submitted. Observations will occur at least two times during the growing season – in late spring/early summer and again in late summer/early fall. Each annual monitoring report, in the format provided in the New England District Compensatory Mitigation Guidance, will be submitted to the Corps, Regulatory Division, Policy Analysis and Technical Support Branch, no later than December 15 of the year being monitored. Failure to perform the monitoring and submit monitoring reports constitutes permit non-compliance. A self-certification form[24] will be completed and signed as the transmittal coversheet for each annual monitoring report and will indicate the permit number and the report number (Monitoring Report 1 of 5, for example). The reports will address the following performance standards in the summary data section and will address the additional items noted in the monitoring report requirements, in the appropriate section. The reports will also include the monitoring-report appendices. The first year of monitoring will be the first year that the site has been through a full growing season after completion of construction and planting. For these permit special conditions, a growing season starts no later than May 31. However, if there are problems that need to be addressed and if the measures to correct them require prior approval from the Corps, the permittee will contact the Corps by

[24] see Appendix E

phone (1-800-362-4367 in MA or 1-800-343-4789 in ME, VT, NH, CT, RI) or letter as soon as the need for corrective action is discovered.

Remedial measures will be implemented - at least two years prior to the completion of the monitoring period - to attain the success standards described below within **[specify number]** growing seasons after completion of construction of the mitigation site(s). Should measures be required within two years of the end of the original monitoring period, the monitoring period will be extended to ensure two years of monitoring after the remedial work is completed. Measures requiring earth movement or changes in hydrology will not be implemented without written approval from the Corps.

At least one reference site adjacent to or near each mitigation site will be described and shown on a locus map.

Performance Standards

[Specific performance standards for the project should be included here. See list of examples below.]

Performance Standard Examples

1) The site has the necessary depth of hydrology, as demonstrated with well data collected at least weekly from March through June or other substantial evidence, to support the designed wetland type as compared to the reference wetland. Minimum of 90% of the site must meet desired hydrology levels. Areas that are too wet or too dry (i.e., seasonal high water tables are more than 3" above or below target levels) should be identified along with suggested corrective measures.

2) Target hydroperiod **[specify]** must be met, within two weeks at beginning and end of season (as long as minimum hydrology technical standard is met).

3) The proposed vegetation diversity and/or density goals for woody plants from the plan are met.

Unless otherwise specified in the mitigation plans, this should be at least 500 trees and shrubs per acre, of which at least 350 per acre are trees for proposed forested cover types, that are healthy and vigorous and are at least 18" tall in 75% of each planned woody zone AND at least the following number of non-exotic species including planted and volunteer species. Volunteer species should support functions consistent with the design goals. To count a species, it should be well represented on the site (e.g., at least 50 individuals of that species per acre).

# species planted	minimum # species required (volunteer and planted)
2	2
3	3
4	3
5	4
6	4
7	5
8	5
9 or more	6

Vegetative zones consist of areas proposed for various types of wetlands (shrub swamp, forested swamp, etc.). The performance standards for density can be assessed using either total inventory or quadrat sampling methods, depending upon the size and complexity of the site.

4) a. Each mitigation site shall have at least 95% areal cover, excluding planned open water areas or planned bare soil areas (such as for turtle nesting), by native species (See Appendix D).

b. Planned emergent areas on each mitigation site shall have at least 80% cover by non-invasive hydrophytes.

c. Planned scrub-shrub and forested cover types shall have at least 60% cover by non-invasive hydrophytes, including at least 15% cover by woody species.

For the purpose of this performance standard, invasive species of hydrophytes are:

Cattails -- *Typha latifolia, Typha angustifolia, Typha glauca*;
Common Reed -- *Phragmites australis*;
Purple Loosestrife -- *Lythrum salicaria*;
Reed Canary Grass -- *Phalaris arundinacea*; and
Glossy Buckthorn – *Frangula alnus* (= *Rhamnus frangula*).
[Other species determined case-by-case]

5) Until canopy coverage exceeds 30%, the average height of all woody stems of tree species including volunteers in each site, must increase by not less than an average of 10% per year by the fifth (Year 5 following construction) and tenth (Year 10 following construction) monitoring years.

6) The fifth year (Year 5) and tenth year (Year 10) monitoring reports shall contain documentation that all vegetation within the buffer areas is healthy and thriving and the average tree height of all established and surviving trees is at least 5 feet in height.

7) There is evidence of expected natural colonization as documented by the presence of at least 100 volunteer native trees and/or shrubs at least 3 feet in height per acre.

8) The following plants are being controlled at the site:

- Common reed (*Phragmites australis*)
- Purple loosestrife (*Lythrum salicaria*)
- Smooth and Common buckthorns (*Frangula alnus*, *Rhamnus cathartica*)
- Russian and Autumn olives (*Elaeagnus angustifolia* and *E. umbellata*)
- Multiflora rose (*Rosa multiflora*)
- Reed canary-grass (*Phalaris arundinacea*)
- Japanese knotweed (*Fallopia japonica*)
- [other species identified as a problem at the site]

For this standard, small patches must be eliminated during the entire monitoring period. Large patches must be aggressively treated and the treatment documented.

9) Site will have documented use by breeding populations of target species: **[insert species]**

10) Site will have documented use by target wildlife species: **[insert species]**

11) Site will have documented use by target macroinvertebrate species: **[insert species]**

12) Soil pH will be within target range of 6.2 – 6.8 for the site.

13) Soil has documented evidence of redoxymorphic features developing by the third year (Year 3) after construction.

14) All slopes, soils, substrates, and constructed features within and adjacent to the mitigation site(s) are stable.

Monitoring Report Requirements

Monitoring reports should generally follow a 10-page maximum report format per site, with a self-certification form transmittal[25]. Submission of electronic formats (e.g., pdf) is strongly encouraged. The information required should be framed within the following format.

[25] see Appendix E

1) Project Overview[26] (1 page)

   Highlighted summary of problems which need immediate attention (e.g., problem with hydrology, severe invasive species problem, serious erosion, major losses from herbivory, etc.). This should be at the beginning of the report and highlighted in the self-certification form and the project overview (Appendices E and F).

2) Requirements (1 page)

   List all mitigation-related requirements as specified in the approved mitigation plan and special conditions of the permit including: the monitoring and performance and/or success standards, required financial assurances, required preservation, etc., and note whether required documents have been provided and evaluate whether the compensatory mitigation project site is successfully achieving the approved performance and/or success standards or trending toward success.

3) Summary Data (maximum of 4 pages)

   Summary data must be provided to substantiate the success and/or potential challenges associated with the compensatory mitigation project. Photo documentation should be provided to support the findings and recommendations, and placed in the Appendix.

- Address performance standards achievement and/or measures to attain the standards.

- Describe the monitoring inspections, and provide their dates, that occurred since the last report.

- Soils data, commensurate with the requirements of the soils portion of the Corps Wetlands Delineation Manual (Technical Report Y-87-1 and approved regional supplements) New England District data form, should be collected after construction and every alternate year throughout the monitoring period. If monitoring wells or gauges were installed as part of the project, this hydrology data should be submitted annually.

- Concisely describe remedial actions done during the monitoring year to meet the performance or success standards – actions such as removing debris, replanting, controlling invasive plant species (with biological, herbicidal, or mechanical methods), regrading the site, applying additional

[26] see Appendix F

topsoil or soil amendments, adjusting site hydrology, etc. Also describe any other remedial actions done at each site.

- Report the status of all erosion control measures on the compensation site(s). Are they in place and functioning? If temporary measures are no longer needed, have they been removed?

- Give visual estimates of (1) percent vegetative cover for each mitigation site and (2) percent cover of the invasive species listed under Success Standard No. 3, above, in each mitigation site.

- What fish and wildlife use the site(s) and what do they use it for (nesting, feeding, shelter, etc.)?

- By species planted, describe the general health and vigor of the surviving plants, the prognosis for their future survival, and a diagnosis of the cause(s) of morbidity or mortality.

4) Maps/Plans (maximum of 3 pages)

Maps must be provided to show the location of the compensatory mitigation site relative to other landscape features, habitat types, locations of photographic reference points, transects, sampling data points, and/or other features pertinent to the mitigation plan. In addition, the submitted maps/plans must clearly delineate the mitigation site boundaries to assist in proper locations for subsequent site visits. Each map or diagram must fit on a standard 8 ½ x 11" piece of paper and include a legend, bar scale, and the location of any photos submitted for review.

5) Conclusions (1 page)

A general statement must be included describing the conditions of the compensatory mitigation project. If performance or success standards are not being met, a brief discussion of the difficulties and potential remedial actions proposed by the permittee, including a timetable, must be provided.

6) Monitoring Report Appendices

<u>Appendix A</u> -- An as-built plan showing topography to 1-foot contours, any inlet/outlet structures and the location and extent of the designed plant community types (e.g., shrub swamp). Within each community type the plan shall show the species planted—but it is not necessary to illustrate the precise location of each individual plant. There should also be a soil profile description and the actual measured organic content of the topsoil. This should be included

in the first monitoring report unless there is grading or soil modifications or additional plantings of different species in subsequent years.

Appendix B – A vegetative species list of volunteers in each plant community type. The volunteer species list should, at a minimum, include those that cover at least 5% of their vegetative layer.

Appendix C -- Representative photos of each mitigation site taken from the same locations for each monitoring event. Photos should be dated and clearly labelled with the direction from which the photo was taken. The photo sites must also be identified on the appropriate maps.

J. ASSESSMENT

The following language (the remainder of item J.) should be included in the narrative portion of the mitigation plan:

➡ **ASSESSMENT**

A post-construction assessment of the condition of the mitigation site(s) shall be performed following the fifth growing season (Year 5) after completion of the mitigation site(s) construction, or by the end of the monitoring period, whichever is later. "Growing season" in this context begins no later than May 31st. To ensure objectivity, the person(s) who prepared the annual monitoring reports shall not perform this assessment without written approval from the Corps. The assessment report shall be submitted to the Corps by December 15 of the year the assessment is conducted; this will coincide with the year of the final monitoring report, so it is acceptable to include both the final monitoring report and assessment in the same document.

The post-construction assessment shall include the four assessment appendices listed below and shall:

- Summarize the original or modified mitigation goals and discuss the level of attainment of these goals at each mitigation site.
- Describe significant problems and solutions during construction and maintenance (monitoring) of the mitigation site(s).
- Identify agency procedures or policies that encumbered implementation of the mitigation plan. Specifically note procedures or policies that contributed to less success or less effectiveness than anticipated in the mitigation plan.

- Recommend measures to improve the efficiency, reduce the cost, or improve the effectiveness of similar projects in the future.

ASSESSMENT APPENDICES:

Appendix A -- Summary of the results of a functions and values assessment of the mitigation site(s), using the same methodology used to determine the functions and values of the impacted wetlands.

Appendix B -- Calculation of the area by type (e.g., wetlands, vernal pools) of aquatic resources in each mitigation site. Wetlands should be identified and delineated using the Corps Wetlands Delineation Manual and approved regional supplements. Supporting documents shall include (1) a scaled drawing showing the aquatic resource boundaries and representative data plots and (2) datasheets for the corresponding data plots.

Appendix C -- Comparison of the area and extent of delineated constructed aquatic resources (from Appendix B) with the area and extent of created aquatic resources proposed in the mitigation plan. This comparison shall be made on a scaled drawing or as an overlay on the as-built plan. This plan shall also show any major vegetation community types.

Appendix D -- Photos of each mitigation site taken from the same locations as the monitoring photos.

K. CONTINGENCY

Describe the procedures to be followed should unforeseen site conditions or circumstances prevent the site from developing as intended. Examples of such situations include but are not limited to, unanticipated beaver activity, disruption of the groundwater by blasting or other construction in the vicinity, unexpected subgrade texture, unearthing an unexpected archaeological site, and encountering hazardous waste.

L. LONG TERM STEWARDSHIP

Appropriate provisions must be made to support the mitigation site in perpetuity. The owner of the site or the holder of a conservation easement will be responsible for ensuring the mitigation site(s) is in compliance with the permit in perpetuity.

M. FINANCIAL ASSURANCES

In accordance with national guidance, financial assurances will be required when the Corps determines it is appropriate to ensure successful implementation of the mitigation[27], to include mitigation construction and monitoring, including remedial actions, and a long-term stewardship endowment. Assurances for construction and monitoring will include most projects where the mitigation work is not accomplished in its entirety prior to the permitted impacts to aquatic resources.

The text to use when such assurances are required is:

➡ The permittee will post a performance bond for $______ for construction of the wetland mitigation, monitoring, and potential remedial action as determined by the Corps of Engineers. This figure was based on the attached worksheet of construction and monitoring costs, plus a specified inflation factor, plus a 10% contingency. The bond shall be in the form of a firm commitment, supported by corporate sureties whose names appear on the list contained in Treasury Department Circular 570. The bond must be in place at all times the construction is underway and during the entire monitoring period, including any extensions required by the Corps of Engineers to ensure permit compliance. Permitted impacts to aquatic resources will not occur until the Corps has approved the bond format, the bond has been executed, and the original **[assumes the Corps is the obligee]** has been provided to the Corps.

Upon completion of construction and written concurrence from the Corps, the bond may be reduced to an amount that will cover the costs of monitoring and possible remedial actions.

Note that other forms of acceptable security may be possible such as an escrow account, postal money order, certified check, cashier's check, irrevocable letter of credit, or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. However, please discuss alternatives to performance bonds with the Corps prior to their use.

Treasury Department Circular 570 is published in the Federal Register, and may be obtained from the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch, 401 14th Street, NW, 2nd Floor, West Wing, Washington, DC 20227, or found at **http://www.fms.treas.gov/c570/index.html** .

N. OTHER COMMENTS

These will be provided by the Corps case-by-case.

[27] In the case of state agencies and other federal agencies which cannot provide bonds, letters of credit, or the like, this issue may be addressed by providing a copy of obligation language which includes funding for the mitigation construction, required number of years of monitoring (including providing reports to the Corps), and appropriate remedial actions..

2. NONTIDAL WETLAND MODULE CHECKLIST

I. Hydrology

1. [ ] Evidence of adequate hydrology to support the desired wetland.
2. [ ] Water source(s)

II. Topsoil

1. [ ] Proposed source of topsoil.
2. [ ] Twelve or more inches of natural or manmade topsoil in all wetland mitigation areas.
3. [ ] Appropriate organic content of topsoil.

III. Planting Plan

1. [ ] Plans use scientific names.
2. [ ] Plant materials are native and indigenous to the area of the site(s); invasive species, nonnative species, and/or cultivars are not proposed for planting or seeding.
3. [ ] Vegetation community types or zones are classified in accordance with Cowardin, et al. (1979) or other similar classification system.
4. [ ] Plan view drawings show proposed locations of planted stock.
5. [ ] More than 50% of the plantings in each zone are species that will become structural determinants for the community type designated for that zone.
6. [ ] Woody stock density is appropriate.
7. [ ] Herbaceous stock density is appropriate.
8. [ ] Seed mix composition is provided.
9. [ ] Representative cross section plans showing vegetative community zones.
10. [ ] Relocation of plantings allowed when appropriate.
11. [ ] Other - Specific staff recommendations related to planting.

IV. Coarse Woody Debris and Other Features

[ ] Appropriate amounts and range of decomposition of coarse woody debris are proposed.

NONTIDAL WETLANDS MODULE DIRECTIONS

I. HYDROLOGY

1. The expected seasonal depth, duration, and timing of both inundation and saturation should be described for each of the proposed habitat zones in the mitigation area (particularly related to root zone of the proposed plantings). If shallow monitoring wells are used to develop this rationale, the observations should be correlated to local soil morphologies, rooting depths, water marks or other local evidence of flooding, ponding, or saturation, and reflect rainfall conditions during monitoring.

2. Plan indicates if the water source is groundwater, surface runoff, precipitation, lake and/or stream overflow, tidal, and/or springs and seeps. Provide substantiation (e.g., well data, adjacent wetland conditions, stream gauge data, precipitation data).

II. TOPSOIL

1. Topsoil for mitigation sites can be a source of invasive species seeds. Provide information on the source and the likelihood that such seeds are in it.

2. Twelve or more inches of natural or manmade topsoil should be used in most wetland mitigation areas. Exceptions might be permanently or semi-permanently inundated or saturated areas and turtle nesting areas. Rationale for less than 12 inches should be provided.

3. Natural topsoil proposed to be used for the creation/restoration/ enhancement of wetlands consists of at least 4-12% organic carbon content (by weight) (or 9-21% organic matter content), **with the percentage specified**. Manmade topsoil used for the creation/restoration/enhancement of wetlands consists of a mixture of equal volumes of organic and mineral materials. This may be accomplished by adding a specific depth of organic material and disking it in to twice that depth. The actual measured organic content of the topsoil used should be provided in the as-built plan submitted with the first monitoring report. Manufactured soil may also have to be tested for contaminants.

III. PLANTING PLAN

1. The use of scientific names ensures that all involved have the correct understanding of the species of plants proposed to be planted or seeded.

2. During the first few years while the designed wetland vegetative zones become established, they are susceptible to colonization and subsequent domination by invasive species. A number of plants are known to be especially troublesome in this regard. The following stipulation shall be included in the mitigation plan, either in the plan view or in the narrative portion of the plan:

➡ To reduce the immediate threat and minimize the long-term potential of degradation, the species included on the "Invasive and Other Unacceptable Plant Species" list in Appendix D of the New England District Mitigation Plan Guidance shall not be included as planting stock in the overall project. Only plant materials native and indigenous to the region shall be used (with the exception of **[specify]**). Species not specified in the mitigation plan shall not be used without prior written approval from the Corps.

3. The Cowardin (1979) classification system is typically used to identify the plant communities proposed. If another system is used, an explanation of terms may be needed.

4. A plan view drawing should show where the various species are proposed to be planted. Since showing each individual plant is neither practical nor realistic, this may be illustrated with areas of uniform species composition and the number of plants or rate of seeding within the polygon. The scale should be in the range of 1"=20' to 1"=100', depending on the size of the site.

5. Although the prevailing hydrology will ultimately influence the type of wetland that will develop, plantings "jump start" the project. When determining species to plant, considerations should include the tendency of some species to volunteer promptly whereas others may take years to move into a site. Determine whether it is preferable to include rapidly establishing species to help prevent invasive species problems or to emphasize planting species unlikely to "volunteer" during the monitoring period.

6. Woody stock should be proposed to be planted in densities not less than 600 trees and shrubs per acre, including at least 400 trees per acre in forested cover types.

7. Where uniform coverage is anticipated, herbaceous stock should be proposed to be planted in densities not less than the equivalent of 3 feet on center for species which spread with underground rhizomes; 2 feet on center for species which form clumps.

8. The list of species proposed in seed mixes should not include any species in the list of invasives in Appendix D. Similarly, non-native genotypes and cultivars should not be used.

9. Cross-sectional drawings should include identification of vegetative community zones (e.g., forested, shrub swamp, etc.). This can be combined with the plans required for grading if they are not too complex.

10. The following stipulation shall be included in the mitigation plan, either in the drawings or in the narrative portion of the plan:

➡ During planting, a qualified wetland professional may relocate up to 50 percent of the plants in each community type if as-built site conditions would pose an unreasonable threat to the survival of plantings installed according to the mitigation plan. The plantings shall be relocated to locations with suitable hydrology and soils and where appropriate structural context with other plantings can be maintained.

IV. COARSE WOODY DEBRIS AND OTHER FEATURES

The following language is included in the mitigation plan, either in the drawings or in the narrative portion of the plan:

➡ A supply of dead and dying woody debris shall cover at least 4% of the ground throughout the mitigation sites after the completion of construction of the mitigation sites. These materials should not include species shown on the list of invasive species (Appendix D) in the New England District Mitigation Plan Guidance.

3. TIDAL WETLAND MODULE CHECKLIST

I. Hydrology

1. [ ] Evidence of adequate hydrology to support the desired wetland.
    a. [ ] elevation of mean high water (MHW).
    b. [ ] elevation of mean low water (MLW).
2. [ ] Salinity

II. Substrate

1. [ ] Proposed source of substrate supplements.
2. [ ] Organic content of substrate supplements (if necessary).

III. Planting Plan

1. [ ] Plans use scientific names.
2. [ ] Plant materials are native and indigenous to the area of the site(s); invasive species, nonnative species, and/or cultivars are not proposed for planting or seeding.
3. [ ] Vegetation community types or zones are classified in accordance with Cowardin, et al. (1979) or other similar classification system.
4. [ ] Plan view drawings show proposed locations of planted stock.
5. [ ] More than 50% of the plantings in each zone are appropriate for the community type designated for that zone.
6. [ ] Woody stock density is appropriate.
7. [ ] Herbaceous stock density is appropriate.
8. [ ] Seed mix composition is provided.
9. [ ] Representative cross section plans showing vegetative community zones in relation to MLW and MHW.
10. [ ] Relocation of plantings allowed when appropriate.
11. [ ] Other - Specific staff recommendations related to planting.

TIDAL WETLAND MODULE DIRECTIONS

I. Hydrology

1. The expected tidal cycle fluctuations in depth, duration, and timing of both inundation and saturation should be described for each of the proposed habitat zones in the mitigation area (particularly related to root zone of the proposed plantings). Note elevations of mean high water (MHW), mean low water (MLW), and the high tide line, as well as expected storm tide.

2. Salinity range is important for plant and animal species usage and survival.

II. Substrate

2. There is no recommended standard for substrate organic content, but it is recommended to match that of a nearby reference tidal wetland.

III. Planting plan

1. – 5. See III. 1. – 5. in Nontidal Wetlands Module.

6. This would only likely be for freshwater tidal systems unless the planting of a riparian zone is included in the tidal mitigation plan.

7. – 8. See III.7. – 8. in Nontidal Wetlands Module. Additionally, salt marsh cordgrass is recommended to be planted on 18-inch centers, 2 culms per hole.

9. Cross-sectional drawings should include identification of vegetative community zones (e.g., high marsh, low marsh, etc.). This can be combined with the plans required for grading if they are not too complex.

10. The following stipulation shall be included in the mitigation plan, either in the drawings or in the narrative portion of the plan:

➡ During planting, a qualified wetland professional may relocate up to 50 percent of the plants in each community type if as-built site conditions would pose an unreasonable threat to the survival of plantings installed according to the mitigation plan. The plantings shall be relocated to locations with suitable hydrology and soils and where appropriate structural context with other plantings can be maintained.

4. VERNAL POOL MODULE CHECKLIST

I. Hydrology

1. [ ] Documentation of hydroperiod of pools which will be impacted.
   a. [ ] Timing of seasonal cycle of inundation and drying.
   b. [ ] Duration of inundation and saturation.
2. [ ] Evidence that mitigation site can provide appropriate hydroperiod to support the desired vernal pool species.
   a. [ ] Documentation of water table and soils characteristics.
   b. [ ] Water source(s) and water budget calculation.

II. Target Species Considerations

1. [ ] Description of vernal pool species populations at impact site.
2. [ ] Evidence of resident population(s) of target species at mitigation site.
3. [ ] Animal transplantation plan is included (if appropriate).

III. Substrate and Physical Characteristics of the Basin

1. [ ] Description and plan drawings of basin shape, slope, depth, area.
2. [ ] Microtopography of pool bottom.
   a. [ ] Proposed source of material for confining layer (if needed).
   b. [ ] Leaves and other decaying organic materials for pool substrate.
3. [ ] Egg attachment sites and woody debris.

IV. Terrestrial Habitat and Landscape Level Characteristics

1. [ ] Description of landscape surrounding vernal pool.
   a. [ ] Percent developed and other barriers.
   b. [ ] Percent forested.
   c. [ ] Location(s) of and proximity to other vernal pools.
   d. [ ] Presence of small mammal burrows and other terrestrial refuges.
2. [ ] Preservation of adjacent terrestrial habitat.

V. Planting Plan

1. [ ] Plans use scientific names.
2. [ ] Plant materials are native and indigenous to the area of the site(s); invasive species, nonnative species, and/or cultivars are not proposed for planting or seeding.
3. [ ] Plan view drawings show proposed locations of planted stock.
4. [ ] Plantings for shading.
5. [ ] Plantings for egg mass attachment.
6. [ ] Seed mix composition is provided.
7. [ ] Other - Specific staff recommendations related to planting.

VI. Monitoring

1. [ ] The monitoring methodology is specified.
    a. [ ] Monitoring period.
    b. [ ] Timing of monitoring visits.
    c. [ ] Egg mass counts.
    d. [ ] Larval sampling (such as larval dip-netting).
    e. [ ] Hydroperiod
2. [ ] Appropriate language included.
3. [ ] Information on state/local vernal pool registration or certification program.

VII. Contingency

VERNAL POOL MODULE DIRECTIONS

I. HYDROLOGY

1. Provide documentation of the hydroperiod of all vernal pools which may be impacted, either directly or indirectly. Hydroperiod documentation must include both the temporal pattern of the inundation/drying cycle and the duration of inundation. Observations should be made and documented during at least one entire breeding season in advance of any construction activity. See definitions.

2. If vernal pool creation or restoration is included as part of the mitigation plan, provide evidence that adequate hydrology exists or will be provided to support the hydroperiod requirements of the target species. In the case of vernal pool enhancement or preservation, provide documentation of the hydroperiod of the existing pools.

2b. See I. 2 in Nontidal Wetlands Module. Water budget calculations (showing all sources of hydrologic inputs to and outputs from the system) should be provided to ensure that desired degree of seasonal drying will occur.

II. TARGET SPECIES CONSIDERATIONS

1. All wildlife observations (including, but not limited to, all vernal pool species) at the impact site(s) must be documented. This documentation should include, but not be limited to all observations of indicator species and facultative species, including those species for which only a single individual has been sighted. Estimates of population size for all observed species should be included when available.

2. The proposed mitigation site and adjacent land should be surveyed for evidence that there is an existing resident population of the target species.

3. Under certain circumstances, such as the absence of an existing resident population of target species, it may be appropriate to inoculate mitigation pools with egg masses from existing pools. A detailed plan must include the source and location of the inoculum, storage and transportation, timing of activity, and provisions to minimize disturbance to the remaining egg mass population.

III. SUBSTRATE AND PHYSICAL CHARACTERISTICS

1. Where vernal pools are to be created or restored, include detailed descriptions and plan drawings of the parameters: basin shape, slope, depth, and area.

2. Mitigation projects involving the creation or restoration of vernal pools should include detailed plans to create a heterogeneous pool bottom that resembles the microtopography of a reference pool.

2b. Appropriate amounts of leaf litter and other decaying organic materials are needed to provide adequate habitat in the pool(s). Source and location should be specified.

3. Appropriate amounts and range of decomposition of coarse woody debris are proposed for pool structure and egg mass attachment sites. Source and location should be specified.

IV. TERRESTRIAL HABITAT AND LANDSCAPE LEVEL CHARACTERISTICS

1. A detailed description of the adjacent terrestrial habitat must be included in the mitigation plan. When feasible, this description should encompass all land within 750 feet of the pool depression edge. A detailed description should include: the percentage of surrounding landscape which is already developed and the types of development; the percentage of the surrounding landscape which consists of intact forest canopy (both wetland and upland); location and proximity to other vernal pools; presence of existing physical barriers to movement.

1d. Adjacent terrestrial habitat should be surveyed for the presence of small mammal burrows and other terrestrial refuges which are often used by vernal pool amphibians to prevent desiccation during migration. Documented evidence that multiple such features exist in the surrounding landscape will enhance the value of the mitigation project.

2. An acceptable mitigation plan must include provisions for preservation (conservation easement) in perpetuity of adjacent terrestrial habitat. Most vernal pool mitigation projects will require preservation of all undeveloped land within 750' of the pool depression edge.

V. PLANTING PLAN

1. – 3. See III. 1. – 3. in Nontidal Wetlands Module.

4. Adequate shade is an important part of vernal pool habitat. Are there existing shade species that will remain? Are there proposed plantings to generate shade? Explain and describe.

5. There should be adequate places for attachment of egg masses from vernal pool species. Typically, these are the woody stems of shrubs or woody debris. Explain and describe proposed attachment provisions.

6. See III. 8. in Nontidal Wetlands Module.

VI. Monitoring

1. Monitoring methodology should be specified and described in detail. All monitoring protocols must include egg mass counts and larval sampling. Other acceptable methodologies include anuran call surveys, dip-netting, and nocturnal road surveys.

➡ **MONITORING**

Pool(s) is monitored for obligate and facultative vernal pool species weekly for four weeks from the beginning of the vernal pool activity in the spring (the actual date will vary throughout New England), then biweekly until the end of July or until the pool is dry, whichever comes first, for the entire monitoring period (minimum of 5 years). The period of monitoring is specified for each monitoring year. Data identify frog species, salamander genera, and the presence/absence of fairy shrimp. Macroinvertebrates can be identified to Order.

In addition, photographs of the pool(s) taken monthly during the pool monitoring period (March/April-July) from a set location(s) will be included. Photographs will include panoramas of surrounding habitat.

Other data required: pH and temperature of water at beginning and end of each monitoring cycle; pool depth at deepest point(s) (or state if >3') to nearest inch or centimeter; substrate of pool(s) (dead leaves, herbaceous vegetation, bare soil—organic or mineral, etc.); plant species noted in and around the perimeter of the pool(s).

If the state has a vernal pool register or certification program, the pool(s) is registered and/or certified prior to the final monitoring report submission.

5. SUBMERGED AQUATIC VEGETATION MODULE CHECKLIST

I. Hydrology

1. [ ] Evidence of appropriate hydrology to support the desired SAV.
   a. [ ] Depth at mean low water.
   b. [ ] Depth at mean high water.
2. [ ] Exposure and wave energy regimes.

II. Other Environmental Factors

1. [ ] Appropriate water quality.
   a. [ ] Light attenuation.
   b. [ ] Quantitative evaluation of nitrogen-loading regimes.
   c. [ ] Temperature.
   d. [ ] Salinity.
2. [ ] Epiphyte presence.
3. [ ] Incidence of herbivory.
4. [ ] Likelihood of wasting disease.
5. [ ] Adequate buffers and unvegetated subtidal areas (to allow for eelgrass beds to expand and/or decrease in size and function and migrate within the embayment).
6. [ ] Results from ESS software.

III. Plans

1. [ ] Planting.
2. [ ] Location of boat access.

IV. Environmental Conditions

1. [ ] Substrate material and quality.
2. [ ] Historical distribution of SAV.

V. Planting Plan

1. [ ] Plans use scientific names.
2. [ ] Planting methods.
3. [ ] Location of donor beds.
4. [ ] Planting densities and grid arrays.
5. [ ] Other - Specific staff recommendations related to planting.

VI. Monitoring

[ ] Appropriate monitoring language is included.

VII. Contingency

SUBMERGED AQUATIC VEGETATION MODULE DIRECTIONS

I. Hydrology

II. Other Environmental Factors

6. Use of Eelgrass Site Selection software is strongly recommended for all eelgrass mitigation and is required for mitigation projects over 0.25 acre in size. Results from the software, along with other environmental data should be submitted to the Corps for review and approval before the preliminary test sites are chosen.

III. Plans

1. A plan view drawing clearly delineating where the eelgrass is proposed to be planted. Since showing each individual plant is neither practical nor realistic, this may be illustrated with the number of plants or rate of seeding within the polygon. The scale should be in the range of 1”=20’ to 1”=100’, depending on the size of the site.

2. The drawings should show the boat access for maintenance and monitoring.

IV. Environmental Conditions

1. Substrate must be suitable for development and maintenance of SAV. The site has the environmental conditions, as demonstrated with data gleaned from archival sources or collected on site, to support the designed subtidal habitat.

2. Identify historical distribution of SAV in the project area.

V. Planting Plan

2. Whole-plant planting and/or seeding are generally appropriate for a mitigation site, as determined through consultation with the Corps. Several eelgrass planting methods have been developed over time (for more information, see http://www.csc.noaa.gov/coastal/expert/natreview/natreview06.htm). When any of the planting methods are used, planting techniques should employ a checkerboard pattern with the shoot density in each quadrat to be 50 per quarter-acre. Among those most commonly used are:

The **horizontal rhizome** technique is commonly employed to restore eelgrass habitat (Davis and Short, 1997). In this approach, rhizomes are harvested from a donor site. After harvesting the shoots, they are gathered into bundles of 50 and transported by cooler to the transplant site. Eelgrass shoots should be installed at a minimum of the initial density of the impacted bed. Two rhizomes are tied together so that their shoots are on opposite ends of the bundle. Then, the whole bundle is manually planted in the substrate by divers. The horizontal rhizome method is labor-intensive and works best when no more than four shoots are bundled together. A variety of this technique involves tying large bundles of shoots together and planting them all at once. Anecdotal evidence indicates favourable success rates employing this method (S. Tuxbury, personal communication).

Broadcasting of eelgrass seed in Chincoteague Bay has met with some success. Although the technique is much less labor-intensive, the sprouting seedlings are very sensitive to environmental conditions at the bottom as well as herbivory and bioturbation. Low overall success rates in New England were reported by Orth, et al., 2009 and Orth, et al., 2008. However, Leschen, et al., 2009 reported good success rates in Boston Harbor.

TERFS (or Transplanting Eelgrass Remotely with Frame Systems) is a rigid frame grid made of wire and bricks (Burdick and Short 2002). Two rhizomes are tied to each of the intersections of the grid with biodegradable material, and then the entire frame is deployed on the bottom. Frames should be planted 2-3 meters apart. The frame is then removed after approximately a month when the rhizomes have established themselves in the substrate. See this link for further information (http://marine.unh.edu/jel/seagrass_ecology/communityeelgrassrestoration/commeelgrassrestor2002.pdf).

3. Native planting stock from the immediate vicinity of the project is ideal. Whenever possible, plants should be salvaged from eelgrass beds destined for removal or impact from the original project. Other donor beds should be carefully chosen. Care must be taken not to cause negative impacts to the donor bed by harvesting. Overharvesting of donor beds can damage physical structure and encourage the invasion of green crabs into the mitigation site. For this reason donor beds not located in the impact area must be specified in the mitigation plan.

VI. Monitoring

The following language should be included in the narrative portion of the mitigation plan (this replaces the standard monitoring language in the Overall Mitigation Plan Guidance):

➡ **MONITORING**

Monitoring should begin one month after transplanting or seeding and again at semi-annual intervals and include:

1. Calculation of the percentage of planting units (clumps or horizontal rhizomes) that survived vs. the total planted.

2. Shoot density (# of shoots vs. baseline shoot density). Shoot density should be measured *in situ* within the 0.0625 m^2 quadrats for each planting grid and within the reference area.

3. Percent cover.

4. Canopy height (80% of the average of the tallest leaves).

5. Presence and number of reproductive shoots.

6. Areal extent of the bed (determined as the total area of continuous eelgrass and patches at the project site, excluding grass that is 100m away (Short, et al., 2006, Lockwood, et al., 1991). The extent of the bed can be mapped using a drop camera or divers recording GPS readings at several points along the edges of the continuous bed and at the last shoot (Short, et al., 2006 and Short, et al., 2001).

Performance Standards

[Specific performance standards for the project should be included here. See list of examples below.]

Performance Standard Examples

Estimating the success (or degradation) of eelgrass mitigation projects requires the evaluation of a number of habitat functions and productivity measures. These include estimates of shoot density, areal extent, epiphyte density, and water quality. Performance standards are project-specific, but some examples are included here, each of the criteria to be met within a minimum of five years for the project to be determined successful.

1) The mitigation site had at least 75% survival of shoots after one year.

2) Shoot densities are no less than 50% of the target densities in the first two growing seasons, followed by no less than 75% in the third, fourth, and fifth years of monitoring.

3) Unless otherwise specified in the mitigation plans, the plant/shoot density is no less than that observed at the impacted site. The density measurement is the greater of the impacted site and the reference site. This can be assessed using either total inventory or quadrat sampling methods, depending upon the size and complexity of the site.

4) Transplants demonstrate at least 25% expansion of areal coverage within 1 year of transplanting. After the first 3 years the parameters are on a trajectory approaching reference levels.

5) Chosen indicators of function (e.g., eelgrass biomass, density) in the transplanted and reference eelgrass beds are compared and a bench mark of success calculated from the reference site data as follows:

- Success Criteria (SC) =100*(mean of all reference sites – 1 standard deviation/mean of all reference sites).
- Measured indicators at the restoration and reference sites are then compared in the following equation:
- Success Ratio (SR) = 100*(mean of one restoration site/ mean of selected reference sites).

When the SR for a given indicator equals or exceeds the SC, the restoration is considered successful for that indicator.

Monitoring Report Requirements

Additional items for inclusion:

Project Overview

- Highlighted summary of problems which need immediate attention (e.g., problems with substrate characteristics, severe invasive species intrusion, serious erosion, major losses from herbivory, disease, etc.). This should be at the beginning of the report and highlighted in the project overview and in the self-certification form.

Requirements

- A copy of this permit's mitigation special conditions and summary of the mitigation goals.

Summary Data

- Address performance standards achievement and/or measures to attain the standards.

- Describe the monitoring inspections, and provide their dates, that occurred since the last report.

- Quantify tidal ranges, measured seasonally, in physical parameters of substrates.

- Quantify water clarity, nitrogen loading, and salinity.

- Presence of crab populations as well as the presence and density of epiphytes (quantified by percent leaf shoot cover) must be estimated.

- Concisely describe remedial actions done during the monitoring year to meet the performance standards – actions such as removing debris, replanting, controlling herbivores (with biological, herbicidal, or mechanical methods), deploying exclosures, adjusting site bathymetry, etc.

- Report the status of all disturbance barriers or other techniques for minimizing effects of bottom disturbance on the compensation site(s). Are they in place and functioning? If temporary measures are no longer needed, have they been removed?

- Give visual estimates of percent vegetative cover for each mitigation site using shoot densities collected in a quadrat sampling plan.

- What fish and wildlife use the site(s) and what do they use it for (nesting, feeding, shelter, etc.)?

- Describe the general health and vigor of the surviving plants, the prognosis for their future survival, and a diagnosis of the cause(s) of morbidity or mortality.

Conclusions

- What remedial measures are recommended to achieve or maintain achievement of the performance standards and otherwise improve the extent to which the mitigation site(s) replace the functions and values lost because of project impacts?

Monitoring Report Appendices

Appendix A – An as-built/as-planted plan showing bathymetry to 1-foot contours and the location and extent of the designed eelgrass beds. Within each community type, the plan shall show the species planted—but it is not necessary to illustrate the precise location of each individual plant. This document should be included in the first monitoring report and updated if there is grading or additional plantings required in subsequent years.

Appendix B – A percent cover of SAV by species. The volunteer species list should, at a minimum, include those that cover at least 5% of the cover.

Appendix C – Video documentation of each mitigation site and representative photos of transects from each mitigation site taken from the same locations for each monitoring event. This documentation will consist of video transect monitoring along fixed lines to be done during the peak growing season at a time to be the same each year. Photos should be dated and clearly labelled with the direction from which the photo was taken. The photo sites must also be identified on the appropriate maps. In addition, in-water surveys will be conducted that include shoot density, % cover, epiphyte % cover, crabs, and light extinction levels.

VII. Contingency

If the beds are not expanding at a desired rate, and success as measured by the performance standards is not met, then a contingency plan should be considered. Describe the procedures to be followed should unforeseen site conditions or circumstances prevent the site from developing as intended. Examples of such situations include ship wrecks, oil spills, weather conditions (drought, heat, etc.), bottom currents, etc.

Alternatives to creation of eelgrass habitat may only be considered as a last resort if the constructed beds fail and/or if no alternate appropriate site can be found (determined after consultation with the Corps). The Corps will have the final say as to whether an alternative shall be used by a permittee in part or in full to meet mitigation requirements. This will be evaluated each year after reviewing results of the monitoring report

There are a number of alternative compensatory mitigation types. These may include:

- Improvements in watershed development activities, such as establishing sediment input management plans.
- Improvement in marine-related technologies, such as alternative techniques to minimize bottom scouring in eelgrass beds.
- Improvement of sewage technologies, such as increasing efficiency of nutrient removal technologies in a sewage system or installing sewer lines to a non-sewered development adjacent to eelgrass habitat.
- Where state policies allow, contribution to an in lieu fee program, provided program funds of at least the amount of the payment are used for eelgrass mitigation.

In all cases except the fourth, these options are not preferred alternatives because of the inability to quantify their potential to enhance or create eelgrass habitat. For this reason, the Corps will require a larger mitigation ratio in these cases.

6. STREAM MODULE CHECKLIST

I. Hydrology

1. [ ] Evidence of appropriate hydrology to support the desired stream type.
   a. [ ] Watershed size.
   b. [ ] Design discharge.
2. [ ] Water source(s).

II. Structure

1. [ ] Planform geometry.
2. [ ] Channel form.
3. [ ] Sinuosity and length.
4. [ ] Floodplain.
5. [ ] Riffles and pools.

III. Riparian Planting Plan

1. [ ] Plans use scientific names.
2. [ ] Plant materials are native and indigenous to the area of the site(s); invasive species, nonnative species, and/or cultivars are not proposed for planting or seeding.
3. [ ] Vegetation community types or zones are classified in accordance with Cowardin, et al. (1979) or other similar classification system.
4. [ ] Plan view drawings show proposed locations of planted stock.
5. [ ] Seed mix composition is provided.
6. [ ] Representative cross section plans showing vegetative community zones.
7. [ ] Relocation of plantings allowed when appropriate.
8. [ ] Other - Specific staff recommendations related to planting.

STREAM MODULE DIRECTIONS

For projects involving removal of dams, ideas for project goals and monitoring may be found in this document: http://www.gulfofmaine.org/streambarrierremoval/.

I. Hydrology

Sources of water and documentation of availability should be provided.

II. Structure

Some of the relevant information includes planform geometry, channel form (e.g., typical channel cross sections), watershed size, design discharge, length, sinuosity, riffles/pools, and floodplain.

III. Riparian Planting Plan

1. – 4. See III. 1. – 4. in Nontidal Wetlands Module.

5. See III. 8. in Nontidal Wetlands Module.

6. See III. 9. in Nontidal Wetlands Module.

7. See III. 10. in Nontidal Wetlands Module.

APPENDIX A

REFERENCES

Ashby, Steven. “Approaches for the Mitigation of Water Quality Functions of Impacted Wetlands – A Review,” ERDC TN-WRAP-02-03 http://www.wes.army.mil/el/wrap/pdf/tnwrap02-3.pdf, U.S. Army Research and Development Center, Vicksburg, MS.

Brinson, M. M. (1993). "A hydrogeomorphic classification for wetlands," Technical Report WRP-DE-4. http://www.wes.army.mil/el/wetlands/pdfs/wrpde4.pdf, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A270 053.

Burdick, C. and F. Short. 2002. A new seagrass restoration method: TERFS. UNH pamphlet, sponsored by NOAA Restoration Center, University of New Hampshire, Durham.

Calhoun, A. J. K. and M.W. Klemens. 2002. Best development practices: conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No.5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, NY.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T LaRoe. (1979) “Classification of wetlands and deepwater habitats of the United States,” Office of Biological Services, FWS/OBS-79/31, December 1979. http://www.wbdg.org/ccb/ENVREG/habitat.pdf , http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm

Davis, R. C., and F. T. Short. 1997. Restoring eelgrass, *Zostera marina* L., habitat using a new transplanting technique: The horizontal rhizome method. Aquatic Botany 59:1-15.

Environmental Laboratory. (1987). “Corps of Engineers Wetlands Delineation Manual,” Technical Report Y-87-1, http://www.wes.army.mil/el/wetlands/pdfs/wlman87.pdf , U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Evans, T.E. and A. Leschen. 2010. Technical Guidelines for the Delineation, Restoration, and Monitoring of Eelgrass (*Zostera marina*) in Massachusetts Coastal Waters. TR-43. Mass. Division of Marine Fisheries, October 2010. http://www.mass.gov/dfwele/dmf/publications/tr_43.pdf

Evans, N.T. and F.T. Short. 2005. Functional trajectory models for assessment of transplant development of seagrass, *Zostera marina* L., beds in the Great Bay Estuary, NH, USA. Estuaries 28: 936–947.

Federal Aviation Administration Advisory Circular AC No: 150/5200-33B Hazardous Wildlife Attractants on or Near Airports, 8/28/2007 http://www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/532dcafa8349a872862573540068c023/$FILE/150_5200_33b.pdf

Fonseca, M. S., W. J. Kenworthy and G. W. Thayer. 1998. Guidelines for the conservation and restoration of seagrasses in the U. S. and adjacent waters. NOAA Coastal Ocean Program. Decision Analysis Series No. 12.

Grant, E.H.C., Jung, R.E., Nichols, J.D., and Hines, J.E. 2005b. Double-observer approach to estimating egg mass abundance of pool-breeding amphibians: Wetlands Ecology and Management, v. 13, p. 305–320.

Leschen, A.S., R.K. Kessler, and B.T. Estrella. 2009. Eelgrass Restoration Project: 5 Year Completion Report. Massachusetts Division of Marine Fisheries. http://www.mass.gov/dfwele/dmf/programsandprojects/hubline/hubline_5yr_eelgrass_restoration.pdf. Accessed 7/29/09.

Lockwood, J.C. 1991. Seagrass Survey Guidelines for New Jersey; Prepared for the New Jersey Interagency Seagrass Policy Committee. National Marine Fisheries Service, Habitat and Protected Species Division, Sandy Hook Laboratory, New Jersey.

Mehrhoff, L.J., J.A. Silander, Jr., S. A. Leicht and E. Mosher. 2003. IPANE: Invasive Plant Atlas of New England. Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, CT, USA. URL: http://invasives.eeb.uconn.edu/ipane/

Minkin, P. and R. Ladd. 2003. Success of Corps-Required Wetland Mitigation in New England. New England District Corps of Engineers, Concord, MA.

National Research Council. 2001. Compensating for Wetland Losses Under the Clean Water Act. National Academy Press. Washington, DC. 322 pp.

North American Amphibian Monitoring Program (NAAMP). 2002. http://www.mp2-pwrc.usgs.gov/naamp/

North American Amphibian Monitoring Program (NAAMP), Massachusetts Procedures and Protocols. 2007.

Paton, P. W. C., Timm B. and T. Tupper. 2003. Monitoring Pond-Breeding Amphibians: A Protocol for the Long-term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore. http://science.nature.nps.gov/im/monitor/protocols/caco_amphibians.pdf.

Sabol, B., D. Shafer, and E. Lord. 2005. Dredging effects on eelgrass (*Zostera marina*) distribution in a New England small boat harbour. U. S. Army Corps of Engineers. Engineer Research and Development Center ERDC/EL TR-05-8.

Short, F. T., D. M. Burdick, C. A. Short, R. C. Davis, and P. A. Morgan. 2000. Developing success criteria for restored eelgrass, salt marsh and mud flat habitats. *Ecological Engineering* 15:239–252.

Short, R. C., B. C. Kopp, C. A. Short and D. M. Burdick. 2002. Site selection model for optimal restoration of eelgrass (*Zostera marina* L). Marine ecology Progress Series 227:253-267.

Short, F. T., L. J. McKenzie, R. G. Coles, K. P. Vidler, and J. L. Gaeckle. 2006. SeagrassNet Manual for Scientific Monitoring of Seagrass Habitat. Worldwide edition. Durham, New Hampshire: University of New Hampshire. 75. p. www.seagrassnet.org

Sprecher, S. W. (2000). "Installing Monitoring Wells/Piezometers in Wetlands," ERDC TN-WRAP-00-02 http://el.erdc.usace.army.mil/wrap/pdf/tnwrap00-2.pdf , U.S. Army Research and Development Center, Vicksburg, MS.

Stephan, C. D. and T. E. Bigford. 1977. Atlantic Coastal Submerged Aquatic Vegetation. Atlantic States Marine Fisheries Commission, ASMFC Habitat Management Series No. 1.

Streever, W., and Perkins, E. (2000). "Importing plant stock for wetland restoration and creation: Maintaining genetic diversity and integrity," *WRAP Technical Notes Collection* (ERDC TN-WRAP-00-03), U.S. Army Engineer Research and Development Center, Vicksburg, MS. *www.wes.army.mil/el/wrap*

Treasury Department Circular 570.

U.S. Army Corps of Engineers, New England District. 1999. The Highway Methodology Workbook Supplement: wetland functions and values, a descriptive approach. http://www.nae.usace.army.mil/reg/hwsplmnt.pdf

U.S. Army Corps of Engineers. 2002. Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Regulatory Guidance Letter 02-02. http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/RGL2-02.pdf

U.S. Army Corps of Engineers, Norfolk District. 2004. Corps and Virginia Department of Environmental Quality Recommendations for Wetland Compensatory Mitigation: Including Site Design, Permit Conditions, Performance and Monitoring Criteria. http://www.nao.usace.army.mil/technical%20services/Regulatory%20branch/Guidance/Annotated_Corps-DEQ_Mit_7-04.pdf

U.S. Army Corps of Engineers. 2005. "Technical Standard for Water-Table Monitoring of Potential Wetland Sites," *WRAP Technical Notes Collection* (ERDC TN-WRAP-05-2), http://el.erdc.usace.army.mil/wrap/pdf/tnwrap05-2.pdf U.S. Army Engineer Research and Development Center, Vicksburg, MS.

U.S. Army Corps of Engineers. 2008. 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources, Final Rule, dated April 10, 2008 ("Mitigation Rule") http://www.usace.army.mil/CECW/Documents/cecwo/reg/materials/33cfr332.pdf**.**

U.S. Army Corps of Engineers. 2008. Minimum Monitoring Requirements for Compensatory Mitigation Projects Involving the Restoration, Establishment, and/or Enhancement of Aquatic Resources. Regulatory Guidance Letter 08-03. http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/rgl08_03.pdf .

U.S. Army Corps of Engineers. 2009. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region*, ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-09-19. Vicksburg, MS: U.S. Army Engineers Research and Development Center.

U.S. Department of Interior, Bureau of Reclamation. 2009. Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species. Technical Memorandum No. 86-68220-07-05. http://www.usbr.gov/pps/EquipmentInspectionandCleaningManual_Sept09.pdf

U.S. EPA. 2002. *Methods for Evaluating Wetland Condition: Using Amphibians in Bioassessments of Wetlands.* Office of Water, U.S. Environmental Protection Agency, Washington, DC. EPA-822-R-02-022.

Williams, S. 2007. Introduced species in seagrass ecosystems: status and concerns. Journal of Experimental Marine Biology and Ecology. 350: 89-110.

APPENDIX B

MITIGATION REPORT
SAMPLE SUMMARY OF PROPOSED MITIGATION

MITIGATION SITE	TYPE OF MITIGATION	SIZE
1	Wetland Enhancement (E), Restoration (R), and Creation (C)	E = 15,600 s.f. R = 49,560 s.f. C = 15,900 s.f.
2	Wetland Creation	42,100 s.f.
3	Wetland Preservation (note: sites 1 and 2 to be preserved as well)	13.5 acres
3	Upland Preservation	6.3 acres

APPENDIX C

MITIGATION REPORT
SAMPLE WETLAND IMPACT AREA FUNCTIONS-SERVICES SUMMARY

(Using the New England District's Highway Methodology Workbook Supplement, Wetland Functions and Values: a Descriptive Approach)
http://www.nae.usace.army.mil/reg/hwsplmnt.pdf

Wetland Impact Area #	Area (s.f.)	Wetland Type (Cowardin)	WETLAND FUNCTIONS AND VALUES												
			G W R / D	F F A	S & T R	N R & T	P E	S & S	F & S H	W L H	T & E	R E C	E D / S	U / H	V Q / A
1	31,350	PFO1/ PSS1B	X	X						P					X
2	14,190	PEM1/ PSS1B	X	P		X			X	X					
3	23,600	PFO1	X							P		X			
4	49,010	PSS1B	X	X		X				P					X
5	2,350	PEM1		X	X	X		P		X					

APPENDIX D

INVASIVE AND OTHER UNACCEPTABLE PLANT SPECIES[28]

a. Herbs:

Aegopodium podagraria	Goutweed or Bishop's weed
Aira caryophyllea	Silver hairgrass
Alliaria petiolata	Garlic mustard
Allium vineale	Field garlic
Ampelopsis brevipedunculata	Porcelain berry
Anthoxanthum odoratum	Sweet vernal grass
Anthriscus sylvestris	Chervil
Arctium minus	Common burdock
Arthraxon hispidus	Hairy joint grass
Asparagus officinalis	Asparagus
Barbarea vulgaris	Yellow rocket
Bassia scoparia (*Kochia scoparia*)	Summer cypress
Bromus tectorum	Drooping brome-grass
Butomus umbellatus	Flowering rush
Cabomba caroliniana	Fanwort
Callitriche stagnalis	Water-starwort
Calystegia sepium	Japanese bindweed
Cardamine impatiens	Bushy rock-cress
Cardamine pratensis	Cuckoo-flower
Carex kobomugi	Japanese sedge
Centaurea stoebe ssp. *micranthos* (*C. biebersteinii*)	Spotted knapweed
Chelidonium majus	Celandine
Cirsium arvense	Canada-thistle
Cirsium palustre	Marsh thistle
Commelina communis	Asiatic day-flower
Cynanchum louiseae (*Vincetoxicum nigrum*)	Black swallow-wort
Cynanchum rossicum (*Vincetoxicum rossicum*)	Black swallow-wort
Cyperus esculentus	Yellow nutsedge
Dactylis glomerata	Orchard-grass
Datura stramonium	Jimsonweed
Echinochloa crus-galli	Barnyard grass
Egeria densa	Giant waterweed
Eichhornia crassipes	Water hyacinth
Eleusine indica	Goosegrass
Elsholtzia ciliata	Elsholtzia

[28] Scientific names are those used primarily in National Wetland Plant List (http://wetland_plants.usace.army.mil/) and secondarily in USDA PLANTS database (http://plants.usda.gov/).

Elymus repens (*Elytrigia repens*)	Quack-grass
Epilobium hirsutum	Hairy willow-herb
Euphorbia cyparissias	Cypress spurge
Euphorbia esula	Leafy spurge
Fallopia baldschuanica (*Polygonum baldschuanicum*, *P. aubertii*)	Silver lace-vine
Fallopia japonica (*Polygonum cuspidatum*)	Japanese knotweed
Fallopia sachalinensis (*Polygonum sachalinense*)	Giant knotweed
Festuca trachyphylla (*F. ovina*, *F. brevipila*)	Sheep fescue
Ficaria verna (*Ranunculus ficaria*)	Lesser celandine
Froelichia gracilis	Slender snake cotton
Geranium ibericum	Nepalese crane's-bill
Geranium sibiricum	Siberian crane's-bill
Geranium thunbergii	Thunberg's geranium
Glaucium flavum	Sea- or horned poppy
Glechoma hederacea	Gill-over-the-ground
Glyceria maxima	Sweet reedgrass
Hemerocallis fulva	Tiger-lily
Heracleum mantegazzianum	Giant hogweed
Hesperis matronalis	Dame's rocket
Hydrilla verticillata	Hydrilla
Hydrocharis morsus-ranae	European frog-bit
Hylotelephium telephium (*Sedum telephium*)	Live-forever or Orpine
Hypericum perforatum	St. John's wort
Impatiens glandulifera	Ornamental jewelweed
Iris pseudacorus	Yellow iris
Lamium spp. (all)	Dead nettle
Lepidium latifolium	Tall pepperwort
Leptochloa panicea	Hair fescue
Lotus corniculatus	Birdsfoot trefoil
Luzula luzuloides	Oakforest woodrush
Lychnis flos-cuculi	Ragged robin
Lysimachia nummularia	Moneywort
Lysimachia vulgaris	Garden loosestrife
Lythrum salicaria	Purple loosestrife
Malva neglecta	Cheeses or common malva
Marsilea quadrifolia	Water shamrock or Eurasian water clover
Mentha arvensis	Field-mint
Microstegium vimineum	Japanese stilt-grass
Miscanthus sinensis	Eulalia
Myosotis scorpioides	True forget-me-not
Myosoton aquaticum	Giant chickweed
Myriophyllum aquaticum	Parrot feather
Myriophyllum heterophyllum	Variable water-milfoil

Myriophyllum spicatum	Eurasian water-milfoil
Najas minor	Lesser naiad
Nasturtium microphyllum (*Rorippa microphylla*)	One-row yellow cress
Nasturtium officionale (*Rorippa nasturtium-aquaticum*)	Watercress
Nymphoides peltata	Yellow floating heart
Onopordum acanthium	Scotch thistle
Ornithogalum umbellatum	Star of Bethlehem
Pastinaca sativa	Wild parsnip
Persicaria maculosa (*Polygonum persicaria*)	Lady's thumb
Persicaria perfoliata (*Polygonum perfoliatum*)	Mile-a-minute vine
Persicaria posumbu (*Polygonum caespitosum*)	Cespitose knotweed
Phalaris arundinacea	Reed canary-grass
Phragmites australis	Reed grass, Phragmites
Pistia stratiotes	Water lettuce
Poa compressa	Canada bluegrass
Poa pratensis	Kentucky bluegrass
Poa trivialis	Rough bluegrass
Potamogeton crispus	Curly pondweed
Puccinellia maritima (*P. americana*)	Seaside alkali-grass
Pueraria montana	Kudzu
Ranunculus repens	Creeping buttercup
Rorippa sylvestris	Creeping yellow cress
Rumex acetosella	Sheep-sorrel
Rumex obtusifolius	Bitter dock
Salvinia molesta	Salvinia
Securigera varia (*Coronilla varia*)	Crown vetch
Senecio jacobaea	Tansy ragwort
Setaria pumila (*S. lutescens, S. glauca*)	Yellow foxtail or yellow bristlegrass
Silphium perfoliatum	Cup plant
Solanum dulcamara	Bittersweet nightshade
Stellaria graminea	Common stitchwort
Tanacetum vulgare	Tansy
Thymus pulegioides	Wild thyme
Trapa natans	Water-chestnut
Tussilago farfara	Coltsfoot
Typha angustifolia	Narrow-leaved cattail
Typha latifolia[29]	Common or Broad-leaved cattail
Typha X glauca	Hybrid cattail
Valeriana officinalis	Garden heliotrope
Verbascum thapsus	Common mullein
Veronica beccabunga	European speedwell

[29] *Typha* spp. are native species which provide good water quality renovation and other functions/values. However, they are aggressive colonizers which, given the opportunity, will preclude establishment of other native species. They are included in this list as species not to be planted, not because they are undesirable in an established wetland, but to provide opportunities for other species to become established. It is likely they will eventually move in without human assistance.

Xanthium strumarium	Common cocklebur

b. Woody Plants:

Acer ginnala	Amur maple
Acer platanoides	Norway maple
Acer pseudoplatanus	Sycamore maple
Actinidia arguta	Kiwi vine
Ailanthus altissima	Tree-of-heaven
Alnus glutinosa	European alder
Amorpha fruticosa	False indigo
Berberis thunbergii	Japanese barberry
Berberis vulgaris	Common barberry
Catalpa speciosa	Western catalpa
Celastrus orbiculatus	Oriental bittersweet
Cytisus scoparius	Scotch broom
Elaeagnus angustifolia	Russian olive
Elaeagnus umbellata	Autumn olive
Euonymus alatus	Winged euonymus
Euonymus hederaceus (*E. fortunei*)	Climbing euonymus
Frangula alnus (*Rhamnus frangula*)	European buckthorn
Humulus japonicus	Japanese hops
Hypericum prolificum	Shrubby St. John's wort
Ligustrum obtusifolium	Japanese privet
Ligustrum ovalifolium	California privet
Ligustrum sinense	Chinese privet
Ligustrum vulgare	Common/hedge privet
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	Amur honeysuckle
Lonicera morrowii	Morrow's honeysuckle
Lonicera tatarica	Tatarian honeysuckle
Lonicera X bella	Morrow's X Tatarian honeysuckle
Lonicera xylosteum	European fly-honeysuckle
Morus alba	White mulberry
Paulownia tomentosa	Princess tree or empress tree
Phellodendron amurense (*P. japonicum*)	Corktree
Populus alba	Silver poplar
Rhamnus cathartica	Common buckthorn
Ribes rubrum (*R. sativum*)	Garden red currant
Robinia pseudoacacia	Black locust
Rosa multiflora	Multiflora rose
Rosa rugosa	Rugosa rose
Rubus phoenicolasius	Wineberry

Salix purpurea[30]	Basket or purple-osier willow
Sorbus aucuparia	European mountain-ash
Taxus cuspidata	Japanese yew
Ulmus pumila	Siberian elm
Wisteria floribunda	Wisteria

[30] This is not appropriate for use in wetland mitigation. In some circumstances it may be appropriate in stream bank stabilization.

APPENDIX E

MITIGATION REPORT
TRANSMITTAL AND SELF-CERTIFICATION

DEPARTMENT OF THE ARMY PERMIT NUMBER:
PROJECT TITLE:

PERMITTEE:
MAILING ADDRESS:

TELEPHONE:

AUTHORIZED AGENT:
MAILING ADDRESS:

TELEPHONE:

ATTACHED MITIGATION REPORT
TITLE:

PREPARERS:

DATE:

CERTIFICATION OF COMPLIANCE: I certify that the attached report is accurate and discloses that the mitigation required by the Department of the Army Permit **[is] [is not]** in full compliance with the terms and conditions of that permit.

CORRECTIVE ACTION: A need for corrective action **[is] [is not]** identified in the attached report.

CONSULTATION: I **[do] [do not]** request consultation with the Corps of Engineers to discuss a corrective strategy or permit modification.

CERTIFIED:____

(Signature of permittee) Date

APPENDIX F

MITIGATION REPORT
PROJECT OVERVIEW FORM

Corps Permit No.:
Mitigation Site Name(s):
Monitoring Report: __________ of _______
Name and Contact Information for Permittee and Agent:

Name of Party Responsible for Conducting the Monitoring:

Date(s) of Inspection(s):

Project Summary:

[include purpose of approved project, acreage and type of aquatic resources impacted, and mitigation acreage and type of aquatic resources authorized to compensate for the aquatic impacts]

Location of and Directions to Mitigation Site(s):

Start and Completion Dates for Mitigation:

Performance Standards **are**/**are not** being met:

[describe how]

Dates of Corrective or Maintenance Activities Conducted Since Last Report:

Recommendations for Additional Remedial Actions:

NWPL - National Wetland Plant List

US Army Corps of Engineers

Northcentral and Northeast
2016 Regional Wetland Plant List

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016.
***The National Wetland Plant List*: 2016 wetland ratings.**
Phytoneuron 2016-30: 1-17. Published 28 April 2016. ISSN 2153 733X

http://wetland-plants.usace.army.mil/

Chamaedaphne calyculata *(L.) Moench* (Leatherleaf) Photo: Jessie Harris

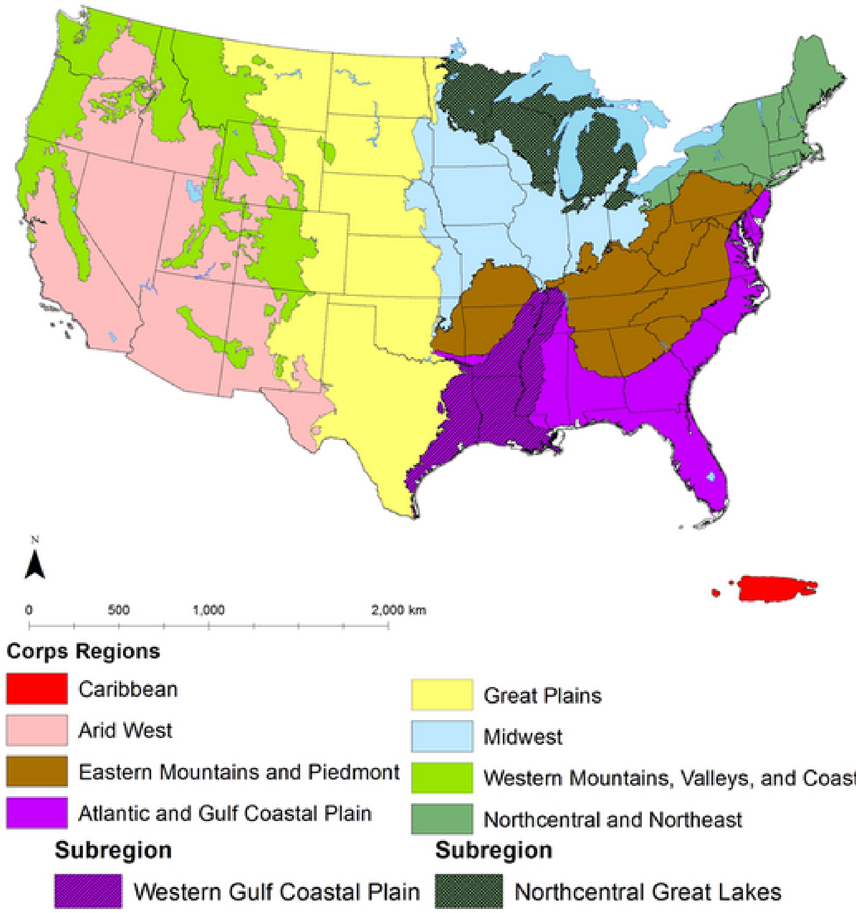
List Counts:

Wetland	NCNE
UPL	185
FACU	807
FAC	477
FACW	579
OBL	802
Rating	2850

User Notes:

1) Plant species not listed are considered UPL for wetland delineation purposes.
2) A few UPL species are listed because they are rated FACU or wetter in at least one Corps Region.

NORTHCENTRAL GREAT LAKES
2016 SUBREGIONAL WETLAND PLANT LIST



Scientific Name	Authorship	Subregion	NCNE	Common Name
Populus tremuloides	Michx.	**NGL = FAC**	**FACU**	Quaking Aspen
Rubus idaeus	L.	**NGL = FAC**	**FACU**	Common Red Raspberry

Scientific Name	Authorship	NCNE	Common Name
Abies balsamea	(L.) P. Mill.	FAC	Balsam Fir
Abies fraseri	(Pursh) Poir.	FACU	Fraser's Fir
Abutilon theophrasti	Medik.	FACU	Velvetleaf
Acalypha gracilens	Gray	FACU	Slender Three-Seed-Mercury
Acalypha poiretii	Spreng.	FACU	Poiret's Copperleaf
Acalypha rhomboidea	Raf.	FACU	Common Three-Seed-Mercury
Acalypha virginica	L.	FACU	Virginia Three-Seed-Mercury
Acer circinatum	Pursh	FAC	Vine Maple
Acer negundo	L.	FAC	Ash-Leaf Maple
Acer nigrum	Michx. f.	FACU	Black Maple
Acer pensylvanicum	L.	FACU	Striped Maple
Acer platanoides	L.	UPL	Norway Maple
Acer rubrum	L.	FAC	Red Maple
Acer saccharinum	L.	FACW	Silver Maple
Acer saccharum	Marsh.	FACU	Sugar Maple
Acer spicatum	Lam.	FACU	Mountain Maple
Achillea millefolium	L.	FACU	Common Yarrow
Achillea ptarmica	L.	FACU	Pearl Yarrow
Achnatherum hymenoides	(Roemer & J.A. Schultes) Barkworth	FACU	Indian Rice Grass
Acmispon americanus	(Nutt.) Rydb.	FACU	American Deerweed
Aconitum uncinatum	L.	FAC	Southern Blue Monkshood
Acorus americanus	(Raf.) Raf.	OBL	Several-Vein Sweetflag
Acorus calamus	L.	OBL	Single-Vein Sweetflag
Actaea pachypoda	Ell.	UPL	White Baneberry
Actaea rubra	(Ait.) Willd.	FACU	Red Baneberry
Adiantum aleuticum	(Rupr.) Paris	FACU	Aleutian Maidenhair
Adiantum pedatum	L.	FACU	Northern Maidenhair
Adoxa moschatellina	L.	FAC	Muskroot
Aegopodium podagraria	L.	FAC	Bishop's Goutweed
Aesculus flava	Ait.	FACU	Yellow Buckeye
Aesculus glabra	Willd.	FAC	Ohio Buckeye
Agalinis aspera	(Dougl. ex Benth.) Britt.	FACU	Tall False Foxglove
Agalinis fasciculata	(Ell.) Raf.	FAC	Beach False Foxglove
Agalinis maritima	(Raf.) Raf.	FACW	Saltmarsh False Foxglove
Agalinis paupercula	(Gray) Britt.	OBL	Small-Flower False Foxglove
Agalinis purpurea	(L.) Pennell	FACW	Purple False Foxglove
Agalinis skinneriana	(Wood) Britt.	FACU	Skinner's False Foxglove
Agalinis tenuifolia	(Vahl) Raf.	FACW	Slender-Leaf False Foxglove
Agarista populifolia	(Lam.) Judd	FACW	Florida-Hobblebush
Agastache nepetoides	(L.) Kuntze	FACU	Yellow Giant-Hyssop
Ageratina altissima	(L.) King & H.E. Robins.	FACU	White Snakeroot
Ageratum conyzoides	L.	FACU	Tropical Whiteweed
Ageratum houstonianum	P. Mill.	FACU	Bluemink
Agoseris glauca	(Pursh) Raf.	FACU	Pale Goat-Chicory
Agrimonia gryposepala	Wallr.	FACU	Tall Hairy Grooveburr
Agrimonia parviflora	Ait.	FAC	Harvestlice
Agrimonia rostellata	Wallr.	FACU	Beaked Grooveburr
Agrimonia striata	Michx.	FACU	Woodland Grooveburr
Agrostis canina	L.	UPL	Velvet Bent
Agrostis capillaris	L.	FAC	Colonial Bent
Agrostis elliottiana	J.A. Schultes	FACU	Elliott's Bent
Agrostis exarata	Trin.	FAC	Spiked Bent
Agrostis gigantea	Roth	FACW	Black Bent
Agrostis hyemalis	(Walt.) B.S.P.	FAC	Winter Bent
Agrostis mertensii	Trin.	FACU	Northern Bent
Agrostis pallens	Trin.	UPL	Seashore Bent
Agrostis perennans	(Walt.) Tuckerman	FACU	Upland Bent
Agrostis scabra	Willd.	FAC	Rough Bent
Agrostis stolonifera	L.	FACW	Spreading Bent
Ailanthus altissima	(P. Mill.) Swingle	UPL	Tree-of-Heaven
Aira caryophyllea	L.	UPL	Common Silver-Hair Grass
Aletris farinosa	L.	FAC	White Colicroot
Alisma gramineum	Lej.	OBL	Narrow-Leaf Water-Plantain
Alisma plantago-aquatica	L.	OBL	European Water-Plantain
Alisma subcordatum	Raf.	OBL	American Water-Plantain
Alisma triviale	Pursh	OBL	Northern Water-Plantain
Alliaria petiolata	(Bieb.) Cavara & Grande	FACU	Garlic-Mustard
Allium canadense	L.	FACU	Meadow Garlic
Allium cernuum	Roth	FACU	Nodding Onion
Allium schoenoprasum	L.	FACU	Wild Chives
Allium tricoccum	Ait.	FACU	Ramp
Allium vineale	L.	FACU	Crow Garlic
Alnus glutinosa	(L.) Gaertn.	FACW	European Alder
Alnus incana	(L.) Moench	FACW	Speckled Alder
Alnus serrulata	(Ait.) Willd.	OBL	Brookside Alder

2016 NWPL - National Wetland Plant List for Wetland Region = NCNE.

Scientific Name	Authorship	NCNE	Common Name
Alnus viridis	(Chaix) DC.	**FAC**	Sitka Alder
Alopecurus aequalis	Sobol.	**OBL**	Short-Awn Meadow-Foxtail
Alopecurus carolinianus	Walt.	**FACW**	Tufted Meadow-Foxtail
Alopecurus geniculatus	L.	**OBL**	Marsh Meadow-Foxtail
Alopecurus myosuroides	Huds.	**FACW**	Slender Meadow-Foxtail
Alopecurus pratensis	L.	**FAC**	Field Meadow-Foxtail
Althaea officinalis	L.	**FAC**	Common Marsh-Mallow
Amaranthus albus	L.	**FACU**	Tumbleweed
Amaranthus arenicola	I.M. Johnston	**FACU**	Sandhill Amaranth
Amaranthus blitoides	S. Wats.	**FACU**	Mat Amaranth
Amaranthus blitum	L.	**FACU**	Purple Amaranth
Amaranthus cannabinus	(L.) Sauer	**OBL**	Tidal-Marsh Amaranth
Amaranthus crassipes	Schlecht.	**FAC**	Spreading Amaranth
Amaranthus graecizans	L.	**FACU**	Italian-Spinach
Amaranthus palmeri	S. Wats.	**FACU**	Careless Weed
Amaranthus pumilus	Raf.	**FACW**	Seaside Amaranth
Amaranthus retroflexus	L.	**FACU**	Red-Root
Amaranthus spinosus	L.	**FACU**	Spiny Amaranth
Amaranthus tricolor	L.	**FACU**	Joseph's-Coat
Amaranthus tuberculatus	(Moq.) Sauer	**OBL**	Rough-Fruit Amaranth
Amaranthus viridis	L.	**FACU**	Slender Amaranth
Ambrosia artemisiifolia	L.	**FACU**	Annual Ragweed
Ambrosia psilostachya	DC.	**FAC**	Perennial Ragweed
Ambrosia trifida	L.	**FAC**	Great Ragweed
Amelanchier alnifolia	(Nutt.) Nutt. ex M. Roemer	**FACU**	Saskatoon Service-Berry
Amelanchier arborea	(Michx. f.) Fern.	**FACU**	Downy Service-Berry
Amelanchier bartramiana	(Tausch) M. Roemer	**FAC**	Oblong-Fruit Service-Berry
Amelanchier canadensis	(L.) Medik.	**FAC**	Canadian Service-Berry
Amelanchier intermedia	Spach	**FACW**	Intermediate Service-Berry
Amelanchier nantucketensis	Bickn.	**FACU**	Nantucket Service-Berry
Amelanchier spicata	(Lam.) K. Koch	**FACU**	Running Service-Berry
Amianthium muscitoxicum	(Walt.) Gray	**FAC**	Flypoison
Ammannia coccinea	Rottb.	**OBL**	Valley Redstem
Ammannia latifolia	L.	**OBL**	Pink Redstem
Ammannia robusta	Heer & Regel	**OBL**	Grand Redstem
Ammophila arenaria	(L.) Link	**FACU**	European Beach Grass
Ammophila breviligulata	Fern.	**UPL**	American Beach Grass
Amorpha fruticosa	L.	**FACW**	False Indigo-Bush
Amorpha nana	Nutt.	**FACU**	Fragrant Indigo-Bush
Ampelopsis arborea	(L.) Koehne	**FACW**	Peppervine
Ampelopsis cordata	Michx.	**FAC**	Heart-Leaf Peppervine
Amphicarpaea bracteata	(L.) Fern.	**FAC**	American Hog-Peanut
Amphicarpum amphicarpon	(Pursh) Nash	**FACW**	Blue Maiden-Cane
Amsinckia spectabilis	Fisch. & C.A. Mey.	**FACU**	Woolly-Breeches
Amsonia tabernaemontana	Walt.	**FACW**	Eastern Bluestar
Anaphalis margaritacea	(L.) Benth. & Hook. f.	**FACU**	Pearly-Everlasting
Andromeda polifolia	L.	**OBL**	Bog-Rosemary
Andropogon gerardii	Vitman	**FACU**	Big Bluestem
Andropogon glomeratus	(Walt.) B.S.P.	**FACW**	Bushy Bluestem
Andropogon hirsutior	(Hack.) Weakley & LeBlond	**FACW**	
Andropogon virginicus	L.	**FACU**	Broom-Sedge
Androsace occidentalis	Pursh	**UPL**	Western Rock-Jasmine
Androsace septentrionalis	L.	**FAC**	Pygmy-Flower Rock-Jasmine
Anemone canadensis	L.	**FACW**	Round-Leaf Thimbleweed
Anemone quinquefolia	L.	**FACU**	Nightcaps
Anemone virginiana	L.	**FACU**	Tall Thimbleweed
Angelica atropurpurea	L.	**OBL**	Purple-Stem Angelica
Angelica lucida	L.	**FAC**	Seacoast Angelica
Anoda cristata	(L.) Schlecht.	**FAC**	Crested Anoda
Antennaria neglecta	Greene	**UPL**	Field Pussytoes
Anthemis cotula	L.	**FACU**	Stinking Chamomile
Anthoxanthum hirtum	(Schrank) Y. Schouten & Veldkamp	**FACW**	Northern Sweet Vernal Grass
Anthoxanthum odoratum	L.	**FACU**	Large Sweet Vernal Grass
Anticlea elegans	(Pursh) Rydb.	**FACW**	Mountain False Deathcamas
Apios americana	Medik.	**FACW**	Groundnut
Aplectrum hyemale	(Muhl. ex Willd.) Torr.	**FAC**	Adam-and-Eve
Apocynum androsaemifolium	L.	**UPL**	Spreading Dogbane
Apocynum cannabinum	L.	**FAC**	Indian-Hemp
Aquilegia canadensis	L.	**FACU**	Red Columbine
Arabidopsis lyrata	(L.) O'Kane & Al-Shehbaz	**FACU**	Lyre-Leaf Thalecress
Arabis alpina	L.	**FAC**	Alpine Eared Rockcress
Arabis eschscholtziana	Andrz.	**FACU**	Pacific-Coast Eared Rockcress
Arabis pycnocarpa	M. Hopkins	**FACU**	Hairy Eared Rockcress
Aralia nudicaulis	L.	**FACU**	Wild Sarsaparilla
Aralia racemosa	L.	**FACU**	American Spikenard

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Aralia spinosa	L.	FAC	Devil's-Walkingstick
Arctanthemum arcticum	(L.) Tzvelev	OBL	Arctic Daisy
Arctium minus	(Hill) Bernh.	FACU	Lesser Burrdock
Arctostaphylos uva-ursi	(L.) Spreng.	UPL	Red Bearberry
Arctous alpinus	(L.) Niedenzu	FAC	Black Torpedoberry
Arenaria serpyllifolia	L.	FAC	Thyme-Leaf Sandwort
Arethusa bulbosa	L.	OBL	Dragon's-Mouth
Arisaema dracontium	(L.) Schott	FACW	Greendragon
Arisaema triphyllum	(L.) Schott	FAC	Jack-in-the-Pulpit
Aristida dichotoma	Michx.	FACU	Church-Mouse Three-Awn
Aristida longespica	Poir.	FACU	Red Three-Awn
Aristida purpurascens	Poir.	UPL	Arrow-Feather Three-Awn
Arivela viscosa	(L.) Raf.	FACU	Tickweed
Armeria maritima	(P. Mill.) Willd.	FACU	Sea Thrift
Arnica lanceolata	Nutt.	FAC	Lance-Leaf Leopardbane
Arnica mollis	Hook.	FAC	Cordilleran Leopardbane
Arnoglossum plantagineum	Raf.	FAC	Groove-Stem Indian-Plantain
Aronia arbutifolia	(L.) Pers.	FACW	Red Chokeberry
Aronia melanocarpa	(Michx.) Ell.	FAC	Black Chokeberry
Aronia prunifolia	(Marsh.) Rehd.	FACW	Purple Chokeberry
Arrhenatherum elatius	(L.) Beauv. ex J.& K. Presl	FACU	Tall Oat Grass
Artemisia annua	L.	FACU	Annual Wormwood
Artemisia biennis	Willd.	FACW	Biennial Wormwood
Artemisia campestris	L.	UPL	Pacific Wormwood
Artemisia ludoviciana	Nutt.	UPL	White Sagebrush
Artemisia stelleriana	Bess.	FACU	Oldwoman
Artemisia vulgaris	L.	UPL	Common Wormwood
Arthraxon hispidus	(Thunb.) Makino	FACW	Small Carp Grass
Aruncus dioicus	(Walt.) Fern.	FACU	Bride's-Feathers
Arundinaria tecta	(Walt.) Muhl.	FACW	Switch Cane
Asarum canadense	L.	UPL	Canadian Wild Ginger
Asclepias exaltata	L.	UPL	Poke Milkweed
Asclepias incarnata	L.	OBL	Swamp Milkweed
Asclepias longifolia	Michx.	UPL	Long-Leaf Milkweed
Asclepias perennis	Walt.	OBL	Aquatic Milkweed
Asclepias purpurascens	L.	FACU	Purple Milkweed
Asclepias rubra	L.	OBL	Red Milkweed
Asclepias speciosa	Torr.	FAC	Showy Milkweed
Asclepias sullivantii	Engelm. ex A.Gray	FAC	Prairie Milkweed
Asclepias syriaca	L.	UPL	Common Milkweed
Asclepias variegata	L.	FACU	Red-Ring Milkweed
Asclepias verticillata	L.	UPL	Whorled Milkweed
Asimina triloba	(L.) Dunal	FAC	Common Pawpaw
Asparagus officinalis	L.	FACU	Asparagus
Asperugo procumbens	L.	FACU	German-Madwort
Asplenium platyneuron	(L.) B.S.P.	FACU	Ebony Spleenwort
Asplenium trichomanes	L.	UPL	Maidenhair Spleenwort
Astragalus agrestis	Dougl. ex G. Don	FACW	Cock's-Head
Astragalus alpinus	L.	FAC	Alpine Milk-Vetch
Astragalus canadensis	L.	FAC	Canadian Milk-Vetch
Astragalus eucosmus	B.L. Robins.	FACU	Elegant Milk-Vetch
Astragalus neglectus	(Torr. & Gray) Sheldon	FACU	Cooper's Milk-Vetch
Astragalus robbinsii	(Oakes) Gray	UPL	Robbins' Milk-Vetch
Athyrium angustum	(Willd.) K. Presl	FAC	Northern Lady Fern
Athyrium asplenioides	(Michx.) A.A. Eat.	FAC	Southern Lady Fern
Atriplex argentea	Nutt.	FAC	Silverscale
Atriplex dioica	Raf.	FAC	Saline Saltbush
Atriplex glabriuscula	Edmondston	FACU	Scotland Orache
Atriplex hortensis	L.	FAC	Garden Orache
Atriplex mucronata	Raf.	FAC	Crested Saltbush
Atriplex patula	L.	FACW	Halberd-Leaf Orache
Atriplex prostrata	Bouchér ex DC.	FAC	Hastate Orache
Atriplex rosea	L.	FACU	Tumbling Orache
Avena sativa	L.	UPL	Oat
Azolla cristata	Kaulfuss	OBL	Crested Mosquito Fern
Azolla microphylla	Kaulfuss	OBL	Mexican Mosquito Fern
Baccharis halimifolia	L.	FACW	Groundseltree
Bacopa rotundifolia	(Michx.) Wettst.	OBL	Disk Water-Hyssop
Baptisia alba	(L.) Vent.	FACU	White Wild Indigo
Baptisia australis	(L.) R. Br.	FACU	Blue Wild Indigo
Barbarea orthoceras	Ledeb.	OBL	American Yellow-Rocket
Barbarea vulgaris	Ait. f.	FAC	Garden Yellow-Rocket
Bartonia paniculata	(Michx.) Muhl.	OBL	Twining Screwstem
Bartonia virginica	(L.) B.S.P.	FACW	Yellow Screwstem
Bassia hirsuta	(L.) Aschers.	OBL	Hairy Smotherweed

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Bassia hyssopifolia	(Pallas) Kuntz	**FACU**	Five-Horn Smotherweed
Bassia scoparia	(L.) A.J. Scott	**FACU**	Mexican-Fireweed
Beckmannia syzigachne	(Steud.) Fern.	**OBL**	American Slough Grass
Berberis thunbergii	DC.	**FACU**	Japanese Barberry
Berberis vulgaris	L.	**FACU**	European Barberry
Berula erecta	(Huds.) Coville	**OBL**	Cut-Leaf-Water-Parsnip
Betula X purpusii	Schneid.	**OBL**	
Betula X sandbergii	Britt.	**OBL**	
Betula alleghaniensis	Britt.	**FAC**	Yellow Birch
Betula cordifolia	Regel	**FACU**	Heart-Leaf Paper Birch
Betula glandulosa	Michx.	**OBL**	Resin Birch
Betula lenta	L.	**FACU**	Sweet Birch
Betula murrayana	Barnes & Dancik	**FACW**	Murray's Birch
Betula nigra	L.	**FACW**	River Birch
Betula papyrifera	Marsh.	**FACU**	Paper Birch
Betula pendula	Roth	**FACU**	European Weeping Birch
Betula populifolia	Marsh.	**FAC**	Gray Birch
Betula pubescens	Ehrh.	**FACW**	Downy Birch
Betula pumila	L.	**OBL**	Bog Birch
Bidens aristosa	(Michx.) Britt.	**FACW**	Bearded Beggarticks
Bidens beckii	Torr. ex Spreng.	**OBL**	Beck's Water-Marigold
Bidens bidentoides	(Nutt.) Britt.	**FACW**	Delmarva Beggarticks
Bidens bipinnata	L.	**FACU**	Spanish-Needles
Bidens cernua	L.	**OBL**	Nodding Burr-Marigold
Bidens discoidea	(Torr. & Gray) Britt.	**FACW**	Small Beggarticks
Bidens eatonii	Fern.	**OBL**	Eaton's Beggarticks
Bidens frondosa	L.	**FACW**	Devil's-Pitchfork
Bidens heterodoxa	(Fern.) Fern. & St. John	**FACW**	Connecticut Beggarticks
Bidens hyperborea	Greene	**OBL**	Estuary Beggarticks
Bidens laevis	(L.) B.S.P.	**OBL**	Smooth Beggarticks
Bidens pilosa	L.	**FACW**	Hairy Beggarticks
Bidens tenuisecta	Gray	**FACW**	Slim-Lobe Beggarticks
Bidens trichosperma	(Michx.) Britt.	**OBL**	Crowned Beggarticks
Bidens tripartita	L.	**FACW**	Three-Lobe Beggarticks
Bidens vulgata	Greene	**FAC**	Tall Beggarticks
Bistorta officinalis	Delarbre	**FACW**	Meadow Bistort
Bistorta vivipara	(L.) Delarbre	**FACW**	Serpent-Grass
Blephilia hirsuta	(Pursh) Benth.	**FACU**	Hairy Pagoda-Plant
Boechera dentata	(Raf.) Al-Shehbaz & Zarucchi	**UPL**	Short's Rockcress
Boechera divaricarpa	(A. Nels.) A.& D. Löve	**FACU**	
Boechera grahamii	(Lehm.) Windham & Al-Shehbaz	**FACU**	Boivin's Rockcress
Boechera stricta	(Graham) Al-Shehbaz	**FACU**	Canadian Rockcress
Boehmeria cylindrica	(L.) Sw.	**OBL**	Small-Spike False Nettle
Boltonia asteroides	(L.) L'Hér.	**FACW**	White Doll's Daisy
Boltonia montana	Townsend & Karaman-Castro	**FACW**	Mountain Doll's Daisy
Botrychium ascendens	W.H. Wagner	**FACU**	Triangle-Lobe Moonwort
Botrychium hesperium	(Maxon & Clausen) W.H. Wagner & Lellinger	**UPL**	Western Moonwort
Botrychium lanceolatum	(Gmel.) Angstr.	**FACW**	Lance-Leaf Moonwort
Botrychium lunaria	(L.) Sw.	**FACW**	Common Moonwort
Botrychium matricariifolium	(A. Braun ex Dowell) A. Braun ex Koch	**FACU**	Daisy-Leaf Moonwort
Botrychium simplex	E. Hitchc.	**FAC**	Least Moonwort
Botrypus virginianus	(L.) Holub	**FACU**	Rattlesnake Fern
Bouteloua dactyloides	(Nutt.) J.T. Columbus	**FACU**	Buffalo Grass
Brachyelytrum erectum	(Schreb. ex Spreng.) Beauv.	**FACU**	Bearded Shorthusk
Brasenia schreberi	J.F. Gmel.	**OBL**	Watershield
Brassica juncea	(L.) Czern.	**UPL**	Chinese Mustard
Brassica rapa	L.	**UPL**	Rape
Braya humilis	(C.A. Mey.) B.L. Robins.	**FACU**	Alpine Northern-Rockcress
Briza media	L.	**FAC**	Perennial Quaking Grass
Briza minor	L.	**FACW**	Lesser Quaking Grass
Bromus arvensis	L.	**FACU**	Field Brome
Bromus briziformis	Fisch. & C.A. Mey.	**UPL**	Rattlesnake Brome
Bromus ciliatus	L.	**FACW**	Fringed Brome
Bromus hordeaceus	L.	**UPL**	Soft Brome
Bromus inermis	Leyss.	**UPL**	Smooth Brome
Bromus kalmii	Gray	**FAC**	Kalm's Brome
Bromus latiglumis	(Scribn. ex Shear) A.S. Hitchc.	**FACW**	Early-Leaf Brome
Bromus madritensis	L.	**UPL**	Compact Brome
Bromus pubescens	Spreng.	**FACU**	Hairy Woodland Brome
Broussonetia papyrifera	(L.) L'Hér. ex Vent.	**UPL**	Paper-Mulberry
Browallia americana	L.	**FACU**	Jamaican-Forget-Me-Not
Buchnera americana	L.	**FAC**	American Bluehearts
Buddleja davidii	Franch.	**FACU**	Orange-Eye Butterfly-Bush
Bulbostylis capillaris	(L.) Kunth ex C.B. Clarke	**FACU**	Dense-Tuft Hair Sedge
Butomus umbellatus	L.	**OBL**	Greater Flowering-Rush

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Cabomba caroliniana	Gray	**OBL**	Carolina Fanwort
Cakile edentula	(Bigelow) Hook.	**FACU**	American Searocket
Cakile maritima	Scop.	**FAC**	European Searocket
Calamagrostis canadensis	(Michx.) Beauv.	**OBL**	Bluejoint
Calamagrostis coarctata	(Torr.) Torr. ex Eat.	**OBL**	Nuttall's Reed Grass
Calamagrostis perplexa	Scribn.	**FACW**	Wood Reed Grass
Calamagrostis pickeringii	Gray	**FACW**	Pickering's Reed Grass
Calamagrostis stricta	(Timm) Koel.	**FACW**	Slim-Stem Reed Grass
Calamovilfa brevipilis	(Torr.) Scribn.	**OBL**	Pine-Barren Sand-Reed
Calandrinia ciliata	(Ruiz & Pavón) DC.	**FACU**	Fringed Redmaids
Calla palustris	L.	**OBL**	Water-Dragon
Callitriche hermaphroditica	L.	**OBL**	Autumn Water-Starwort
Callitriche heterophylla	Pursh	**OBL**	Greater Water-Starwort
Callitriche marginata	Torr.	**OBL**	Winged Water-Starwort
Callitriche palustris	L.	**OBL**	Vernal Water-Starwort
Callitriche stagnalis	Scop.	**OBL**	Pond Water-Starwort
Callitriche terrestris	Raf.	**FACW**	Terrestrial Water-Starwort
Calluna vulgaris	(L.) Hull	**FAC**	Heather
Calopogon tuberosus	(L.) B.S.P.	**OBL**	Tuberous Grass-Pink
Caltha natans	Pallas ex Georgi	**OBL**	Floating Marsh-Marigold
Caltha palustris	L.	**OBL**	Yellow Marsh-Marigold
Calycanthus floridus	L.	**FACU**	Eastern Sweetshrub
Calypso bulbosa	(L.) Oakes	**FACW**	Fairy-Slipper Orchid
Calyptocarpus vialis	Less.	**FACU**	Straggler Daisy
Calystegia sepium	(L.) R. Br.	**FAC**	Hedge False Bindweed
Camassia scilloides	(Raf.) Cory	**FAC**	Atlantic Camas
Camelina microcarpa	Andrz. ex DC.	**UPL**	Little-Pod False Flax
Camelina sativa	(L.) Crantz	**FACU**	Gold-of-Pleasure
Campanula aparinoides	Pursh	**OBL**	Marsh Bellflower
Campanula rotundifolia	L.	**FACU**	Bluebell-of-Scotland
Campanulastrum americanum	(L.) Small	**FAC**	American-Bellflower
Campsis radicans	(L.) Seem. ex Bureau	**FAC**	Trumpet-Creeper
Canadanthus modestus	(Lindl.) Nesom	**FAC**	Canada-Aster
Canna X generalis	Bailey (pro sp.)	**FACW**	
Capsella bursa-pastoris	(L.) Medik.	**FACU**	Shepherd's-Purse
Cardamine X anomala	(Eames) K. Schum. (pro sp.)	**FACU**	
Cardamine X incisa	(Eames) K. Schum. (pro sp.)	**FACU**	
Cardamine angustata	O.E. Schulz	**FACU**	Slender Toothwort
Cardamine bellidifolia	L.	**FACW**	Alpine Bittercress
Cardamine bulbosa	(Schreb. ex Muhl.) B.S.P.	**OBL**	Bulbous Bittercress
Cardamine concatenata	(Michx.) Sw.	**FACU**	Cut-Leaf Toothwort
Cardamine diphylla	(Michx.) Wood	**FACU**	Crinkleroot
Cardamine douglassii	Britt.	**FACW**	Limestone Bittercress
Cardamine flexuosa	With.	**FAC**	Woodland Bittercress
Cardamine hirsuta	L.	**FACU**	Hairy Bittercress
Cardamine impatiens	L.	**FAC**	Narrow-Leaf Bittercress
Cardamine longii	Fern.	**OBL**	Long's Bittercress
Cardamine parviflora	L.	**FAC**	Sand Bittercress
Cardamine pensylvanica	Muhl. ex Willd.	**FACW**	Quaker Bittercress
Cardamine rotundifolia	Michx.	**OBL**	American Bittercress
Cardiospermum halicacabum	L.	**FAC**	Love-in-a-Puff
Carduus nutans	L.	**FACU**	Nodding Plumeless-Thistle
Carex X aestivaliformis	Mackenzie	**FAC**	
Carex X stenolepis	Less.	**FAC**	
Carex X subimpressa	Clokey (pro sp.)	**OBL**	
Carex abscondita	Mackenzie	**FACU**	Thicket Sedge
Carex acutiformis	Ehrh.	**OBL**	Lesser Pond Sedge
Carex alata	Torr.	**OBL**	Broad-Wing Sedge
Carex albicans	Willd. ex Spreng.	**UPL**	White-Tinge Sedge
Carex albolutescens	Schwein.	**FACW**	Green-White Sedge
Carex alopecoidea	Tuckerman	**FACW**	Fox-Tail Sedge
Carex amphibola	Steud.	**FAC**	Eastern Narrow-Leaf Sedge
Carex annectens	(Bickn.) Bickn.	**FACW**	Yellow-Fruit Sedge
Carex aquatilis	Wahlenb.	**OBL**	Leafy Tussock Sedge
Carex arcta	Boott	**OBL**	Northern Cluster Sedge
Carex arkansana	(Bailey) Bailey	**FAC**	Arkansas Sedge
Carex atherodes	Spreng.	**OBL**	Wheat Sedge
Carex atlantica	Bailey	**FACW**	Prickly Bog Sedge
Carex atratiformis	Britt.	**FACW**	Scabrous Black Sedge
Carex aurea	Nutt.	**FACW**	Golden-Fruit Sedge
Carex austrina	Mackenzie	**FACU**	Southern Sedge
Carex baileyi	Britt.	**OBL**	Bailey's Sedge
Carex barrattii	Schwein. & Torr.	**OBL**	Barratt's Sedge
Carex bebbii	Olney ex Fern.	**OBL**	Bebb's Sedge
Carex bicknellii	Britt.	**FAC**	Bicknell's Sedge

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Carex bigelowii	Torr. ex Schwein.	FACW	Bigelow's Sedge
Carex billingsii	(Knight) Kirschb.	OBL	Billings' Sedge
Carex blanda	Dewey	FAC	Eastern Woodland Sedge
Carex brevior	(Dewey) Mackenzie	FAC	Short-Beak Sedge
Carex bromoides	Schkuhr ex Willd.	FACW	Brome-Like Sedge
Carex brunnescens	(Pers.) Poir.	FACW	Brownish Sedge
Carex bullata	Schkuhr ex Willd.	OBL	Button Sedge
Carex bushii	Mackenzie	FAC	Bush's Sedge
Carex buxbaumii	Wahlenb.	OBL	Brown Bog Sedge
Carex canescens	L.	OBL	Hoary Sedge
Carex capillaris	L.	FACW	Hair-Like Sedge
Carex capitata	L.	FAC	Capitate Sedge
Carex caroliniana	Schwein.	FAC	Carolina Sedge
Carex castanea	Wahlenb.	FACW	Chestnut-Color Sedge
Carex cephaloidea	(Dewey) Dewey	FACU	Thin-Leaf Sedge
Carex cephalophora	Muhl. ex Willd.	FACU	Oval-Leaf Sedge
Carex cherokeensis	Schwein.	FACW	Cherokee Sedge
Carex chordorrhiza	Ehrh. ex L. f.	OBL	Rope-Root Sedge
Carex collinsii	Nutt.	OBL	Collins' Sedge
Carex comosa	Boott	OBL	Bearded Sedge
Carex complanata	Torr. & Hook.	FACU	Hirsute Sedge
Carex concinna	R. Br.	FACU	Low Northern Sedge
Carex conjuncta	Boott	FACW	Soft Fox Sedge
Carex conoidea	Schkuhr ex Willd.	FACW	Open-Field Sedge
Carex corrugata	Fern.	FACW	Prune-Fruit Sedge
Carex crawei	Dewey	FACW	Crawe's Sedge
Carex crawfordii	Fern.	FACW	Crawford's Sedge
Carex crinita	Lam.	OBL	Fringed Sedge
Carex cristatella	Britt.	FACW	Crested Sedge
Carex crus-corvi	Shuttlw. ex Kunze	OBL	Raven-Foot Sedge
Carex cryptolepis	Mackenzie	OBL	Northeastern Sedge
Carex cumulata	(Bailey) Fern.	FACU	Clustered Sedge
Carex davisii	Schwein. & Torr.	FAC	Davis' Sedge
Carex debilis	Michx.	FACW	White-Edge Sedge
Carex decomposita	Muhl.	OBL	Cypress-Knee Sedge
Carex deweyana	Schwein.	FACU	Dewey's Sedge
Carex diandra	Schrank	OBL	Lesser Tussock Sedge
Carex digitalis	Willd.	UPL	Slender Woodland Sedge
Carex disperma	Dewey	OBL	Soft-Leaf Sedge
Carex divulsa	Stokes	FAC	Grassland Sedge
Carex eburnea	Boott	FACU	Bristle-Leaf Sedge
Carex echinata	Murr.	OBL	Star Sedge
Carex emoryi	Dewey	OBL	Emory's Sedge
Carex exilis	Dewey	OBL	Coastal Sedge
Carex extensa	Goodenough	OBL	Long-Bract Sedge
Carex festucacea	Schkuhr ex Willd.	FAC	Fescue Sedge
Carex flava	L.	OBL	Yellow-Green Sedge
Carex foenea	Willd.	UPL	Bronze-Head Oval Sedge
Carex folliculata	L.	OBL	Northern Long Sedge
Carex formosa	Dewey	FAC	Handsome Sedge
Carex frankii	Kunth	OBL	Frank's Sedge
Carex garberi	Fern.	FACW	Elk Sedge
Carex glaucodea	Tuckerman ex Olney	FAC	Blue Sedge
Carex gracillima	Schwein.	FACU	Graceful Sedge
Carex granularis	Muhl. ex Willd.	FACW	Limestone-Meadow Sedge
Carex gravida	Bailey	FACU	Heavy Sedge
Carex grayi	Carey	FACW	Gray's Sedge
Carex grisea	Wahlenb.	FAC	Inflated Narrow-Leaf Sedge
Carex gynandra	Schwein.	OBL	Nodding Sedge
Carex gynocrates	Wormsk. ex Drej.	OBL	Northern Bog Sedge
Carex hallii	Olney	FACW	Deer Sedge
Carex haydenii	Dewey	OBL	Cloud Sedge
Carex heleonastes	L. f.	OBL	Hudson Bay Sedge
Carex hormathodes	Fern.	OBL	Marsh Straw Sedge
Carex hyalinolepis	Steud.	OBL	Shoreline Sedge
Carex hystericina	Muhl. ex Willd.	OBL	Porcupine Sedge
Carex interior	Bailey	OBL	Inland Sedge
Carex intumescens	Rudge	FACW	Greater Bladder Sedge
Carex lacustris	Willd.	OBL	Lakebank Sedge
Carex laeviconica	Dewey	OBL	Smooth-Cone Sedge
Carex laevivaginata	(Kükenth.) Mackenzie	OBL	Smooth-Sheath Sedge
Carex lasiocarpa	Ehrh.	OBL	Woolly-Fruit Sedge
Carex laxiflora	Lam.	UPL	Broad Loose-Flower Sedge
Carex lenticularis	Michx.	OBL	Lakeshore Sedge
Carex leporina	L.	FAC	Oval Sedge

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Carex leptalea	Wahlenb.	**OBL**	Bristly-Stalk Sedge
Carex leptonervia	(Fern.) Fern.	**FAC**	Nerveless Woodland Sedge
Carex limosa	L.	**OBL**	Mud Sedge
Carex livida	(Wahlenb.) Willd.	**OBL**	Livid Sedge
Carex lonchocarpa	Willd.	**OBL**	Southern Long Sedge
Carex longii	Mackenzie	**OBL**	Long's Sedge
Carex louisianica	Bailey	**OBL**	Louisiana Sedge
Carex lupuliformis	Sartwell ex Dewey	**OBL**	False Hop Sedge
Carex lupulina	Muhl. ex Willd.	**OBL**	Hop Sedge
Carex lurida	Wahlenb.	**OBL**	Shallow Sedge
Carex mackenziei	Krecz.	**FACW**	Mackenzie's Sedge
Carex magellanica	Lam.	**OBL**	Boreal-Bog Sedge
Carex meadii	Dewey	**FAC**	Mead's Sedge
Carex media	R. Br.	**FACW**	Montana Sedge
Carex michauxiana	Boeckl.	**OBL**	Michaux's Sedge
Carex microglochin	Wahlenb.	**OBL**	False Uncinia Sedge
Carex mitchelliana	M.A. Curtis	**OBL**	Mitchell's Sedge
Carex molesta	Mackenzie ex Bright	**FAC**	Troublesome Sedge
Carex muricata	L.	**FAC**	Muricate Sedge
Carex muskingumensis	Schwein.	**OBL**	Muskingum Sedge
Carex nebrascensis	Dewey	**OBL**	Nebraska Sedge
Carex nigra	(L.) Reichard	**FACW**	Smooth Black Sedge
Carex nigromarginata	Schwein.	**UPL**	Black-Edge Sedge
Carex normalis	Mackenzie	**FACW**	Greater Straw Sedge
Carex novae-angliae	Schwein.	**FACU**	New England Sedge
Carex oklahomensis	Mackenzie	**OBL**	Oklahoma Sedge
Carex oligosperma	Michx.	**OBL**	Few-Seed Sedge
Carex paleacea	Schreb. ex Wahlenb.	**OBL**	Chaffy Sedge
Carex pallescens	L.	**FAC**	Pale Sedge
Carex parryana	Dewey	**FACW**	Parry's Sedge
Carex pauciflora	Lightf.	**OBL**	Few-Flower Sedge
Carex pedunculata	Muhl. ex Willd.	**FAC**	Long-Stalk Sedge
Carex pellita	Muhl. ex Willd.	**OBL**	Woolly Sedge
Carex polymorpha	Muhl.	**FACU**	Variable Sedge
Carex praegracilis	W. Boott	**FACW**	Clustered Field Sedge
Carex prairea	Dewey ex Wood	**FACW**	Prairie Sedge
Carex prasina	Wahlenb.	**OBL**	Drooping Sedge
Carex praticola	Rydb.	**FAC**	Northern Meadow Sedge
Carex projecta	Mackenzie	**FACW**	Necklace Sedge
Carex pseudocyperus	L.	**OBL**	Cypress-Like Sedge
Carex radiata	(Wahlenb.) Small	**FAC**	Eastern Star Sedge
Carex rariflora	(Wahlenb.) Sm.	**OBL**	Loose-Flower Alpine Sedge
Carex recta	Boott	**OBL**	Estuary Sedge
Carex retroflexa	Muhl. ex Willd.	**FACU**	Reflexed Sedge
Carex retrorsa	Schwein.	**OBL**	Retrorse Sedge
Carex richardsonii	R. Br.	**UPL**	Richardson's Sedge
Carex rosea	Schkuhr ex Willd.	**FACU**	Rosy Sedge
Carex rostrata	Stokes	**OBL**	Swollen Beaked Sedge
Carex salina	Wahlenb.	**FACW**	Saltmarsh Sedge
Carex sartwellii	Dewey	**OBL**	Sartwell's Sedge
Carex saxatilis	L.	**FACW**	Russet Sedge
Carex scabrata	Schwein.	**OBL**	Eastern Rough Sedge
Carex schweinitzii	Dewey ex Schwein.	**OBL**	Schweinitz's Sedge
Carex scirpoidea	Michx.	**FACU**	Canadian Single-Spike Sedge
Carex scoparia	Schkuhr ex Willd.	**FACW**	Pointed Broom Sedge
Carex seorsa	Howe	**FACW**	Weak Stellate Sedge
Carex shortiana	Dewey	**FACW**	Short's Sedge
Carex siccata	Dewey	**UPL**	Dry-Spike Sedge
Carex sparganioides	Muhl. ex Willd.	**FACU**	Burr-Reed Sedge
Carex spicata	Huds.	**FACU**	Prickly Sedge
Carex sprengelii	Dewey ex Spreng.	**FAC**	Long-Beak Sedge
Carex squarrosa	L.	**OBL**	Squarrose Sedge
Carex sterilis	Willd.	**OBL**	Dioecious Sedge
Carex stipata	Muhl. ex Willd.	**OBL**	Stalk-Grain Sedge
Carex straminea	Willd. ex Schkuhr	**OBL**	Eastern Straw Sedge
Carex striata	Michx.	**OBL**	Walter's Sedge
Carex stricta	Lam.	**OBL**	Uptight Sedge
Carex styloflexa	Buckl.	**FAC**	Bent Sedge
Carex suberecta	(Olney) Britt.	**OBL**	Prairie Straw Sedge
Carex swanii	(Fern.) Mackenzie	**FACU**	Swan's Sedge
Carex sychnocephala	Carey	**FACW**	Many-Head Sedge
Carex sylvatica	Huds.	**FACU**	European Woodland Sedge
Carex tenera	Dewey	**FAC**	Quill Sedge
Carex tenuiflora	Wahlenb.	**OBL**	Sparse-Flower Sedge
Carex tetanica	Schkuhr	**FACW**	Rigid Sedge

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Carex torreyi	Tuckerman	FACU	Torrey's Sedge
Carex torta	Boott ex Tuckerman	OBL	Tw isted Sedge
Carex triangularis	Boeckl.	OBL	Eastern Fox Sedge
Carex tribuloides	Wahlenb.	FACW	Blunt Broom Sedge
Carex trichocarpa	Muhl. ex Willd.	OBL	Hairy-Fruit Sedge
Carex trisperma	Dew ey	OBL	Three-Seed Sedge
Carex tuckermanii	Dew ey	OBL	Tuckerman's Sedge
Carex typhina	Michx.	OBL	Cat-Tail Sedge
Carex utriculata	Boott	OBL	Northw est Territory Sedge
Carex vaginata	Tausch	OBL	Sheathed Sedge
Carex venusta	Dew ey	OBL	Dark-Green Sedge
Carex vesicaria	L.	OBL	Lesser Bladder Sedge
Carex viridula	Michx.	OBL	Little Green Sedge
Carex vulpinoidea	Michx.	OBL	Common Fox Sedge
Carex w iegandii	Mackenzie	OBL	Wiegand's Sedge
Carex w illdenow ii	Schkuhr ex Willd.	UPL	Willdenow 's Sedge
Carex w oodii	Dew ey	FACU	Pretty Sedge
Carpinus caroliniana	Walt.	FAC	American Hornbeam
Carum carvi	L.	UPL	Caraw ay
Carya cordiformis	(Wangenh.) K. Koch	FAC	Bitter-Nut Hickory
Carya glabra	(P. Mill.) Sw eet	FACU	Pignut Hickory
Carya illinoinensis	(Wangenh.) K. Koch	FACW	Pecan
Carya laciniosa	(Michx. f.) G. Don	FACW	Shell-Bark Hickory
Carya ovalis	(Wangenh.) Sarg.	FACU	Red Hickory
Carya ovata	(P. Mill.) K. Koch	FACU	Shag-Bark Hickory
Castilleja coccinea	(L.) Spreng.	FAC	Scarlet Indian-Paintbrush
Castilleja septentrionalis	Lindl.	FACU	Labrador Indian-Paintbrush
Catabrosa aquatica	(L.) Beauv.	OBL	Water Whorl Grass
Catalpa bignonioides	Walt.	FACU	Southern Catalpa
Catalpa speciosa	Warder ex Engelm.	FACU	Northern Catalpa
Celastrus orbiculatus	Thunb.	UPL	Asian Bittersw eet
Celastrus scandens	L.	FACU	American Bittersw eet
Celosia argentea	L.	UPL	Silver Cock's-Comb
Celtis occidentalis	L.	FAC	Common Hackberry
Cenchrus americanus	(L.) O. Morrone	FACU	Pearl-Millet
Cenchrus ciliaris	L.	UPL	Buffel Grass
Cenchrus longispinus	(Hack.) Fern.	UPL	Innocent-Weed
Cenchrus tribuloides	L.	UPL	Sand-Dune Sandburr
Centaurea X moncktonii	C.E. Britton	FACU	
Centaurea cyanus	L.	UPL	Garden Cornflow er
Centaurea jacea	L.	FACU	Brow n-Ray Knapw eed
Centaurium erythraea	Rafn	FAC	European Centaury
Centaurium pulchellum	(Sw .) Hayek ex Hand.-Maz. et al.	FAC	Branched Centaury
Centipeda minima	(L.) A. Braun & Aschers.	UPL	Spreading-Sneezew eed
Centromadia pungens	(Hook. & Arn.) Greene	FAC	Pungent False Tarplant
Cephalanthus occidentalis	L.	OBL	Common Buttonbush
Cerastium arvense	L.	FACU	Field Mouse-Ear Chickw eed
Cerastium brachypodum	(Engelm. ex Gray) B.L. Robins.	FACU	Short-Stalk Mouse-Ear Chickw eed
Cerastium fontanum	Baumg.	FACU	Common Mouse-Ear Chickw eed
Cerastium glomeratum	Thuill.	FACU	Sticky Mouse-Ear Chickw eed
Cerastium nutans	Raf.	FACU	Nodding Mouse-Ear Chickw eed
Ceratophyllum demersum	L.	OBL	Coon's-Tail
Ceratophyllum echinatum	Gray	OBL	Spineless Hornw ort
Ceratophyllum muricatum	Cham.	OBL	Prickly Hornw ort
Cercis canadensis	L.	FACU	Redbud
Chaerophyllum procumbens	(L.) Crantz	FAC	Spreading Chervil
Chaerophyllum tainturieri	Hook.	FACU	Hairy-Fruit Chervil
Chamaecrista fasciculata	(Michx.) Greene	FACU	Sleepingplant
Chamaecrista nictitans	(L.) Moench	FACU	Partridge-Pea
Chamaecyparis thyoides	(L.) B.S.P.	OBL	Atlantic White-Cedar
Chamaedaphne calyculata	(L.) Moench	OBL	Leatherleaf
Chamaelirium luteum	(L.) Gray	FACU	Fairyw and
Chamaenerion angustifolium	(L.) Scop.	FAC	Narrow -Leaf Firew eed
Chasmanthium latifolium	(Michx.) Yates	FACW	Indian Wood-Oats
Chasmanthium laxum	(L.) Yates	FACW	Slender Wood-Oats
Chelidonium majus	L.	UPL	Greater Celandine
Chelone glabra	L.	OBL	White Turtlehead
Chelone lyonii	Pursh	FACW	Pink Turtlehead
Chelone obliqua	L.	OBL	Red Turtlehead
Chenopodium album	L.	FACU	Lamb's-Quarters
Chenopodium chenopodioides	(L.) Aellen	FACW	Low Goosefoot
Chenopodium foliosum	(Moench) Aschers.	FACU	Leafy Goosefoot
Chenopodium fremontii	S. Wats.	FACU	Fremont's Goosefoot
Chenopodium glaucum	L.	FACW	Oak-Leaf Goosefoot
Chenopodium leptophyllum	(Moq.) Nutt. ex S. Wats.	FACU	Narrow -Leaf Goosefoot

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Chenopodium murale	L.	**FACU**	Nettle-Leaf Goosefoot
Chenopodium rubrum	L.	**OBL**	Red Goosefoot
Chionanthus virginicus	L.	**FAC**	White Fringetree
Chloris ciliata	Sw.	**UPL**	Fringed Windmill Grass
Chloris gayana	Kunth	**FACU**	Rhodes Grass
Chloris virgata	Sw.	**FACU**	Feather Windmill Grass
Chrysopsis mariana	(L.) Ell.	**UPL**	Maryland Golden-Aster
Chrysosplenium americanum	Schwein. ex Hook.	**OBL**	American Golden-Saxifrage
Cichorium intybus	L.	**FACU**	Chicory
Cicuta bulbifera	L.	**OBL**	Bulblet-Bearing Water-Hemlock
Cicuta maculata	L.	**OBL**	Spotted Water-Hemlock
Cinna arundinacea	L.	**FACW**	Sweet Wood-Reed
Cinna latifolia	(Trev. ex Goepp.) Griseb.	**FACW**	Slender Wood-Reed
Circaea alpina	L.	**FACW**	Small Enchanter's-Nightshade
Circaea canadensis	(L.) Hill	**FACU**	Broad-Leaf Enchanter's-Nightshade
Cirsium arvense	(L.) Scop.	**FACU**	Canadian Thistle
Cirsium discolor	(Muhl. ex Willd.) Spreng.	**UPL**	Field Thistle
Cirsium flodmanii	(Rydb.) Arthur	**FACU**	Flodman's Thistle
Cirsium horridulum	Michx.	**FACU**	Yellow Thistle
Cirsium muticum	Michx.	**OBL**	Swamp Thistle
Cirsium palustre	(L.) Scop.	**FACW**	Marsh Thistle
Cirsium undulatum	(Nutt.) Spreng.	**FACU**	Wavy-Leaf Thistle
Cirsium vulgare	(Savi) Ten.	**FACU**	Bull Thistle
Citrullus lanatus	(Thunb.) Matsumura & Nakai	**UPL**	Watermelon
Cladium mariscoides	(Muhl.) Torr.	**OBL**	Smooth Saw-Grass
Claytonia caroliniana	Michx.	**FACU**	Carolina Springbeauty
Claytonia perfoliata	Donn ex Willd.	**FACU**	Miner's-Lettuce
Claytonia sibirica	L.	**FACW**	Siberian Springbeauty
Claytonia virginica	L.	**FACU**	Virginia Springbeauty
Clematis pitcheri	Torr. & Gray	**FACU**	Bluebill
Clematis terniflora	DC.	**UPL**	Sweet Autumn Virgin's-Bower
Clematis virginiana	L.	**FAC**	Devil's-Darning-Needles
Clematis vitalba	L.	**FACU**	Evergreen Traveler's-Joy
Clethra alnifolia	L.	**FAC**	Coastal Sweet-Pepperbush
Clinopodium arkansanum	(Nutt.) House	**FACW**	Limestone Wild Basil
Clintonia borealis	(Ait.) Raf.	**FAC**	Yellow Bluebead-Lily
Clitoria mariana	L.	**FACU**	Atlantic Pigeonwings
Coeloglossum viride	(L.) Hartman	**FAC**	Long-Bract Frog Orchid
Coelorachis cylindrica	(Michx.) Nash	**FACU**	Carolina Joint-Tail Grass
Coix lacryma-jobi	L.	**FACW**	Job's-Tears
Coleataenia anceps	(Michx.) Soreng	**FACW**	Beaked Cut-Throat Grass
Coleataenia longifolia	(Torr.) Soreng	**FACW**	Long-Leaf Cut-Throat Grass
Coleataenia rigidula	(Bosc ex Nees) LeBlond	**FACW**	Red-Top Cut-Throat Grass
Coleataenia stipitata	(Nash) LeBlond	**FACW**	Stipitate Cut-Throat Grass
Collinsia verna	Nutt.	**FACU**	Spring Blue-Eyed Mary
Collinsonia canadensis	L.	**FAC**	Richweed
Collomia linearis	Nutt.	**FACU**	Narrow-Leaf Mountain-Trumpet
Comandra umbellata	(L.) Nutt.	**FACU**	Bastard-Toadflax
Comarum palustre	L.	**OBL**	Purple Marshlocks
Commelina communis	L.	**FAC**	Asiatic Dayflower
Commelina diffusa	Burm. f.	**FACW**	Climbing Dayflower
Commelina erecta	L.	**UPL**	White-Mouth Dayflower
Commelina virginica	L.	**FACW**	Virginia Dayflower
Conioselinum chinense	(L.) B.S.P.	**FACW**	Chinese Hemlock-Parsley
Conium maculatum	L.	**FACW**	Poison-Hemlock
Conoclinium coelestinum	(L.) DC.	**FAC**	Blue Mistflower
Coptidium lapponicum	(L.) Gandog.	**OBL**	
Coptis trifolia	(L.) Salisb.	**FACW**	Three-Leaf Goldthread
Corallorhiza maculata	(Raf.) Raf.	**FACU**	Summer Coralroot
Corallorhiza striata	Lindl.	**FACU**	Hooded Coralroot
Corallorhiza trifida	Chatelain	**FACW**	Yellow Coralroot
Corallorhiza wisteriana	Conrad	**FACU**	Spring Coralroot
Coreopsis lanceolata	L.	**FACU**	Lance-Leaf Tickseed
Coreopsis pubescens	Ell.	**FACU**	Star Tickseed
Coreopsis rosea	Nutt.	**FACW**	Pink Tickseed
Coreopsis tinctoria	Nutt.	**FACU**	Golden Tickseed
Coreopsis tripteris	L.	**FAC**	Tall Tickseed
Corispermum americanum	(Nutt.) Nutt.	**FACU**	American Bugseed
Corispermum welshii	Mosyakin	**FACU**	Welsh's Bugseed
Cornus alba	L.	**FACW**	Red Osier
Cornus alternifolia	L. f.	**FACU**	Alternate-Leaf Dogwood
Cornus amomum	P. Mill.	**FACW**	Silky Dogwood
Cornus canadensis	L.	**FAC**	Canadian Bunchberry
Cornus drummondii	C.A. Mey.	**FAC**	Rough-Leaf Dogwood
Cornus florida	L.	**FACU**	Flowering Dogwood

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Cornus obliqua	Raf.	**FACW**	Pale Dogwood
Cornus racemosa	Lam.	**FAC**	Gray Dogwood
Cortaderia selloana	(J.A. & J.H. Schultes) Aschers. & Graebn.	**FACU**	Selloa Pampus Grass
Corydalis flavula	(Raf.) DC.	**FACU**	Yellow Fumewort
Corylus americana	Marsh.	**FACU**	American Hazelnut
Corylus avellana	L.	**FACU**	Common Filbert
Corylus cornuta	Marsh.	**FACU**	Beaked Hazelnut
Cosmos bipinnatus	Cav.	**FAC**	Garden Cosmos
Cosmos parviflorus	(Jacq.) Pers.	**FACU**	Southwestern Cosmos
Cosmos sulphureus	Cav.	**FACU**	Sulphur Cosmos
Cotula australis	(Sieber ex Spreng.) Hook. f.	**FAC**	Australian Water-Buttons
Cotula coronopifolia	L.	**OBL**	Common Brassbuttons
Crassula aquatica	(L.) Schoenl.	**OBL**	Water Pygmyweed
Crataegus berberifolia	Torr. & Gray	**FAC**	Barberry Hawthorn
Crataegus crus-galli	L.	**FAC**	Cock-Spur Hawthorn
Crataegus douglasii	Lindl.	**FAC**	Black Hawthorn
Crataegus forbesae	Beadle	**FACU**	Forbes' Hawthorn
Crataegus mollis	Scheele	**FAC**	Downy Hawthorn
Crataegus monogyna	Jacq.	**FACU**	English Hawthorn
Crataegus phaenopyrum	(L. f.) Medik.	**FAC**	Washington Hawthorn
Crataegus viridis	L.	**OBL**	Green Hawthorn
Crepis capillaris	(L.) Wallr.	**UPL**	Smooth Hawk's-Beard
Crepis runcinata	(James) Torr. & Gray	**FACW**	Fiddle-Leaf Hawk's-Beard
Crotalaria rotundifolia	Walt. ex J.F. Gmel.	**UPL**	Rabbitbells
Crypsis schoenoides	(L.) Lam.	**OBL**	Swamp Prickle Grass
Cryptogramma stelleri	(Gmel.) Prantl	**FACU**	Fragile Rockbrake
Cryptotaenia canadensis	(L.) DC.	**FAC**	Canadian Honewort
Ctenium aromaticum	(Walt.) Wood	**FACW**	Toothache Grass
Cuphea viscosissima	Jacq.	**FACU**	Blue Waxweed
Cyclachaena xanthiifolia	(Nutt.) Fresen.	**FAC**	Carelessweed
Cycloloma atriplicifolium	(Spreng.) Coult.	**FACU**	Winged-Pigweed
Cynanchum laeve	(Michx.) Pers.	**FAC**	Honeyvine
Cynodon dactylon	(L.) Pers.	**FACU**	Bermuda Grass
Cynoglossum officinale	L.	**UPL**	Gypsy-Flower
Cynosurus cristatus	L.	**FAC**	Crested Dog's-Tail Grass
Cyperus acuminatus	Torr. & Hook. ex Torr.	**OBL**	Taper-Tip Flat Sedge
Cyperus bipartitus	Torr.	**FACW**	Shining Flat Sedge
Cyperus compressus	L.	**FACW**	Poorland Flat Sedge
Cyperus dentatus	Torr.	**OBL**	Toothed Flat Sedge
Cyperus diandrus	Torr.	**OBL**	Umbrella Flat Sedge
Cyperus difformis	L.	**OBL**	Variable Flat Sedge
Cyperus echinatus	(L.) Wood	**FAC**	Globe Flat Sedge
Cyperus eragrostis	Lam.	**FACW**	Tall Flat Sedge
Cyperus erythrorhizos	Muhl.	**OBL**	Red-Root Flat Sedge
Cyperus esculentus	L.	**FACW**	Chufa
Cyperus filicinus	Vahl	**OBL**	Fern Flat Sedge
Cyperus flavescens	L.	**OBL**	Yellow Flat Sedge
Cyperus flavicomus	Michx.	**FAC**	White-Edge Flat Sedge
Cyperus fuscus	L.	**FAC**	Galingale
Cyperus involucratus	Rottb.	**OBL**	Alternate-Leaf Flat Sedge
Cyperus iria	L.	**FACW**	Ricefield Flat Sedge
Cyperus lancastriensis	Porter ex Gray	**FAC**	Many-Flower Flat Sedge
Cyperus lupulinus	(Spreng.) Marcks	**FACU**	Great Plains Flat Sedge
Cyperus odoratus	L.	**OBL**	Rusty Flat Sedge
Cyperus polystachyos	Rottb.	**FACW**	Many-Spike Flat Sedge
Cyperus pseudovegetus	Steud.	**FACW**	Marsh Flat Sedge
Cyperus retrofractus	(L.) Torr.	**UPL**	Rough Flat Sedge
Cyperus retrorsus	Chapman	**FACU**	Pine-Barren Flat Sedge
Cyperus rotundus	L.	**FACU**	Purple Flat Sedge
Cyperus schweinitzii	Torr.	**FACU**	Sand Flat Sedge
Cyperus serotinus	Rottb.	**OBL**	Tidal-Marsh Flat Sedge
Cyperus squarrosus	L.	**OBL**	Awned Flat Sedge
Cyperus strigosus	L.	**FACW**	Straw-Color Flat Sedge
Cypripedium X andrewsii	A.M. Fuller	**FACW**	
Cypripedium acaule	Ait.	**FACW**	Pink Lady's-Slipper
Cypripedium arietinum	R. Br.	**FACW**	Ram-Head Lady's-Slipper
Cypripedium candidum	Muhl. ex Willd.	**OBL**	Small White Lady's-Slipper
Cypripedium parviflorum	Salisb.	**FAC**	Yellow Lady's-Slipper
Cypripedium reginae	Walt.	**FACW**	Showy Lady's-Slipper
Cyrtorhyncha cymbalaria	(Pursh) Britt.	**OBL**	Alkali Buttercup
Cystopteris bulbifera	(L.) Bernh.	**FACW**	Bulblet Bladder Fern
Cystopteris fragilis	(L.) Bernh.	**FACU**	Brittle Bladder Fern
Cystopteris protrusa	(Weatherby) Blasdell	**FACU**	Lowland Bladder Fern
Dactylis glomerata	L.	**FACU**	Orchard Grass
Dalea leporina	(Ait.) Bullock	**UPL**	Fox-Tail Prairie-Clover

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Danthonia californica	Boland.	**FACU**	California Wild Oat Grass
Danthonia compressa	Austin	**FACU**	Flattened Wild Oat Grass
Danthonia intermedia	Vasey	**FAC**	Timber Wild Oat Grass
Danthonia sericea	Nutt.	**FACU**	Silky Wild Oat Grass
Daphne mezereum	L.	**FACU**	Paradise-Plant
Dasiphora fruticosa	(L.) Rydb.	**FACW**	Golden-Hardhack
Dasistoma macrophylla	(Nutt.) Raf.	**FACU**	Mullein-Foxglove
Datura wrightii	Regel	**FACU**	Sacred Thorn-Apple
Daucus carota	L.	**UPL**	Queen Anne's-Lace
Decodon verticillatus	(L.) Ell.	**OBL**	Swamp-Loosestrife
Decumaria barbara	L.	**OBL**	Woodvamp
Deinandra fasciculata	(DC.) Greene	**FACU**	Clustered Moonshine-Daisy
Dendrolycopodium dendroideum	(Michx.) A. Haines	**FACU**	Prickley Tree-Club-Moss
Dendrolycopodium obscurum	(L.) A. Haines	**FACU**	Princess-Pine
Dennstaedtia punctilobula	(Michx.) T. Moore	**UPL**	Hay-Scented Fern
Deparia acrostichoides	(Sw.) M. Kato	**FAC**	Silvery-Spleenwort
Deschampsia caespitosa	(L.) Beauv.	**FACW**	Tufted Hair Grass
Deschampsia danthonioides	(Trin.) Munro	**FACW**	Annual Hair Grass
Deschampsia elongata	(Hook.) Munro	**FACW**	Slender Hair Grass
Deschampsia flexuosa	(L.) Trin.	**FACU**	Wavy Hair Grass
Descurainia incana	(Bernh. ex Fisch. & C.A. Mey.) Dorn	**UPL**	Mountain Tansy-Mustard
Desmanthus illinoensis	(Michx.) MacM. ex B.L. Robins. & Fern.	**FACU**	Prairie Bundle-Flower
Desmodium canadense	(L.) DC.	**FAC**	Showy Tick-Trefoil
Desmodium paniculatum	(L.) DC.	**FACU**	Panicled-Leaf Tick-Trefoil
Dianthus armeria	L.	**UPL**	Deptford Pink
Dianthus deltoides	L.	**UPL**	Maiden Pink
Diarrhena obovata	(Gleason) Brandenburg	**FACU**	Hairy Beakgrain
Dicentra formosa	(Andrews) Walp.	**FACU**	Pacific Bleedinghearts
Dichanthelium aciculare	(Desv. ex Poir.) Gould & C.A. Clark	**FACU**	Needle-Leaf Rosette Grass
Dichanthelium acuminatum	(Sw.) Gould & C.A. Clark	**FAC**	Tapered Rosette Grass
Dichanthelium boreale	(Nash) Freckmann	**FAC**	Northern Rosette Grass
Dichanthelium clandestinum	(L.) Gould	**FACW**	Deer-Tongue Rosette Grass
Dichanthelium commutatum	(J.A. Schultes) Gould	**FAC**	Variable Rosette Grass
Dichanthelium dichotomum	(L.) Gould	**FAC**	Cypress Rosette Grass
Dichanthelium latifolium	(L.) Harville	**FACU**	Broad-Leaf Rosette Grass
Dichanthelium laxiflorum	(Lam.) Gould	**FACU**	Open-Flower Rosette Grass
Dichanthelium leibergii	(Vasey) Freckmann	**FACU**	Leiberg's Rosette Grass
Dichanthelium leucothrix	(Nash) Freckmann	**FACW**	Rough Rosette Grass
Dichanthelium oligosanthes	(J.A. Schultes) Gould	**FACU**	Heller's Rosette Grass
Dichanthelium ovale	(Ell.) Gould & C.A. Clark	**FACU**	Egg-Leaf Rosette Grass
Dichanthelium portoricense	(Desv. ex Hamilton) B.F. Hansen & Wunderlin	**FACU**	Hemlock Rosette Grass
Dichanthelium scabriusculum	(Ell.) Gould & C.A. Clark	**OBL**	Woolly Rosette Grass
Dichanthelium scoparium	(Lam.) Gould	**FACW**	Broom Rosette Grass
Dichanthelium sphaerocarpon	(Ell.) Gould	**FACU**	Round-Seed Rosette Grass
Dichondra carolinensis	Michx.	**FACW**	Carolina Pony's-Foot
Didiplis diandra	(Nutt. ex DC.) Wood	**OBL**	Water-Purslane
Dieteria canescens	(Pursh) Nutt.	**FAC**	Hoar False Tansy-Aster
Digitalis purpurea	L.	**FACU**	Purple Foxglove
Digitaria ciliaris	(Retz.) Koel.	**FACU**	Southern Crab Grass
Digitaria ischaemum	(Schreb. ex Schweig.) Schreb. ex Muhl.	**FACU**	Smooth Crab Grass
Digitaria sanguinalis	(L.) Scop.	**FACU**	Hairy Crab Grass
Digitaria violascens	Link	**FACU**	Violet Crab Grass
Dinebra panicea	(Retz.) P.M. Peterson & N. Snow	**FACW**	Needle Viper Grass
Diodia teres	Walt.	**FACU**	Poorjoe
Diodia virginiana	L.	**FACW**	Virginia Buttonweed
Dioscorea villosa	L.	**FAC**	Wild Yam
Diospyros virginiana	L.	**FAC**	Common Persimmon
Diphasiastrum alpinum	(L.) Holub	**FACU**	Alpine Creeping-Cedar
Diphasiastrum complanatum	(L.) Holub	**FACU**	Trailing Creeping-Cedar
Diplachne fusca	(L.) Beauv.ex Roemer & J.A. Schultes	**OBL**	Bearded Sprangletop
Diplazium pycnocarpon	(Spreng.) Broun	**FAC**	Glade Fern
Dipsacus fullonum	L.	**FACU**	Fuller's Teasel
Dipsacus laciniatus	L.	**FACU**	Cut-Leaf Teasel
Dirca palustris	L.	**FAC**	Eastern Leatherwood
Distichlis spicata	(L.) Greene	**FACW**	Coastal Salt Grass
Dodecatheon meadia	L.	**FACU**	Pride-of-Ohio
Doellingeria sericocarpoides	Small	**FACW**	Southern White-Top
Doellingeria umbellata	(P. Mill.) Nees	**FACW**	Parasol White-Top
Dracocephalum parviflorum	Nutt.	**FACU**	American Dragonhead
Dracopis amplexicaulis	(Vahl) Cass.	**FACU**	Clasping-Coneflower
Drosera X belezeana	E.G. Camus	**OBL**	
Drosera X obovata	Mert. & Koch (pro sp.)	**OBL**	
Drosera anglica	Huds.	**OBL**	English Sundew
Drosera filiformis	Raf.	**OBL**	Thread-Leaf Sundew
Drosera intermedia	Hayne	**OBL**	Spoon-Leaf Sundew

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Drosera linearis	Goldie	**OBL**	Slender-Leaf Sundew
Drosera rotundifolia	L.	**OBL**	Round-Leaf Sundew
Dryas integrifolia	Vahl	**FACU**	White Mountain-Avens
Drymocallis arguta	(Pursh) Rydb.	**FACU**	Tall Woodbeauty
Dryopteris X boottii	(Tuckerman) Underwood (pro sp.)	**FACW**	
Dryopteris X correllii	W.H. Wagner	**FACW**	
Dryopteris X mickelii	J.H. Peck	**FAC**	
Dryopteris X triploidea	Wherry	**FAC**	
Dryopteris X uliginosa	(A. Braun ex Dowell) Druce	**FAC**	
Dryopteris campyloptera	Clarkson	**FACU**	Mountain Wood Fern
Dryopteris carthusiana	(Vill.) H.P. Fuchs	**FACW**	Spinulose Wood Fern
Dryopteris celsa	(Wm. Palmer) Knowlt., Palmer & Pollard ex Small	**OBL**	Log Fern
Dryopteris clintoniana	(D.C. Eat.) Dowell	**FACW**	Clinton's Wood Fern
Dryopteris cristata	(L.) Gray	**OBL**	Crested Wood Fern
Dryopteris expansa	(K. Presl) Fraser-Jenkins & Jermy	**FAC**	Spreading Wood Fern
Dryopteris goldiana	(Hook. ex Goldie) Gray	**FAC**	Goldie's Wood Fern
Dryopteris intermedia	(Muhl. ex Willd.) Gray	**FAC**	Evergreen Wood Fern
Dryopteris marginalis	(L.) Gray	**FACU**	Marginal Wood Fern
Dulichium arundinaceum	(L.) Britt.	**OBL**	Three-Way Sedge
Dysphania ambrosioides	(L.) Mosyakin & Clemants	**FACU**	Mexican-Tea
Dysphania aristata	(L.) Mosyakin & Clemants	**FACU**	Aristata Wormseed
Dysphania botrys	(L.) Mosyakin & Clemants	**FACU**	Jerusalem-Oak
Echinochloa colona	(L.) Link	**FACW**	Jungle-Rice
Echinochloa crus-galli	(L.) Beauv.	**FAC**	Large Barnyard Grass
Echinochloa esculenta	(A. Braun) H. Scholtz	**FACU**	Japanese Water Grass
Echinochloa frumentacea	Link	**FAC**	Japanese-Millet
Echinochloa muricata	(Beauv.) Fern.	**OBL**	Rough Barnyard Grass
Echinochloa walteri	(Pursh) Heller	**OBL**	Long-Awn Cock's-Spur Grass
Echinocystis lobata	(Michx.) Torr. & Gray	**FACW**	Wild Cucumber
Echinodorus berteroi	(Spreng.) Fassett	**OBL**	Upright Burrhead
Eclipta prostrata	(L.) L.	**FACW**	False Daisy
Egeria densa	Planch.	**OBL**	Brazilian-Waterweed
Eichhornia crassipes	(Mart.) Solms	**OBL**	Common Water-Hyacinth
Elaeagnus angustifolia	L.	**FACU**	Russian-Olive
Elaeagnus commutata	Bernh. ex Rydb.	**UPL**	American Silver-Berry
Elatine americana	(Pursh) Arn.	**OBL**	American Waterwort
Elatine minima	(Nutt.) Fisch. & C.A. Mey.	**OBL**	Small Waterwort
Elatine rubella	Rydb.	**OBL**	Red-Stem Waterwort
Elatine triandra	Schkuhr	**OBL**	Eurasian Waterwort
Eleocharis acicularis	(L.) Roemer & J.A. Schultes	**OBL**	Needle Spike-Rush
Eleocharis aestuum	D.M. Hines ex A. A. Haines	**OBL**	Tidal Spike-Rush
Eleocharis atropurpurea	(Retz.) J.& K. Presl	**FACW**	Purple Spike-Rush
Eleocharis compressa	Sullivant	**FACW**	Flat-Stem Spike-Rush
Eleocharis diandra	C. Wright	**OBL**	Wright's Spike-Rush
Eleocharis elliptica	Kunth	**OBL**	Elliptic Spike-Rush
Eleocharis engelmannii	Steud.	**FACW**	Engelmann's Spike-Rush
Eleocharis equisetoides	(Ell.) Torr.	**OBL**	Horsetail-Spike-Rush
Eleocharis fallax	Weatherby	**OBL**	Creeping Spike-Rush
Eleocharis geniculata	(L.) Roemer & J.A. Schultes	**OBL**	Capitate Spike-Rush
Eleocharis halophila	(Fern. & Brack.) Fern. & Brack.	**OBL**	Saltmarsh Spike-Rush
Eleocharis intermedia	J.A. Schultes	**OBL**	Intermediate Spike-Rush
Eleocharis mamillata	(Lindb. f.) Lindb. f.	**OBL**	Soft-Stem Spike-Rush
Eleocharis melanocarpa	Torr.	**FACW**	Black-Fruit Spike-Rush
Eleocharis microcarpa	Torr.	**OBL**	Small-Fruit Spike-Rush
Eleocharis nitida	Fern.	**OBL**	Quill Spike-Rush
Eleocharis obtusa	(Willd.) J.A. Schultes	**OBL**	Blunt Spike-Rush
Eleocharis olivacea	Torr.	**OBL**	Bright-Green Spike-Rush
Eleocharis palustris	(L.) Roemer & J.A. Schultes	**OBL**	Common Spike-Rush
Eleocharis parvula	(Roemer & J.A. Schultes) Link ex Bluff, Nees & Schauer	**OBL**	Little-Head Spike-Rush
Eleocharis quadrangulata	(Michx.) Roemer & J.A. Schultes	**OBL**	Square-Stem Spike-Rush
Eleocharis quinqueflora	(F.X. Hartmann) Schwarz	**OBL**	Few-Flower Spike-Rush
Eleocharis radicans	(A. Dietr.) Kunth	**OBL**	Rooted Spike-Rush
Eleocharis robbinsii	Oakes	**OBL**	Robbins' Spike-Rush
Eleocharis rostellata	(Torr.) Torr.	**OBL**	Beaked Spike-Rush
Eleocharis tenuis	(Willd.) J.A. Schultes	**FACW**	Slender Spike-Rush
Eleocharis tortilis	(Link) J.A. Schultes	**FACW**	Twisted Spike-Rush
Eleocharis tricostata	Torr.	**OBL**	Three-Angle Spike-Rush
Eleocharis tuberculosa	(Michx.) Roemer & J.A. Schultes	**OBL**	Cone-Cup Spike-Rush
Eleocharis wolfii	(Gray) Gray ex Britt.	**OBL**	Wolf's Spike-Rush
Eleusine indica	(L.) Gaertn.	**FACU**	Indian Goose Grass
Ellisia nyctelea	(L.) L.	**FAC**	Aunt Lucy
Elodea bifoliata	St. John	**OBL**	Two-Leaf Waterweed
Elodea canadensis	Michx.	**OBL**	Canadian Waterweed
Elodea nuttallii	(Planch.) St. John	**OBL**	Western Waterweed
Elodea schweinitzii	(Planch.) Caspary	**OBL**	Schweinitz's Waterweed

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Elymus alaskanus	(Scribn. & Merr.) A. Löve	**UPL**	Alaska Wild Rye
Elymus canadensis	L.	**FACU**	Nodding Wild Rye
Elymus curvatus	Piper	**FAC**	Awnless Wild Rye
Elymus glaucus	Buckl.	**FACU**	Blue Wild Rye
Elymus hystrix	L.	**FACU**	Eastern Bottle-Brush Grass
Elymus lanceolatus	(Scribn. & J.G. Sm.) Gould	**FACU**	Streamside Wild Rye
Elymus repens	(L.) Gould	**FACU**	Creeping Wild Rye
Elymus riparius	Wieg.	**FACW**	River-Bank Wild Rye
Elymus trachycaulus	(Link) Gould ex Shinners	**FACU**	Slender Wild Rye
Elymus villosus	Muhl. ex Willd.	**FACU**	Hairy Wild Rye
Elymus virginicus	L.	**FACW**	Virginia Wild Rye
Elymus wiegandii	Fern.	**FAC**	Wiegand's Wild Rye
Empetrum nigrum	L.	**FAC**	Black Crowberry
Endodeca serpentaria	(L.) Raf.	**UPL**	Virginia-Snakeroot
Enemion biternatum	Raf.	**FAC**	Eastern False Rue-Anemone
Epilobium anagallidifolium	Lam.	**FACW**	Pimpernel Willowherb
Epilobium ciliatum	Raf.	**FACW**	Fringed Willowherb
Epilobium coloratum	Biehler	**OBL**	Purple-Leaf Willowherb
Epilobium hirsutum	L.	**FACW**	Codlins-and-Cream
Epilobium hornemannii	Reichenb.	**FACW**	Hornemann's Willowherb
Epilobium lactiflorum	Hausskn.	**FACW**	White-Flower Willowherb
Epilobium leptophyllum	Raf.	**OBL**	Bog Willowherb
Epilobium palustre	L.	**OBL**	Marsh Willowherb
Epilobium parviflorum	Schreb.	**FACW**	Small-Flower Hairy Willowherb
Epilobium strictum	Muhl. ex Spreng.	**OBL**	Downy Willowherb
Epipactis helleborine	(L.) Crantz	**UPL**	Helleborine
Epipactis palustris	(L.) Crantz	**FACW**	Marsh-Orchid
Equisetum X ferrissii	Clute (pro sp.)	**FACW**	
Equisetum X litorale	Kühlewein ex Rupr. (pro sp.)	**OBL**	
Equisetum X mackaii	(Newm.) Brichan	**FACW**	
Equisetum X nelsonii	(A.A. Eat.) Schaffn. (pro sp.)	**FAC**	
Equisetum arvense	L.	**FAC**	Field Horsetail
Equisetum fluviatile	L.	**OBL**	Water Horsetail
Equisetum hyemale	L.	**FAC**	Tall Scouring-Rush
Equisetum laevigatum	A. Braun	**FACW**	Smooth Scouring-Rush
Equisetum palustre	L.	**FACW**	Marsh Horsetail
Equisetum pratense	Ehrh.	**FACW**	Meadow Horsetail
Equisetum scirpoides	Michx.	**FAC**	Dwarf Scouring-Rush
Equisetum sylvaticum	L.	**FACW**	Woodland Horsetail
Equisetum telmateia	Ehrh.	**OBL**	Giant Horsetail
Equisetum variegatum	Schleich. ex F. Weber & D.M.H. Mohr	**FACW**	Variegated Scouring-Rush
Eragrostis bahiensis	Schrad. ex J.A. Schultes	**FAC**	Bahia Love Grass
Eragrostis cilianensis	(All.) Vign. ex Janchen	**FACU**	Stink Grass
Eragrostis ciliaris	(L.) R. Br.	**FACU**	Gopher-Tail Love Grass
Eragrostis frankii	C.A. Mey. ex Steud.	**FACW**	Sandbar Love Grass
Eragrostis hirsuta	(Michx.) Nees	**FACU**	Big-Top Love Grass
Eragrostis hypnoides	(Lam.) B.S.P.	**OBL**	Teal Love Grass
Eragrostis mexicana	(Hornem.) Link	**FAC**	Mexican Love Grass
Eragrostis pectinacea	(Michx.) Nees ex Jedw.	**FAC**	Purple Love Grass
Eragrostis pilosa	(L.) Beauv.	**FACU**	Indian Love Grass
Eragrostis refracta	(Muhl.) Scribn.	**FACW**	Meadow Love Grass
Eragrostis reptans	(Michx.) Nees	**OBL**	Creeping Love Grass
Eragrostis spectabilis	(Pursh) Steud.	**UPL**	Petticoat-Climber
Erica tetralix	L.	**FACU**	Cross-Leaf Heath
Erigeron acris	L.	**FAC**	Bitter Fleabane
Erigeron annuus	(L.) Pers.	**FACU**	Eastern Daisy Fleabane
Erigeron canadensis	L.	**FACU**	Canadian Horseweed
Erigeron flagellaris	Gray	**FAC**	Trailing Fleabane
Erigeron glabellus	Nutt.	**FACW**	Streamside Fleabane
Erigeron hyssopifolius	Michx.	**FACW**	Hyssop-Leaf Fleabane
Erigeron lonchophyllus	Hook.	**FACW**	Short-Ray Fleabane
Erigeron philadelphicus	L.	**FAC**	Philadelphia Fleabane
Erigeron pulchellus	Michx.	**FACU**	Robin's-Plantain
Erigeron strigosus	Muhl. ex Willd.	**FACU**	Prairie Fleabane
Eriocaulon aquaticum	(Hill) Druce	**OBL**	Seven-Angle Pipewort
Eriocaulon decangulare	L.	**OBL**	Ten-Angle Pipewort
Eriocaulon parkeri	B.L. Robins.	**OBL**	Estuary Pipewort
Eriochloa acuminata	(J. Presl) Kunth	**FACW**	Taper-Tip Cup Grass
Eriochloa contracta	A.S. Hitchc.	**FAC**	Prairie Cup Grass
Eriophorum angustifolium	Honckeny	**OBL**	Tall Cotton-Grass
Eriophorum chamissonis	C.A. Mey.	**OBL**	Chamisso's Cotton-Grass
Eriophorum gracile	W.D.J. Koch	**OBL**	Slender Cotton-Grass
Eriophorum russeolum	Fries ex Hartman	**OBL**	Russet-Bristle Cotton-Grass
Eriophorum tenellum	Nutt.	**OBL**	Few-Nerve Cotton-Grass
Eriophorum vaginatum	L.	**OBL**	Tussock Cotton-Grass

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Eriophorum virginicum	L.	**OBL**	Taw ny Cotton-Grass
Eriophorum viridicarinatum	(Engelm.) Fern.	**OBL**	Tassel Cotton-Grass
Erodium botrys	(Cav.) Bertol.	**FACU**	Long-Beak Stork's-Bill
Eryngium aquaticum	L.	**OBL**	Rattlesnake-Master
Eryngium yuccifolium	Michx.	**FAC**	Button Eryngo
Erysimum cheiranthoides	L.	**FACU**	Worm-Seed Wallflow er
Erythronium albidum	Nutt.	**FACU**	Small White Faw n-Lily
Eubotrys racemosa	(L.) Nutt.	**FACW**	Sw amp Deciduous-Doghobble
Eubotrys recurva	(Buckl.) Britt.	**FACU**	Red-Tw ig Deciduous-Doghobble
Euchiton involucratus	(G. Forst.) A. Anderb.	**FACW**	Star-Cudw eed
Euonymus americanus	L.	**FAC**	American Straw berry-Bush
Euonymus atropurpureus	Jacq.	**FACU**	Eastern Wahoo
Euonymus obovatus	Nutt.	**FACU**	Running Straw berry-Bush
Eupatorium capillifolium	(Lam.) Small	**FACU**	Dog-Fennel
Eupatorium leucolepis	(DC.) Torr. & Gray	**FACW**	Justicew eed
Eupatorium novae-angliae	(Fern.) V.I. Sullivan ex A. Haines & Sorrie	**FACW**	New England Thoroughw ort
Eupatorium perfoliatum	L.	**FACW**	Common Boneset
Eupatorium pilosum	Walt.	**FACW**	Rough Boneset
Eupatorium resinosum	Torr. ex DC.	**OBL**	Pine-Barren Thoroughw ort
Eupatorium rotundifolium	L.	**FAC**	Round-Leaf Thoroughw ort
Eupatorium serotinum	Michx.	**FAC**	Late-Flow ering Thoroughw ort
Euphorbia commutata	Engelm. ex Gray	**UPL**	Tinted Woodland Spurge
Euphorbia cyathophora	Murr.	**FACU**	Fire-on-the-Mountain
Euphorbia hirta	L.	**UPL**	Pill-Pod Sandmat
Euphorbia humistrata	Engelm. ex Gray	**FACW**	Spreading Sandmat
Euphorbia maculata	L.	**FACU**	Spotted Sandmat
Euphorbia marginata	Pursh	**FACU**	Snow -on-the-Mountain
Euphorbia nutans	Lag.	**FACU**	Eyebane
Euphorbia polygonifolia	L.	**UPL**	Seaside Sandmat
Euphorbia prostrata	Ait.	**FACU**	Prostrate Sandmat
Euphorbia serpens	Kunth	**FACW**	Matted Sandmat
Euphorbia spathulata	Lam.	**FACU**	Warty Spurge
Euphrasia randii	B.L. Robins.	**FACW**	Small Eyebright
Euphrasia stricta	D. Wolff ex J.F. Lehm.	**FACU**	Drug Eyebright
Eurybia macrophylla	(L.) Cass.	**UPL**	Large-Leaf Wood-Aster
Eurybia radula	(Ait.) Nesom	**OBL**	Rough Wood-Aster
Eustachys petraea	(Sw .) Desv.	**FACU**	Pinew oods Finger Grass
Euthamia caroliniana	(L.) Greene ex Porter & Britt.	**FAC**	Slender Goldentop
Euthamia graminifolia	(L.) Nutt.	**FAC**	Flat-Top Goldentop
Euthamia gymnospermoides	Greene	**FACW**	Texas Goldentop
Eutrochium dubium	(Willd. ex Poir.) E. Lamont	**FACW**	Coastal-Plain Trumpetw eed
Eutrochium fistulosum	(Barratt) E. Lamont	**FACW**	Trumpetw eed
Eutrochium maculatum	(L.) E. Lamont	**OBL**	Spotted Trumpetw eed
Eutrochium purpureum	(L.) E. Lamont	**FAC**	Sw eet-Scented Joe-Pye-Weed
Fagus grandifolia	Ehrh.	**FACU**	American Beech
Fallopia convolvulus	(L.) A. Löve	**FACU**	Black-Bindw eed
Fallopia dumetorum	(L.) Holub	**FAC**	Corpse Black-Bindw eed
Fallopia scandens	(L.) Holub	**FAC**	Climbing Black-Bindw eed
Fatoua villosa	(Thunb.) Nakai	**FAC**	Hairy Crabw eed
Festuca altaica	Trin.	**FACU**	Rough Fescue
Festuca ovina	L.	**UPL**	Sheep Fescue
Festuca paradoxa	Desv.	**FAC**	Clustered Fescue
Festuca rubra	L.	**FACU**	Red Fescue
Festuca subverticillata	(Pers.) Alexeev	**FACU**	Nodding Fescue
Festuca trachyphylla	(Hack.) Krajina	**UPL**	Hard Fescue
Ficaria verna	Huds.	**FACW**	Eurasian-Buttercup
Ficus carica	L.	**UPL**	Common Fig
Filipendula rubra	(Hill) B.L. Robins.	**FACW**	Queen-of-the-Prairie
Filipendula ulmaria	(L.) Maxim.	**FAC**	Queen-of-the-Meadow
Fimbristylis annua	(All.) Roemer & J.A. Schultes	**FACW**	Annual Fimbry
Fimbristylis autumnalis	(L.) Roemer & J.A. Schultes	**FACW**	Slender Fimbry
Fimbristylis caroliniana	(Lam.) Fern.	**FACW**	Carolina Fimbry
Fimbristylis castanea	(Michx.) Vahl	**OBL**	Marsh Fimbry
Fimbristylis puberula	(Michx.) Vahl	**OBL**	Hairy Fimbry
Flaveria trinervia	(Spreng.) C. Mohr	**FACW**	Clustered Yellow tops
Floerkea proserpinacoides	Willd.	**FAC**	False Mermaidw eed
Fragaria chiloensis	(L.) P. Mill.	**FACU**	Beach Straw berry
Fragaria vesca	L.	**UPL**	Woodland Straw berry
Fragaria virginiana	Duchesne	**FACU**	Virginia Straw berry
Frangula alnus	P. Mill.	**FAC**	Glossy False Buckthorn
Frangula caroliniana	(Walt.) Gray	**FAC**	Carolina False Buckthorn
Frangula purshiana	(DC.) Cooper	**FACU**	Cascara False Buckthorn
Fraxinus americana	L.	**FACU**	White Ash
Fraxinus nigra	Marsh.	**FACW**	Black Ash
Fraxinus pennsylvanica	Marsh.	**FACW**	Green Ash

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Fraxinus profunda	(Bush) Bush ex Britt.	**OBL**	Pumpkin Ash
Fuirena pumila	(Torr.) Spreng.	**OBL**	Dwarf Umbrella Sedge
Fuirena squarrosa	Michx.	**OBL**	Hairy Umbrella Sedge
Gaillardia pulchella	Foug.	**UPL**	Firewheel
Galactia volubilis	(L.) Britt.	**FAC**	Downy Milk-Pea
Galax urceolata	(Poir.) Brummitt	**FACU**	Beetleweed
Galeopsis tetrahit	L.	**FACU**	Brittle-Stem Hemp-Nettle
Galinsoga parviflora	Cav.	**UPL**	Gallant-Soldier
Galinsoga quadriradiata	Ruiz & Pavón	**FACU**	Shaggy-Soldier
Galium aparine	L.	**FACU**	Sticky-Willy
Galium asprellum	Michx.	**OBL**	Rough Bedstraw
Galium boreale	L.	**FAC**	Northern Bedstraw
Galium brevipes	Fern. & Wieg.	**OBL**	Limestone-Swamp Bedstraw
Galium circaezans	Michx.	**FACU**	Licorice Bedstraw
Galium concinnum	Torr. & Gray	**FACU**	Shining Bedstraw
Galium divaricatum	Pourret ex Lam.	**FACU**	Lamarck's Bedstraw
Galium labradoricum	(Wieg.) Wieg.	**OBL**	Northern Bog Bedstraw
Galium mollugo	L.	**FACU**	White Bedstraw
Galium obtusum	Bigelow	**FACW**	Blunt-Leaf Bedstraw
Galium palustre	L.	**OBL**	Common Marsh Bedstraw
Galium tinctorium	(L.) Scop.	**OBL**	Stiff Marsh Bedstraw
Galium trifidum	L.	**FACW**	Three-Petal Bedstraw
Galium triflorum	Michx.	**FACU**	Fragrant Bedstraw
Gamochaeta pensylvanica	(Willd.) Cabrera	**FACU**	Pennsylvania Everlasting
Gamochaeta purpurea	(L.) Cabrera	**FACU**	Spoon-Leaf Purple Everlasting
Gastridium phleoides	(Nees & Meyen) C.E. Hubbard	**FACU**	Nit Grass
Gaultheria hispidula	(L.) Muhl. ex Bigelow	**FACW**	Creeping-Snowberry
Gaultheria procumbens	L.	**FACU**	Eastern Teaberry
Gaylussacia baccata	(Wangenh.) K. Koch	**FACU**	Black Huckleberry
Gaylussacia bigeloviana	(Fern.) Sorrie & Weakley	**OBL**	Northern Dwarf Huckleberry
Gaylussacia dumosa	(Andr.) Torr. & Gray	**FAC**	Southern Dwarf Huckleberry
Gaylussacia frondosa	(L.) Torr. & Gray ex Torr.	**FAC**	Blue Huckleberry
Gentiana affinis	Griseb.	**FACU**	Pleated Gentian
Gentiana alba	Muhl. ex Nutt.	**FACU**	Yellow Gentian
Gentiana andrewsii	Griseb.	**FACW**	Closed Bottle Gentian
Gentiana clausa	Raf.	**FACW**	Bottle Gentian
Gentiana linearis	Froel.	**FACW**	Narrow-Leaf Gentian
Gentiana rubricaulis	Schwein.	**OBL**	Closed Gentian
Gentiana saponaria	L.	**FACW**	Harvestbells
Gentianella amarella	(L.) Börner	**OBL**	Autumn Dwarf-Gentian
Gentianella quinquefolia	(L.) Small	**FAC**	Agueweed
Gentianopsis crinita	(Froel.) Ma	**FACW**	Greater Fringed-Gentian
Gentianopsis virgata	(Raf.) Holub	**OBL**	Lesser Fringed-Gentian
Geocaulon lividum	(Richards.) Fern.	**FAC**	False Toadflax
Geranium maculatum	L.	**FACU**	Spotted Crane's-Bill
Geranium robertianum	L.	**FACU**	Lesser Herbrobert
Geum aleppicum	Jacq.	**FAC**	Yellow Avens
Geum canadense	Jacq.	**FAC**	White Avens
Geum laciniatum	Murr.	**FACW**	Rough Avens
Geum macrophyllum	Willd.	**FACW**	Large-Leaf Avens
Geum peckii	Pursh	**OBL**	Mountain Avens
Geum rivale	L.	**OBL**	Purple Avens
Geum triflorum	Pursh	**FACU**	Old-Man's-Whiskers
Geum vernum	(Raf.) Torr. & Gray	**FACU**	Spring Avens
Geum virginianum	L.	**FACU**	Cream Avens
Glechoma hederacea	L.	**FACU**	Groundivy
Gleditsia aquatica	Marsh.	**OBL**	Water-Locust
Gleditsia triacanthos	L.	**FAC**	Honey-Locust
Glossostigma cleistanthum	W.R. Barker	**OBL**	Mudmats
Glyceria acutiflora	Torr.	**OBL**	Creeping Manna Grass
Glyceria borealis	(Nash) Batchelder	**OBL**	Small Floating Manna Grass
Glyceria canadensis	(Michx.) Trin.	**OBL**	Rattlesnake Manna Grass
Glyceria declinata	Brébiss.	**OBL**	Waxy Manna Grass
Glyceria fluitans	(L.) R. Br.	**OBL**	Water Manna Grass
Glyceria grandis	S. Wats.	**OBL**	American Manna Grass
Glyceria laxa	(Scribn.) Scribn.	**OBL**	Limp Manna Grass
Glyceria maxima	(Hartman) Holmb.	**OBL**	Reed Manna Grass
Glyceria melicaria	(Michx.) F.T. Hubbard	**OBL**	Melic Manna Grass
Glyceria obtusa	(Muhl.) Trin.	**OBL**	Atlantic Manna Grass
Glyceria septentrionalis	A.S. Hitchc.	**OBL**	Floating Manna Grass
Glyceria striata	(Lam.) A.S. Hitchc.	**OBL**	Fowl Manna Grass
Glycyrrhiza lepidota	Pursh	**FACU**	American Licorice
Gnaphalium uliginosum	L.	**FAC**	Marsh Cudweed
Gomphrena globosa	L.	**UPL**	Common Globe-Amaranth
Goodyera oblongifolia	Raf.	**FACU**	Green-Leaf Rattlesnake-Plantain

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Goodyera pubescens	(Willd.) R. Br.	**FACU**	Dow ny Rattlesnake-Plantain
Goodyera repens	(L.) R. Br.	**FACU**	Dw arf Rattlesnake-Plantain
Goodyera tesselata	Lodd.	**FACU**	Checkered Rattlesnake-Plantain
Gossypium hirsutum	L.	**UPL**	Upland Cotton
Graphephorum melicoides	(Michx.) Desv.	**FACW**	
Gratiola aurea	Pursh	**OBL**	Golden Hedge-Hyssop
Gratiola neglecta	Torr.	**OBL**	Clammy Hedge-Hyssop
Gratiola virginiana	L.	**OBL**	Round-Fruit Hedge-Hyssop
Grindelia camporum	Greene	**FACU**	Great Valley Gumw eed
Grindelia ciliata	(Nutt.) Spreng.	**UPL**	Spanishgold
Grindelia squarrosa	(Pursh) Dunal	**FACU**	Curly-Cup Gumw eed
Gymnocarpium dryopteris	(L.) New man	**FACU**	Northern Oak Fern
Gymnocarpium robertianum	(Hoffmann) New man	**FACU**	Limestone Oak Fern
Gynandropsis gynandra	(L.) Briq.	**FACU**	Spiderw isp
Hackelia virginiana	(L.) I.M. Johnston	**FACU**	Beggar's-Lice
Halenia deflexa	(Sm.) Griseb.	**FAC**	American Spurred-Gentian
Halesia carolina	L.	**FACU**	Carolina Silverbell
Hamamelis virginiana	L.	**FACU**	American Witch-Hazel
Hammarbya paludosa	(L.) Kuntze	**OBL**	
Hedera helix	L.	**FACU**	English Ivy
Hedysarum alpinum	L.	**FAC**	Alpine Sw eet-Vetch
Helanthium tenellum	Britt.	**OBL**	Dw arf Burhead Pygmy Sw ordplant
Helenium amarum	(Raf.) H. Rock	**FACU**	Yellow dicks
Helenium autumnale	L.	**FACW**	Fall Sneezew eed
Helenium flexuosum	Raf.	**FAC**	Purple-Head Sneezew eed
Helianthus angustifolius	L.	**FACW**	Sw amp Sunflow er
Helianthus annuus	L.	**FACU**	Common Sunflow er
Helianthus debilis	Nutt.	**UPL**	Cucumber-Leaf Sunflow er
Helianthus decapetalus	L.	**FACU**	Thin-Leaf Sunflow er
Helianthus giganteus	L.	**FACW**	Giant Sunflow er
Helianthus grosseserratus	Martens	**FACW**	Saw -Tooth Sunflow er
Helianthus maximiliani	Schrad.	**UPL**	Maximilian Sunflow er
Helianthus microcephalus	Torr. & Gray	**FACU**	Small Woodland Sunflow er
Helianthus nuttallii	Torr. & Gray	**FACW**	Nuttall's Sunflow er
Helianthus occidentalis	Riddell	**FACU**	Few -Leaf Sunflow er
Helianthus strumosus	L.	**FACU**	Pale-Leaf Woodland Sunflow er
Helianthus tuberosus	L.	**FACU**	Jerusalem-Artichoke
Heliopsis helianthoides	(L.) Sw eet	**FACU**	Smooth Oxeye
Heliotropium curassavicum	L.	**OBL**	Seaside Heliotrope
Heliotropium indicum	L.	**FACW**	Indian Heliotrope
Helminthotheca echioides	(L.) Holub	**UPL**	Akan Asante
Helonias bullata	L.	**OBL**	Sw amp-Pink
Helosciadium nodiflorum	(L.) W.D.J. Koch	**OBL**	Fool's-Watercress
Hemerocallis fulva	(L.) L.	**UPL**	Orange Day-Lily
Heracleum mantegazzianum	Sommier & Levier	**FAC**	Giant Hogw eed
Heracleum maximum	Bartr.	**FACW**	American Cow -Parsnip
Heracleum sphondylium	L.	**UPL**	Eltrot
Hesperis matronalis	L.	**FACU**	Mother-of-the-Evening
Heteranthera dubia	(Jacq.) MacM.	**OBL**	Grass-Leaf Mud-Plantain
Heteranthera limosa	(Sw .) Willd.	**OBL**	Blue Mud-Plantain
Heteranthera reniformis	Ruiz & Pavón	**OBL**	Kidney-Leaf Mud-Plantain
Heuchera americana	L.	**FACU**	American Alumroot
Heuchera richardsonii	R. Br.	**FACU**	Richardson's Alumroot
Hexastylis shuttleworthii	(Britten & Baker) Small	**FACU**	Large-Flow er Heartleaf
Hibiscus laevis	All.	**OBL**	Halberd-Leaf Rose-Mallow
Hibiscus moscheutos	L.	**OBL**	Crimson-Eyed Rose-Mallow
Hieracium greenii	Porter & Britt.	**FACU**	Green's Haw kw eed
Hieracium gronovii	L.	**UPL**	Queendevil
Hippuris vulgaris	L.	**OBL**	Common Mare's-Tail
Holcus lanatus	L.	**FACU**	Common Velvet Grass
Holcus mollis	L.	**FACU**	Creeping Velvet Grass
Honckenya peploides	(L.) Ehrh.	**FACU**	Seaside Sandplant
Hordeum brachyantherum	Nevski	**FACW**	Meadow Barley
Hordeum jubatum	L.	**FAC**	Fox-Tail Barley
Hordeum marinum	Huds.	**FACU**	Seaside Barley
Hordeum murinum	L.	**FACU**	Wall Barley
Hordeum pusillum	Nutt.	**FAC**	Little Barley
Hottonia inflata	Ell.	**OBL**	American Featherfoil
Houstonia caerulea	L.	**FACU**	Quaker-Ladies
Houstonia pusilla	Schoepf	**FACU**	Tiny Bluet
Humulus japonicus	Sieb. & Zucc.	**FACU**	Japanese Hop
Humulus lupulus	L.	**FACU**	Common Hop
Huperzia lucidula	(Michx.) Trevisan	**FAC**	Shining Fir-Moss
Huperzia porophila	(Lloyd & Underw ood) Holub	**FACU**	Rock Fir-Moss
Huperzia selago	(L.) Bernh. ex Mart. & Schrank	**FACU**	Fir-Moss

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Hybanthus concolor	(T.F. Forst.) Spreng.	**FACU**	Eastern Green-Violet
Hydrangea arborescens	L.	**FACU**	Wild Hydrangea
Hydrangea paniculata	Sieb.	**FAC**	Panicled Hydrangea
Hydrilla verticillata	(L. f.) Royle	**OBL**	Water-Thyme
Hydrocharis morsus-ranae	L.	**OBL**	Common Frogbit
Hydrocotyle americana	L.	**OBL**	American Marsh-Pennywort
Hydrocotyle prolifera	Kellogg	**OBL**	Proliferous Marsh-Pennywort
Hydrocotyle ranunculoides	L. f.	**OBL**	Floating Marsh-Pennywort
Hydrocotyle sibthorpioides	Lam.	**FACW**	Lawn Marsh-Pennywort
Hydrocotyle umbellata	L.	**OBL**	Many-Flower Marsh-Pennywort
Hydrocotyle verticillata	Thunb.	**OBL**	Whorled Marsh-Pennywort
Hydrophyllum canadense	L.	**FAC**	Blunt-Leaf Waterleaf
Hydrophyllum virginianum	L.	**FAC**	Shawnee-Salad
Hypericum X dissimulatum	Bickn.	**FACW**	
Hypericum adpressum	Raf. ex W. Bart.	**OBL**	Creeping St. John's-Wort
Hypericum ascyron	L.	**FAC**	Great St. John's-Wort
Hypericum boreale	(Britt.) Bickn.	**OBL**	Northern St. John's-Wort
Hypericum canadense	L.	**FACW**	Lesser Canadian St. John's-Wort
Hypericum crux-andreae	(L.) Crantz	**FACU**	St. Peter's-Wort
Hypericum densiflorum	Pursh	**FACW**	Bushy St. John's-Wort
Hypericum denticulatum	Walt.	**FACW**	Coppery St. John's-Wort
Hypericum drummondii	(Grev. & Hook.) Torr. & Gray	**FACU**	Nits-and-Lice
Hypericum ellipticum	Hook.	**OBL**	Pale St. John's-Wort
Hypericum fraseri	(Spach) Steud.	**OBL**	Fraser's St. John's-Wort
Hypericum gentianoides	(L.) B.S.P.	**FACU**	Orange-Grass
Hypericum gymnanthum	Engelm. & Gray	**OBL**	Clasping-Leaf St. John's-Wort
Hypericum hypericoides	(L.) Crantz	**FACU**	St. Andrew's-Cross
Hypericum kalmianum	L.	**FACW**	Kalm's St. John's-Wort
Hypericum majus	(Gray) Britt.	**FACW**	Greater Canadian St. John's-Wort
Hypericum mutilum	L.	**FACW**	Dwarf St. John's-Wort
Hypericum perforatum	L.	**UPL**	Common St. John's-Wort
Hypericum prolificum	L.	**FACU**	Shrubby St. John's-Wort
Hypericum punctatum	Lam.	**FAC**	Spotted St. John's-Wort
Hypericum sphaerocarpum	Michx.	**FACU**	Round-Seed St. John's-Wort
Hypericum tubulosum	Walt.	**OBL**	Lesser St. John's-Wort
Hypericum virginicum	L.	**OBL**	Virginia St. John's-Wort
Hypericum walteri	J.G. Gmel.	**OBL**	Greater St. John's-Wort
Hypochaeris radicata	L.	**FACU**	Hairy Cat's-Ear
Hypoxis hirsuta	(L.) Coville	**FAC**	Eastern Yellow Star-Grass
Ilex aquifolium	L.	**FACU**	English Holly
Ilex cassine	L.	**FACW**	Dahoon
Ilex glabra	(L.) Gray	**FACW**	Inkberry
Ilex laevigata	(Pursh) Gray	**OBL**	Smooth Winterberry
Ilex montana	Torr. & Gray ex Gray	**FACU**	Mountain Holly
Ilex opaca	Ait.	**FACU**	American Holly
Ilex verticillata	(L.) Gray	**FACW**	Common Winterberry
Iliamna remota	Greene	**FAC**	Kankakee-Mallow
Impatiens balsamina	L.	**UPL**	Garden-Balsam
Impatiens capensis	Meerb.	**FACW**	Spotted Touch-Me-Not
Impatiens glandulifera	Royle	**FAC**	Policeman's-Helmet
Impatiens pallida	Nutt.	**FACW**	Pale Touch-Me-Not
Impatiens walleriana	Hook. f.	**FACW**	Buzzy-Lizzy
Inula helenium	L.	**FACU**	Elecampane
Iodanthus pinnatifidus	(Michx.) Steud.	**FACW**	Purple-Rocket
Ipomoea coccinea	L.	**FAC**	Redstar
Ipomoea hederacea	Jacq.	**FAC**	Ivy-Leaf Morning-Glory
Ipomoea hederifolia	L.	**UPL**	Scarlet-Creeper
Ipomoea lacunosa	L.	**FACW**	Whitestar
Ipomoea pandurata	(L.) G.F.W. Mey.	**FACU**	Man-of-the-Earth
Ipomoea pes-caprae	(L.) R. Br.	**FAC**	Bay-Hops
Ipomoea purpurea	(L.) Roth	**FACU**	Common Morning-Glory
Ipomoea quamoclit	L.	**FACU**	Cypress-Vine
Iris brevicaulis	Raf.	**OBL**	Zigzag Iris
Iris fulva	Ker-Gawl.	**OBL**	Copper Iris
Iris hookeri	Penny ex G. Don	**FACW**	
Iris lacustris	Nutt.	**FAC**	Dwarf Lake Iris
Iris prismatica	Pursh ex Ker-Gawl.	**OBL**	Slender Blue Iris
Iris pseudacorus	L.	**OBL**	Pale-Yellow Iris
Iris versicolor	L.	**OBL**	Harlequin Blueflag
Iris virginica	L.	**OBL**	Virginia Blueflag
Isoetes X brittonii	Brunton & W.C. Taylor	**OBL**	
Isoetes X dodgei	A.A. Eat. (pro sp.)	**OBL**	
Isoetes X eatonii	Dodge (pro sp.)	**OBL**	
Isoetes X echtuckeri	D.F. Brunton & D.M. Britton	**OBL**	
Isoetes X fairbrothersii	J.D. Montgomery & W.C. Taylor	**OBL**	

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Isoetes X foveolata	A.A. Eat. ex Dodge (pro sp.)	OBL	
Isoetes X harveyi	A.A. Eat. (pro sp.)	OBL	
Isoetes X hickeyi	W.C. Taylor & N. Luebke	OBL	
Isoetes acadiensis	Kott	OBL	Acadian Quillwort
Isoetes appalachiana	D.F. Brunton & D.M. Britton	OBL	Appalachian Quillwort
Isoetes echinospora	Durieu	OBL	Spiny-Spore Quillwort
Isoetes engelmannii	A. Braun	OBL	Engelmann's Quillwort
Isoetes lacustris	L.	OBL	Western Lake Quillwort
Isoetes melanopoda	Gay & Durieu ex Durieu	OBL	Black-Foot Quillwort
Isoetes novae-angliae	D.F. Brunton & D.M. Britton	OBL	New England Quillwort
Isoetes prototypus	D.M. Britt.	OBL	Spike Quillwort
Isoetes riparia	Engelm. ex A. Braun	OBL	Shore Quillwort
Isoetes tuckermanii	A. Braun	OBL	Tuckerman's Quillwort
Isoetes valida	(Engelm.) Clute	OBL	True Quillwort
Isotrema tomentosum	(Sims) Huber	FAC	Woolly Pipevine
Isotria medeoloides	(Pursh) Raf.	FACU	Green Five-Leaf Orchid
Isotria verticillata	Raf.	FAC	Purple Five-Leaf Orchid
Itea virginica	L.	OBL	Virginia Sweetspire
Iva annua	L.	FAC	Annual Marsh-Elder
Iva axillaris	Pursh	FAC	Deer-Root
Iva frutescens	L.	FACW	Jesuit's-Bark
Jacobaea vulgaris	Gaertn.	UPL	Stinking Willie
Jacquemontia tamnifolia	(L.) Griseb.	UPL	Hairy Clustervine
Juglans cinerea	L.	FACU	White Walnut
Juglans nigra	L.	FACU	Black Walnut
Juncus X oronensis	Fern. (pro sp.)	FACW	
Juncus acuminatus	Michx.	OBL	Knotty-Leaf Rush
Juncus alpinoarticulatus	Chaix	OBL	Northern Green Rush
Juncus anthelatus	(Wieg.) R.E. Brooks	FACW	Kentucky Rush
Juncus articulatus	L.	OBL	Joint-Leaf Rush
Juncus balticus	Willd.	OBL	Baltic Rush
Juncus brachycarpus	Engelm.	FACW	White-Root Rush
Juncus brachycephalus	(Engelm.) Buch.	OBL	Small-Head Rush
Juncus brevicaudatus	(Engelm.) Fern.	OBL	Narrow-Panicle Rush
Juncus bufonius	L.	FACW	Toad Rush
Juncus bulbosus	L.	OBL	Bulbous Rush
Juncus caesariensis	Coville	OBL	New Jersey Rush
Juncus canadensis	J. Gay ex Laharpe	OBL	Canadian Rush
Juncus compressus	Jacq.	FACW	Round-Fruit Rush
Juncus debilis	Gray	OBL	Weak Rush
Juncus dichotomus	Ell.	FACW	Forked Rush
Juncus diffusissimus	Buckl.	FACW	Slim-Pod Rush
Juncus dudleyi	Wieg.	FACW	Dudley's Rush
Juncus effusus	L.	OBL	Lamp Rush
Juncus ensifolius	Wikstr.	FACW	Dagger-Leaf Rush
Juncus filiformis	L.	FACW	Thread Rush
Juncus gerardii	Loisel.	OBL	Saltmarsh Rush
Juncus greenei	Oakes & Tuckerman	FAC	Greene's Rush
Juncus gymnocarpus	Coville	OBL	Pennsylvania Rush
Juncus inflexus	L.	FACW	European Blue Rush
Juncus interior	Wieg.	FAC	Inland Rush
Juncus longistylis	Torr.	FACW	Long-Style Rush
Juncus marginatus	Rostk.	FACW	Bog Rush
Juncus militaris	Bigelow	OBL	Bayonet Rush
Juncus nodatus	Coville	OBL	Stout Rush
Juncus nodosus	L.	OBL	Knotted Rush
Juncus pelocarpus	E. Mey.	OBL	Brown-Fruit Rush
Juncus pylaei	Laharpe	OBL	Common Rush
Juncus scirpoides	Lam.	FACW	Needle-Pod Rush
Juncus secundus	Beauv. ex Poir.	FACU	Lopsided Rush
Juncus squarrosus	L.	FACW	Mosquito Rush
Juncus stygius	L.	OBL	Moor Rush
Juncus subcaudatus	(Engelm.) Coville & Blake	OBL	Woodland Rush
Juncus subnodulosus	Schrank	OBL	Blunt-Flower Rush
Juncus subtilis	E. Mey.	OBL	Greater Creeping Rush
Juncus tenuis	Willd.	FAC	Lesser Poverty Rush
Juncus torreyi	Coville	FACW	Torrey's Rush
Juncus trifidus	L.	FACU	Highland Rush
Juncus vaseyi	Engelm.	FACW	Vasey's Rush
Juniperus communis	L.	FACU	Common Juniper
Juniperus horizontalis	Moench	FACU	Creeping Juniper
Juniperus virginiana	L.	FACU	Eastern Red-Cedar
Justicia americana	(L.) Vahl	OBL	American Water-Willow
Kalmia angustifolia	L.	FAC	Sheep-Laurel
Kalmia buxifolia	(Berg.) Gift & K.A. Kron	FACU	Sand-Myrtle

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Kalmia latifolia	L.	FACU	Mountain-Laurel
Kalmia polifolia	Wangenh.	OBL	Bog-Laurel
Kickxia elatine	(L.) Dumort.	FAC	Sharp-Leaf Cancerw ort
Kosteletzkya pentacarpos	(L.) Ledeb.	OBL	Virginia Fen-Rose
Krigia biflora	(Walt.) Blake	FACU	Tw o-Flow er Dw arf-Dandelion
Krigia caespitosa	(Raf.) Chambers	FACU	Weedy Dw arf-Dandelion
Krigia virginica	(L.) Willd.	UPL	Virginia Dw arf-Dandelion
Kummerowia stipulacea	(Maxim.) Makino	FACU	Korean-Clover
Kummerowia striata	(Thunb.) Schindl.	FACU	Japanese-Clover
Kyllinga gracillima	Miq.	FACW	Pasture Spike Sedge
Kyllinga pumila	Michx.	FACW	Low Spike Sedge
Lachnagrostis filiformis	(G. Forst.) Trin.	FAC	Common Blow n Grass
Lachnanthes caroliniana	(Lam.) Dandy	OBL	Carolina Redroot
Lactuca biennis	(Moench) Fern.	FAC	Wild Blue Lettuce
Lactuca canadensis	L.	FACU	Canadian Blue Lettuce
Lactuca floridana	(L.) Gaertn.	FACU	Woodland Lettuce
Lactuca graminifolia	Michx.	UPL	Grass-Leaf Lettuce
Lactuca ludoviciana	(Nutt.) Riddell	UPL	Louisiana Lettuce
Lactuca saligna	L.	FACU	Willow -Leaf Lettuce
Lactuca serriola	L.	FACU	Prickly Lettuce
Lactuca tatarica	(L.) C.A. Mey.	FAC	Russian Blue Lettuce
Landoltia punctata	(G.F.W. Mey.) D.H. Les & D.J. Craw ford	OBL	Dotted Duckmeat
Laportea canadensis	(L.) Weddell	FACW	Canadian Wood-Nettle
Lapsana communis	L.	FACU	Common Nipplew ort
Larix laricina	(Du Roi) K. Koch	FACW	American Larch
Lasthenia californica	DC. ex Lindl.	UPL	California Goldfields
Lasthenia minor	(DC.) Ornduff	FAC	Coastal Goldfields
Lathyrus hirsutus	L.	FACU	Singletary Vetchling
Lathyrus japonicus	Willd.	FACU	Sea Vetchling
Lathyrus palustris	L.	FACW	Marsh Vetchling
Lathyrus pratensis	L.	FACU	Meadow Vetchling
Lathyrus venosus	Muhl. ex Willd.	FAC	Veiny Vetchling
Leersia lenticularis	Michx.	OBL	Catchfly Grass
Leersia oryzoides	(L.) Sw .	OBL	Rice Cut Grass
Leersia virginica	Willd.	FACW	White Grass
Lemna aequinoctialis	Welw .	OBL	Lesser Duckw eed
Lemna gibba	L.	OBL	Inflated Duckw eed
Lemna minor	L.	OBL	Common Duckw eed
Lemna minuta	Kunth	OBL	Least Duckw eed
Lemna obscura	(Austin) Daubs	OBL	Little Duckw eed
Lemna perpusilla	Torr.	OBL	Minute Duckw eed
Lemna trisulca	L.	OBL	Ivy-Leaf Duckw eed
Lemna turionifera	Landolt	OBL	Turion Duckw eed
Lemna valdiviana	Phil.	OBL	Pale Duckw eed
Leontodon saxatilis	Lam.	UPL	Lesser Haw kbit
Lepidium appelianum	Al-Shehbaz	UPL	Globe-Pod Pepperw ort
Lepidium densiflorum	Schrad.	FACU	Miner's Pepperw ort
Lepidium latifolium	L.	FACU	Broad-Leaf Pepperw ort
Lepidium nitidum	Nutt.	FAC	Shining Pepperw ort
Lepidium perfoliatum	L.	FACU	Clasping Pepperw ort
Lepidium virginicum	L.	FACU	Poorman's-Pepperw ort
Leptochloa crinita	(Lag.) P.M. Peterson & N. Snow	FAC	False Rhodes Grass
Lespedeza angustifolia	(Pursh) Ell.	FAC	Narrow -Leaf Bush-Clover
Lespedeza capitata	Michx.	FACU	Round-Head Bush-Clover
Lespedeza cuneata	(Dum.-Cours.) G. Don	UPL	Chinese Bush-Clover
Leucanthemum vulgare	Lam.	UPL	Ox-Eye Daisy
Leucospora multifida	(Michx.) Nutt.	FACW	Narrow -Leaf Paleseed
Leucothoe axillaris	(Lam.) D. Don	FACW	Coastal Doghobble
Leucothoe fontanesiana	(Steud.) Sleumer	FACW	Highland Doghobble
Leymus arenarius	(L.) Hochst.	FACU	European Lyme Grass
Leymus mollis	(Trin.) Pilger	FACU	American Lyme Grass
Liatris ligulistylis	(A. Nels.) K. Schum.	FACU	Strap-Style Gayfeather
Liatris pycnostachya	Michx.	FAC	Cat-Tail Gayfeather
Liatris scariosa	(L.) Willd.	UPL	Devil's-Bite
Liatris spicata	(L.) Willd.	FAC	Dense Gayfeather
Ligusticum scoticum	L.	FAC	Scot's Lovage
Ligustrum sinense	Lour.	FACU	Chinese Privet
Ligustrum vulgare	L.	FACU	European Privet
Lilaeopsis chinensis	(L.) Kuntze	OBL	Eastern Grassw ort
Lilium canadense	L.	FAC	Canadian Lily
Lilium michiganense	Farw .	FACW	Michigan Lily
Lilium philadelphicum	L.	FAC	Wood Lily
Lilium superbum	L.	FACW	Turk's-Cap Lily
Limnobium spongia	(Bosc) L.C. Rich. ex Steud.	OBL	American Spongeplant
Limonium carolinianum	(Walt.) Britt.	OBL	Carolina Sea-Lavender

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Limosella aquatica	L.	OBL	Awl-Leaf Mudwort
Limosella australis	R. Br.	OBL	Welsh Mudwort
Lindera benzoin	(L.) Blume	FACW	Northern Spicebush
Lindernia dubia	(L.) Pennell	OBL	Yellow-Seed False Pimpernel
Lindernia procumbens	(Krock.) Borb.	FACW	Prostrate False Pimpernel
Linnaea borealis	L.	FAC	American Twinflower
Linum floridanum	(Planch.) Trel.	FAC	Florida Yellow Flax
Linum intercursum	Bickn.	FACU	Sandplain Flax
Linum medium	(Planch.) Britt.	FACU	Stiff Yellow Flax
Linum striatum	Walt.	FACW	Ridged Yellow Flax
Linum virginianum	L.	FAC	Woodland Flax
Liparis liliifolia	(L.) L.C. Rich. ex Ker-Gawl.	FACU	Brown Wide-Lip Orchid
Liparis loeselii	(L.) L.C. Rich.	FACW	Yellow Wide-Lip Orchid
Lipocarpha drummondii	(Nees) G. Tucker	FACW	Drummond's Halfchaff Sedge
Lipocarpha micrantha	(Vahl) G. Tucker	OBL	Small-Flower Halfchaff Sedge
Liquidambar styraciflua	L.	FAC	Sweet-Gum
Liriodendron tulipifera	L.	FACU	Tuliptree
Littorella americana	Fern.	OBL	American Shoreweed
Lobelia cardinalis	L.	OBL	Cardinal-Flower
Lobelia dortmanna	L.	OBL	Water Lobelia
Lobelia inflata	L.	FACU	Indian-Tobacco
Lobelia kalmii	L.	OBL	Brook Lobelia
Lobelia nuttallii	J.A. Schultes	FACW	Nuttall's Lobelia
Lobelia puberula	Michx.	FACW	Downy Lobelia
Lobelia siphilitica	L.	FACW	Great Blue Lobelia
Lobelia spicata	Lam.	FAC	Pale-Spike Lobelia
Loiseleuria procumbens	(L.) Desv.	FACW	Alpine-Azalea
Lolium perenne	L.	FACU	Perennial Rye Grass
Lomatogonium rotatum	(L.) Fries ex Fern.	OBL	Marsh-Felwort
Lonicera X bella	Zabel	FACU	
Lonicera canadensis	Bartr. ex Marsh.	FACU	American Fly-Honeysuckle
Lonicera dioica	L.	FACU	Limber Honeysuckle
Lonicera hirsuta	Eat.	FAC	Hairy Honeysuckle
Lonicera involucrata	(Richards.) Banks ex Spreng.	FACU	Four-Line Honeysuckle
Lonicera japonica	Thunb.	FACU	Japanese Honeysuckle
Lonicera morrowii	Gray	FACU	Morrow's Honeysuckle
Lonicera oblongifolia	(Goldie) Hook.	OBL	Swamp Fly-Honeysuckle
Lonicera sempervirens	L.	FACU	Trumpet Honeysuckle
Lonicera tatarica	L.	FACU	Twinsisters
Lonicera villosa	(Michx.) J.A. Schultes	FACW	Mountain Fly-Honeysuckle
Lotus corniculatus	L.	FACU	Garden Bird's-Foot-Trefoil
Lotus tenuis	Waldst. & Kit. ex Willd.	FACU	Narrow-Leaf Bird's-Foot-Trefoil
Ludwigia alternifolia	L.	OBL	Seedbox
Ludwigia decurrens	Walt.	OBL	Wing-Leaf Primrose-Willow
Ludwigia grandiflora	(M. Micheli) Greuter & Burdet	OBL	Large-Flower Primrose-Willow
Ludwigia palustris	(L.) Ell.	OBL	Marsh Primrose-Willow
Ludwigia peploides	(Kunth) Raven	OBL	Floating Primrose-Willow
Ludwigia polycarpa	Short & Peter	OBL	Many-Fruit Primrose-Willow
Ludwigia sphaerocarpa	Ell.	OBL	Globe-Fruit Primrose-Willow
Lupinus polyphyllus	Lindl.	FACU	Blue-Pod Lupine
Luzula acuminata	Raf.	FACU	Hairy Wood-Rush
Luzula bulbosa	(Wood) Smyth & Smyth	FACU	Bulbous Wood-Rush
Luzula campestris	(L.) DC.	FAC	Field Wood-Rush
Luzula confusa	Lindeberg	FAC	Northern Wood-Rush
Luzula congesta	(Thuill.) Lej.	FAC	Heath Wood-Rush
Luzula echinata	(Small) F.J. Herm.	FACU	Hedgehog Wood-Rush
Luzula multiflora	(Ehrh.) Lej.	FACU	Common Wood-Rush
Luzula pallidula	J. Kirschner	FAC	Pale European Wood-Rush
Luzula parviflora	(Ehrh.) Desv.	FAC	Small-Flower Wood-Rush
Luzula spicata	(L.) DC.	UPL	Spiked Wood-Rush
Lycopodiella X copelandii	(Eig.) Cranfill	FACW	
Lycopodiella alopecuroides	(L.) Cranfill	FACW	Fox-Tail Club-Moss
Lycopodiella appressa	(Chapman) Cranfill	FACW	Southern Appressed Club-Moss
Lycopodiella inundata	(L.) Holub	OBL	Northern Bog Club-Moss
Lycopodiella margueritae	J.G. Bruce, W.H. Wagner, & Beitel	FACW	Prostrate Club-Moss
Lycopodiella subappressa	J.G. Bruce, W.H. Wagner, & Beitel	FACW	Northern Appressed Club-Moss
Lycopodium clavatum	L.	FAC	Running Ground-Pine
Lycopodium lagopus	(Laestad. ex Hartm.) Zinserl. ex Kuzen	FACU	Single-Cone Ground-Pine
Lycopus X sherardii	Steele (pro sp.)	OBL	
Lycopus americanus	Muhl. ex W. Bart.	OBL	Cut-Leaf Water-Horehound
Lycopus amplectens	Raf.	OBL	Clasping Water-Horehound
Lycopus asper	Greene	OBL	Rough Water-Horehound
Lycopus europaeus	L.	OBL	Gypsywort
Lycopus rubellus	Moench	OBL	Taper-Leaf Water-Horehound
Lycopus uniflorus	Michx.	OBL	Northern Water-Horehound

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Lycopus virginicus	L.	**OBL**	Virginia Water-Horehound
Lygodium japonicum	(Thunb. ex Murr.) Sw.	**FAC**	Japanese Climbing Fern
Lygodium palmatum	(Bernh.) Sw.	**FACW**	American Climbing Fern
Lyonia ligustrina	(L.) DC.	**FACW**	Maleberry
Lyonia mariana	(L.) D. Don	**FAC**	Piedmont Staggerbush
Lysimachia X producta	(Gray) Fern. (pro sp.)	**FAC**	
Lysimachia arvensis	(L.) U. Manns & A. Anderb.	**FACU**	Scarlet Yellow-Loosestrife
Lysimachia ciliata	L.	**FACW**	Fringed Yellow-Loosestrife
Lysimachia hybrida	Michx.	**OBL**	Lowland Yellow-Loosestrife
Lysimachia lanceolata	Walt.	**FAC**	Lance-Leaf Yellow-Loosestrife
Lysimachia maritima	(L.) Galasso, Banfi & Soldano	**OBL**	Sea-Milkwort
Lysimachia minima	(L.) U. Manns & A. Anderb.	**FACU**	Chaffweed
Lysimachia nummularia	L.	**FACW**	Creeping-Jenny
Lysimachia punctata	L.	**OBL**	Large Yellow-Loosestrife
Lysimachia quadriflora	Sims	**OBL**	Four-Flower Yellow-Loosestrife
Lysimachia quadrifolia	L.	**FACU**	Whorled Yellow-Loosestrife
Lysimachia terrestris	(L.) B.S.P.	**OBL**	Swampcandles
Lysimachia thyrsiflora	L.	**OBL**	Tufted Yellow-Loosestrife
Lysimachia vulgaris	L.	**FACW**	Garden Yellow-Loosestrife
Lythrum alatum	Pursh	**OBL**	Wing-Angle Loosestrife
Lythrum hyssopifolium	L.	**OBL**	Hyssop Loosestrife
Lythrum lineare	L.	**OBL**	Saltmarsh Loosestrife
Lythrum portula	(L.) D.A. Webb	**OBL**	Spatula-Leaf Loosestrife
Lythrum salicaria	L.	**OBL**	Purple Loosestrife
Maclura pomifera	(Raf.) Schneid.	**FACU**	Osage-Orange
Madia glomerata	Hook.	**FACU**	Mountain Tarplant
Magnolia acuminata	(L.) L.	**FACU**	Cucumber-Tree
Magnolia fraseri	Walt.	**FACU**	Fraser's Magnolia
Magnolia tripetala	(L.) L.	**FACU**	Umbrella Magnolia
Magnolia virginiana	L.	**FACW**	Sweet-Bay
Mahonia aquifolium	(Pursh) Nutt.	**UPL**	Holly-Leaf Oregon-Grape
Maianthemum canadense	Desf.	**FACU**	False Lily-of-the-Valley
Maianthemum racemosum	(L.) Link	**FACU**	Feathery False Solomon's-Seal
Maianthemum stellatum	(L.) Link	**FAC**	Starry False Solomon's-Seal
Maianthemum trifolium	(L.) Sloboda	**OBL**	Three-Leaf False Solomon's-Seal
Malaxis monophyllos	(L.) Sw.	**FACW**	White Adder's-Mouth Orchid
Malaxis unifolia	Michx.	**FAC**	Green Adder's-Mouth Orchid
Malvastrum coromandelianum	(L.) Garcke	**FACU**	Three-Lobe False Mallow
Marrubium vulgare	L.	**FACU**	White Horehound
Marsilea quadrifolia	L.	**OBL**	European Water-Clover
Marsilea vestita	Hook. & Grev.	**OBL**	Hairy Water-Clover
Matricaria discoidea	DC.	**FACU**	Pineapple-Weed
Matteuccia struthiopteris	(L.) Todaro	**FAC**	Ostrich Fern
Mazus pumilus	(Burm. f.) Steenis	**UPL**	Japanese Mazus
Medeola virginiana	L.	**FACU**	Indian Cucumber-Root
Medicago lupulina	L.	**FACU**	Black Medick
Medicago polymorpha	L.	**FACU**	Toothed Medick
Medicago sativa	L.	**UPL**	Alfalfa
Meehania cordata	(Nutt.) Britt.	**FACU**	Meehan's-Mint
Melampyrum lineare	Desr.	**FACU**	American Cow-Wheat
Melia azedarach	L.	**FACU**	China-Berry
Melilotus indicus	(L.) All.	**FACU**	Indian Sweet-Clover
Melilotus officinalis	(L.) Lam.	**FACU**	Yellow Sweet-Clover
Melissa officinalis	L.	**UPL**	Lemonbalm
Melochia corchorifolia	L.	**FACU**	Chocolate-Weed
Menispermum canadense	L.	**FAC**	Canadian Moonseed
Mentha X gracilis	Sole (pro sp.)	**OBL**	
Mentha X piperita	L. (pro sp.)	**OBL**	
Mentha X rotundifolia	(L.) Huds. (pro sp.)	**FAC**	
Mentha X villosa	Huds. (pro sp.)	**FAC**	
Mentha aquatica	L.	**OBL**	Water Mint
Mentha arvensis	L.	**FACW**	American Wild Mint
Mentha spicata	L.	**FACW**	Spearmint
Mentha suaveolens	Ehrh.	**FAC**	Apple Mint
Menyanthes trifoliata	L.	**OBL**	Buck-Bean
Mertensia maritima	(L.) S.F. Gray	**FACW**	Oysterleaf
Mertensia paniculata	(Ait.) G. Don	**FAC**	Tall Bluebells
Mertensia virginica	(L.) Pers. ex Link	**FAC**	Virginia Bluebells
Micranthemum micranthemoides	(Nutt.) Wettst.	**OBL**	Nuttall's Mudflower
Micranthes foliolosa	(R. Br.) Gornall	**OBL**	Leafy-Stem Pseudosaxifrage
Micranthes micranthidifolia	(Haw.) Small	**OBL**	Lettuce-Leaf Pseudosaxifrage
Micranthes pensylvanica	(L.) Haw.	**OBL**	Eastern Swamp Pseudosaxifrage
Micranthes virginiensis	(Michx.) Small	**FACU**	Early Pseudosaxifrage
Microseris douglasii	(DC.) Schultz-Bip.	**UPL**	Douglas' Silverpuffs
Microstegium vimineum	(Trin.) A. Camus	**FAC**	Japanese Stilt Grass

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Mikania scandens	(L.) Willd.	**OBL**	Climbing Hempvine
Milium effusum	L.	**FACU**	American Millet Grass
Mimosa pudica	L.	**FACU**	Shameplant
Mimulus alatus	Ait.	**OBL**	Sharp-Wing Monkey-Flow er
Mimulus glabratus	Kunth	**OBL**	Round-Leaf Monkey-Flow er
Mimulus guttatus	DC.	**OBL**	Seep Monkey-Flow er
Mimulus michiganensis	(Pennell) Posto & Prather	**OBL**	Michigan Monkey-Flow er
Mimulus moschatus	Dougl. ex Lindl.	**OBL**	Muskflow er
Mimulus ringens	L.	**OBL**	Allegheny Monkey-Flow er
Minuartia patula	(Michx.) Mattf.	**UPL**	Pitcher's Stitchw ort
Minuartia rubella	(Wahlenb.) Hiern.	**UPL**	Boreal Stitchw ort
Mirabilis jalapa	L.	**UPL**	Marvel-of-Peru
Mirabilis nyctaginea	(Michx.) MacM.	**UPL**	Heart-Leaf Four-O'clock
Miscanthus sinensis	Anderss.	**UPL**	Chinese Silver Grass
Mitchella repens	L.	**FACU**	Partridge-Berry
Mitella diphylla	L.	**FACU**	Tw o-Leaf Bishop's-Cap
Mitella nuda	L.	**FACW**	Bare-Stem Bishop's-Cap
Modiola caroliniana	(L.) G. Don	**FACU**	Carolina Bristle-Mallow
Moehringia lateriflora	(L.) Fenzl	**FACU**	Blunt-Leaf Grove-Sandw ort
Moehringia macrophylla	(Hook.) Fenzl	**FACU**	Large-Leaf Grove-Sandw ort
Molinia caerulea	(L.) Moench	**FACU**	Purple Moor Grass
Mollugo verticillata	L.	**FAC**	Green Carpetw eed
Momordica charantia	L.	**FACU**	Balsam-Pear
Monarda clinopodia	L.	**FACU**	White Bergamot
Monarda didyma	L.	**FACU**	Scarlet Beebalm
Monarda fistulosa	L.	**FACU**	Osw ego-Tea
Monarda punctata	L.	**UPL**	Spotted Beebalm
Moneses uniflora	(L.) Gray	**FAC**	Single-Delight
Monolepis nuttalliana	(J.A. Schultes) Greene	**UPL**	Nuttall's Poverty-Weed
Monotropa uniflora	L.	**FACU**	One-Flow er Indian-Pipe
Montia chamissoi	(Ledeb. ex Spreng.) Greene	**OBL**	Chamisso's Candy-Flow er
Montia fontana	L.	**OBL**	Fountain Candy-Flow er
Montia linearis	(Dougl. ex Hook.) Greene	**FAC**	Linear-Leaf Candy-Flow er
Morella cerifera	(L.) Small	**FAC**	Southern Bayberry
Morella pensylvanica	(Mirbel) Kartesz	**FAC**	Northern Bayberry
Morus alba	L.	**FACU**	White Mulberry
Morus rubra	L.	**FACU**	Red Mulberry
Muhlenbergia asperifolia	(Nees & Meyen ex Trin.) Parodi	**FACW**	Alkali Muhly
Muhlenbergia capillaris	(Lam.) Trin.	**FACU**	Hair-Aw n Muhly
Muhlenbergia expansa	(Poir.) Trin.	**FACW**	Spreading Muhly
Muhlenbergia frondosa	(Poir.) Fern.	**FACW**	Wire-Stem Muhly
Muhlenbergia glabrifloris	Scribn.	**FAC**	Smooth Muhly
Muhlenbergia glomerata	(Willd.) Trin.	**OBL**	Spiked Muhly
Muhlenbergia mexicana	(L.) Trin.	**FACW**	Mexican Muhly
Muhlenbergia racemosa	(Michx.) B.S.P.	**FACU**	Green Muhly
Muhlenbergia richardsonis	(Trin.) Rydb.	**FACW**	Matted Muhly
Muhlenbergia schreberi	J.F. Gmel.	**FAC**	Nimblew ill
Muhlenbergia sylvatica	(Torr.) Torr. ex Gray	**FACW**	Woodland Muhly
Muhlenbergia tenuiflora	(Willd.) B.S.P.	**FACU**	Slim-Flow er Muhly
Muhlenbergia uniflora	(Muhl.) Fern.	**OBL**	Bog Muhly
Myosotis arvensis	(L.) Hill	**FACU**	Rough Forget-Me-Not
Myosotis discolor	Pers.	**UPL**	Yellow Scorpion-Grass
Myosotis laxa	Lehm.	**OBL**	Bay Forget-Me-Not
Myosotis macrosperma	Engelm.	**FAC**	Large-Seed Forget-Me-Not
Myosotis scorpioides	L.	**OBL**	True Forget-Me-Not
Myosotis sylvatica	Ehrh. ex Hoffmann	**UPL**	Woodland Forget-Me-Not
Myosotis verna	Nutt.	**FACU**	Spring Forget-Me-Not
Myosoton aquaticum	(L.) Moench	**FAC**	Giant-Chickw eed
Myosurus minimus	L.	**FAC**	Tiny Mousetail
Myrica gale	L.	**OBL**	Sw eetgale
Myriophyllum alterniflorum	DC.	**OBL**	Alternate-Flow er Water-Milfoil
Myriophyllum aquaticum	(Vell.) Verdc.	**OBL**	Parrot's-Feather
Myriophyllum farwellii	Morong	**OBL**	Farw ell's Water-Milfoil
Myriophyllum heterophyllum	Michx.	**OBL**	Tw o-Leaf Water-Milfoil
Myriophyllum hippuroides	Nutt. ex Torr. & Gray	**OBL**	Western Water-Milfoil
Myriophyllum humile	(Raf.) Morong	**OBL**	Low Water-Milfoil
Myriophyllum pinnatum	(Walt.) B.S.P.	**OBL**	Cut-Leaf Water-Milfoil
Myriophyllum sibiricum	Komarov	**OBL**	Siberian Water-Milfoil
Myriophyllum spicatum	L.	**OBL**	Eurasian Water-Milfoil
Myriophyllum tenellum	Bigelow	**OBL**	Slender Water-Milfoil
Myriophyllum verticillatum	L.	**OBL**	Whorled Water-Milfoil
Nabalus albus	(L.) Hook.	**FACU**	White Rattlesnake-Root
Nabalus altissimus	(L.) Hook.	**FACU**	Tall Rattlesnake-Root
Nabalus crepidineus	(Michx.) DC.	**FAC**	Nodding Rattlesnake-Root
Nabalus racemosus	(Michx.) DC.	**FACW**	Purple Rattlesnake-Root

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Najas flexilis	(Willd.) Rostk. & Schmidt	**OBL**	Wavy Waternymph
Najas gracillima	(A. Braun ex Engelm.) Magnus	**OBL**	Slender Waternymph
Najas guadalupensis	(Spreng.) Magnus	**OBL**	Guadalupe Waternymph
Najas marina	L.	**OBL**	Holly-Leaf Waternymph
Najas minor	All.	**OBL**	Brittle Waternymph
Napaea dioica	L.	**FACW**	Glade-Mallow
Nasturtium microphyllum	Boenn. ex Reichenb.	**OBL**	One-Row Watercress
Nasturtium officinale	Ait. f.	**OBL**	Watercress
Navarretia intertexta	(Benth.) Hook.	**FACW**	Needle-Leaf Pincushion-Plant
Navarretia leucocephala	Benth.	**OBL**	White-Flower Pincushion-Plant
Nelumbo lutea	Willd.	**OBL**	American Lotus
Nelumbo nucifera	Gaertn.	**OBL**	Sacred Lotus
Nemopanthus mucronatus	(L.) Loes.	**OBL**	Catberry
Neottia auriculata	(Wieg.) Szlach.	**FACW**	Auricled Twayblade
Neottia bifolia	(Raf.) Baumbach	**FACW**	Southern Twayblade
Neottia convallarioides	(Sw.) Rich	**FACW**	Broad-Lip Twayblade
Neottia cordata	(L.) Rich	**FACW**	Heart-Leaf Twayblade
Neottia smallii	(Wieg.) Szlach.	**FACW**	Kidney-Leaf Twayblade
Nepeta cataria	L.	**FACU**	Catnip
Nicotiana quadrivalvis	Pursh	**FACU**	Indian Tobacco
Nicotiana tabacum	L.	**UPL**	Cultivated Tobacco
Nuphar X rubrodisca	Morong	**OBL**	
Nuphar advena	(Ait.) Ait. f.	**OBL**	Yellow Pond-Lily
Nuphar microphylla	(Pers.) Fern.	**OBL**	
Nuphar sagittifolia	(Walt.) Pursh	**OBL**	
Nuphar variegata	Dur.	**OBL**	
Nymphaea leibergii	Morong	**OBL**	Dwarf Water-Lily
Nymphaea odorata	Ait.	**OBL**	American White Water-Lily
Nymphoides cordata	(Ell.) Fern.	**OBL**	Little Floatingheart
Nymphoides peltata	(Gmel.) Kuntze	**OBL**	Yellow Floatingheart
Nyssa biflora	Walt.	**OBL**	Swamp Tupelo
Nyssa sylvatica	Marsh.	**FAC**	Black Tupelo
Ocimum basilicum	L.	**UPL**	Sweet Basil
Oclemena X blakei	(Porter) Nesom	**FACW**	
Oclemena acuminata	(Michx.) Greene	**FACU**	Whorled Nodding-Aster
Oclemena nemoralis	(Ait.) Greene	**OBL**	Bog Nodding-Aster
Oenanthe aquatica	(L.) Poir.	**OBL**	Fine-Leaf Water-Dropwort
Oenanthe javanica	(Blume) DC.	**OBL**	Water-Celery
Oenothera biennis	L.	**FACU**	King's-Cureall
Oenothera curtiflora	W.L. Wagner & Hoch	**FACU**	Velvetweed
Oenothera fruticosa	L.	**FACU**	Narrow-Leaf Evening-Primrose
Oenothera gaura	W.L. Wagner & Hoch	**FACU**	Biennial Evening-Primrose
Oenothera laciniata	Hill	**FACU**	Cut-Leaf Evening-Primrose
Oenothera parviflora	L.	**FACU**	Northern Evening-Primrose
Oenothera perennis	L.	**FAC**	Small Evening-Primrose
Oenothera pilosella	Raf.	**FAC**	Meadow Evening-Primrose
Oenothera rhombipetala	Nutt. ex Torr. & Gray	**FACU**	Greater Four-Point Evening-Primrose
Oenothera villosa	Thunb.	**FAC**	Hairy Evening-Primrose
Oldenlandia uniflora	L.	**FACW**	Clustered Mille-Graines
Onoclea sensibilis	L.	**FACW**	Sensitive Fern
Ophioglossum pusillum	Raf.	**FACW**	Northern Adder's-Tongue
Ophioglossum vulgatum	L.	**FACW**	Southern Adder's-Tongue
Oplopanax horridus	(Small) Miq.	**FACW**	Devil's-Club
Orbexilum pedunculatum	(P. Mill.) Rydb.	**FACU**	Sampson's-Snakeroot
Ornithogalum umbellatum	L.	**FACU**	Sleepydick
Orobanche uniflora	L.	**UPL**	Naked Broom-Rape
Orontium aquaticum	L.	**OBL**	Goldenclub
Orthilia secunda	(L.) House	**FAC**	Sidebells
Orthocarpus bracteosus	Benth.	**FACW**	Rosy Owl-Clover
Orthocarpus luteus	Nutt.	**FACU**	Golden-Tongue Owl-Clover
Osmorhiza berteroi	DC.	**FACU**	Mountain Sweet-Cicely
Osmorhiza claytonii	(Michx.) C.B. Clarke	**FACU**	Hairy Sweet-Cicely
Osmorhiza longistylis	(Torr.) DC.	**FACU**	Aniseroot
Osmunda X ruggii	R. Tryon	**FACW**	
Osmunda claytoniana	L.	**FAC**	Interrupted Fern
Osmunda spectabilis	Willd.	**OBL**	Royal Fern
Osmundastrum cinnamomeum	(L.) K. Presl	**FACW**	Cinnamon Fern
Ostrya virginiana	(P. Mill.) K. Koch	**FACU**	Eastern Hop-Hornbeam
Oxalis corniculata	L.	**FACU**	Creeping Yellow Wood-Sorrel
Oxalis dillenii	Jacq.	**FACU**	Slender Yellow Wood-Sorrel
Oxalis montana	Raf.	**FACU**	Sleeping-Beauty
Oxalis stricta	L.	**FACU**	Upright Yellow Wood-Sorrel
Oxydendrum arboreum	(L.) DC.	**FACU**	Sourwood
Oxypolis rigidior	(L.) Raf.	**OBL**	Stiff Cowbane
Oxyria digyna	(L.) Hill	**FACW**	Mountain-Sorrel

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Oxytropis lambertii	Pursh	**FACU**	Stemless Locoweed
Packera anonyma	(Wood) W.A. Weber & A. Löve	**UPL**	Small's Groundsel
Packera aurea	(L.) A.& D. Löve	**FACW**	Golden Groundsel
Packera glabella	(Poir.) C. Jeffrey	**FACW**	Cress-Leaf Groundsel
Packera indecora	(Greene) A.& D. Löve	**FACW**	Rayless Mountain Groundsel
Packera obovata	(Muhl. ex Willd.) W.A. Weber & A. Löve	**FACU**	Round-Leaf Groundsel
Packera pauciflora	(Pursh) A.& D. Löve	**FACU**	Rayless Alpine Groundsel
Packera paupercula	(Michx.) A.& D. Löve	**FAC**	Balsam Groundsel
Packera plattensis	(Nutt.) W.A. Weber & A. Löve	**FACU**	Prairie Groundsel
Packera pseudaurea	(Rydb.) W.A. Weber & A. Löve	**FACW**	Streambank Groundsel
Packera schweinitziana	(Nutt.) W.A. Weber & A. Löve	**FACW**	Schweinitz's Groundsel
Panicum amarum	Ell.	**FACU**	Bitter Panic Grass
Panicum capillare	L.	**FAC**	Common Panic Grass
Panicum dichotomiflorum	Michx.	**FACW**	Fall Panic Grass
Panicum flexile	(Gattinger) Scribn.	**FACW**	Wiry Panic Grass
Panicum gattingeri	Nash	**FAC**	Gattinger's Panic Grass
Panicum philadelphicum	Bernh. ex Trin.	**FAC**	Philadelphia Panic Grass
Panicum verrucosum	Muhl.	**FACW**	Warty Panic Grass
Panicum virgatum	L.	**FAC**	Wand Panic Grass
Parapholis incurva	(L.) C.E. Hubbard	**FACU**	Curved Sickle Grass
Parathelypteris noveboracensis	(L.) Ching	**FAC**	New York Fern
Parathelypteris simulata	(Davenport) Holttum	**FACW**	Bog Fern
Parietaria floridana	Nutt.	**FACU**	Florida Pellitory
Parietaria pensylvanica	Muhl. ex Willd.	**FACU**	Pennsylvania Pellitory
Parnassia glauca	Raf.	**OBL**	Fen Grass-of-Parnassus
Parnassia palustris	L.	**OBL**	Marsh Grass-of-Parnassus
Parnassia parviflora	DC.	**OBL**	Small-Flower Grass-of-Parnassus
Parthenium hysterophorus	L.	**UPL**	Santa Maria Feverfew
Parthenocissus inserta	(Kerner) Fritsch	**FACU**	Thicket-Creeper
Parthenocissus quinquefolia	(L.) Planch.	**FACU**	Virginia-Creeper
Pascopyrum smithii	(Rydb.) A. Löve	**FACU**	Western-Wheat Grass
Paspalum floridanum	Michx.	**FACW**	Florida Crown Grass
Paspalum laeve	Michx.	**FAC**	Field Crown Grass
Paspalum racemosum	Lam.	**FAC**	Peruvian Crown Grass
Paspalum repens	Berg.	**OBL**	Horse-Tail Crown Grass
Paspalum setaceum	Michx.	**FACU**	Slender Crown Grass
Paulownia tomentosa	(Thunb.) Sieb. & Zucc. ex Steud.	**UPL**	Princesstree
Pedicularis canadensis	L.	**FACU**	Canadian Lousewort
Pedicularis furbishiae	S. Wats.	**FACW**	St. Johns River Lousewort
Pedicularis lanceolata	Michx.	**FACW**	Swamp Lousewort
Peltandra virginica	(L.) Schott	**OBL**	Green Arrow-Arum
Penstemon calycosus	Small	**FACU**	Long-Sepal Beardtongue
Penstemon digitalis	Nutt. ex Sims	**FAC**	Foxglove Beardtongue
Penstemon gracilis	Nutt.	**UPL**	Lilac Beardtongue
Penstemon laevigatus	Ait.	**FACU**	Eastern Smooth Beardtongue
Penstemon pallidus	Small	**UPL**	Pale Beardtongue
Penthorum sedoides	L.	**OBL**	Ditch-Stonecrop
Perilla frutescens	(L.) Britt.	**FAC**	Beefsteakplant
Peritoma serrulata	(Pursh) DC.	**FACU**	Rocky Mountain Beeplant
Persicaria amphibia	(L.) S.F. Gray p.p.	**OBL**	Water Smartweed
Persicaria arifolia	(L.) Haralds.	**OBL**	Halberd-Leaf Tearthumb
Persicaria careyi	(Olney) Greene	**FACW**	Carey's Smartweed
Persicaria hydropiper	(L.) Delarbre	**OBL**	Mild Water-Pepper
Persicaria hydropiperoides	(Michx.) Small	**OBL**	Swamp Smartweed
Persicaria lapathifolia	(L.) S.F. Gray	**FACW**	Dock-Leaf Smartweed
Persicaria longiseta	(Bruijn) Kitagawa	**FAC**	Bristly Lady's-Thumb
Persicaria maculosa	S.F. Gray	**FAC**	Spotted Lady's-Thumb
Persicaria minor	(Huds.) Opiz	**OBL**	Pygmy Smartweed
Persicaria orientalis	(L.) Spach	**FACU**	Kiss-Me-Over-the-Garden-Gate
Persicaria pensylvanica	(L.) M. Gómez	**FACW**	Pinkweed
Persicaria perfoliata	(L.) H. Gross	**FAC**	Asiatic Tearthumb
Persicaria posumbu	(Buch.-Ham. ex D. Don) H. Gross	**FACU**	Oriental Lady's-Thumb
Persicaria punctata	(Ell.) Small	**OBL**	Dotted Smartweed
Persicaria puritanorum	(Fern.) Soják	**FACW**	Puritan Smartweed
Persicaria robustior	(Small) Bickn.	**OBL**	Stout Smartweed
Persicaria sagittata	(L.) Gross.	**OBL**	Arrow-Leaf Tearthumb
Persicaria setacea	(Baldw.) Small	**OBL**	Bog Smartweed
Persicaria virginiana	(L.) Gaertn.	**FAC**	Jumpseed
Persicaria wallichii	Greuter & Burdet	**FAC**	Garden Smartweed
Petasites frigidus	(L.) Fries	**FACW**	Arctic Sweet-Colt's-Foot
Petasites hybridus	(L.) P.G. Gaertn., B. Mey. & Scherb.	**FAC**	Pestilence-Wort
Phalaris arundinacea	L.	**FACW**	Reed Canary Grass
Phalaris canariensis	L.	**FACU**	Common Canary Grass
Phalaris paradoxa	L.	**FAC**	Mediterranean Canary Grass
Phegopteris connectilis	(Michx.) Watt	**FACU**	Narrow Beech Fern

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Phegopteris hexagonoptera	(Michx.) Fée	**FACU**	Broad Beech Fern
Phleum alpinum	L.	**FACW**	Mountain Timothy
Phleum pratense	L.	**FACU**	Common Timothy
Phlox divaricata	L.	**FACU**	Wild Blue Phlox
Phlox glaberrima	L.	**FACW**	Smooth Phlox
Phlox maculata	L.	**FACW**	Wild Sweetwilliam
Phlox paniculata	L.	**FACU**	Fall Phlox
Phlox pilosa	L.	**FACU**	Downy Phlox
Phragmites australis	(Cav.) Trin. ex Steud.	**FACW**	Common Reed
Phryma leptostachya	L.	**FACU**	American Lopseed
Phyla cuneifolia	(Torr.) Greene	**FACW**	Wedgeleaf
Phyla lanceolata	(Michx.) Greene	**OBL**	Northern Frogfruit
Phyllanthus caroliniensis	Walt.	**FAC**	Carolina Leaf-Flower
Physalis angulata	L.	**FAC**	Cut-Leaf Ground-Cherry
Physalis philadelphica	Lam.	**UPL**	Mexican Ground-Cherry
Physalis pubescens	L.	**UPL**	Husk-Tomato
Physocarpus opulifolius	(L.) Maxim.	**FACW**	Atlantic Ninebark
Physostegia angustifolia	Fern.	**FACW**	Narrow-Leaf False Dragonhead
Physostegia parviflora	Nutt. ex Gray	**FACW**	Western False Dragonhead
Physostegia virginiana	(L.) Benth.	**FACW**	Obedient-Plant
Phytolacca americana	L.	**FACU**	American Pokeweed
Phytolacca icosandra	L.	**FAC**	Tropical Pokeweed
Picea glauca	(Moench) Voss	**FACU**	White Spruce
Picea mariana	(P. Mill.) B.S.P.	**FACW**	Black Spruce
Picea pungens	Engelm.	**FACU**	Blue Spruce
Picea rubens	Sarg.	**FACU**	Red Spruce
Pilea fontana	(Lunell) Rydb.	**FACW**	Lesser Clearweed
Pilea microphylla	(L.) Liebm.	**FAC**	Rockweed
Pilea pumila	(L.) Gray	**FACW**	Canadian Clearweed
Pimpinella saxifraga	L.	**FACU**	Solid-Stem Burnet-Saxifrage
Pinguicula vulgaris	L.	**OBL**	Common Butterwort
Pinus banksiana	Lamb.	**FACU**	Jack Pine
Pinus ponderosa	P.& C. Lawson	**UPL**	Ponderosa Pine
Pinus resinosa	Ait.	**FACU**	Red Pine
Pinus rigida	P. Mill.	**FACU**	Pitch Pine
Pinus strobus	L.	**FACU**	Eastern White Pine
Piperia dilatata	(Pursh) Szlach. & Rutk.	**FACW**	Scentbottle
Piperia unalascensis	(Spreng.) Rydb.	**UPL**	Alaska Rein Orchid
Piptochaetium avenaceum	(L.) Parodi	**FACU**	Black-Seed Spear Grass
Pistia stratiotes	L.	**OBL**	Water-Lettuce
Plagiobothrys figuratus	(Piper) I.M. Johnston ex M.E. Peck	**OBL**	Fragrant Popcorn-Flower
Plagiobothrys hispidulus	(Greene) I.M. Johnston	**FACW**	Harsh Popcorn-Flower
Plagiobothrys reticulatus	(Piper) I.M. Johnston	**FACW**	Netted Popcorn-Flower
Plagiobothrys trachycarpus	(Gray) I.M. Johnston	**FACW**	Rough-Fruit Popcorn-Flower
Planodes virginicum	(L.) Greene	**FACU**	Virginia Winged Rockcress
Plantago arenaria	Waldst. & Kit.	**FACU**	Sand Plantain
Plantago cordata	Lam.	**OBL**	Heart-Leaf Plantain
Plantago coronopus	L.	**FACU**	Buck-Horn Plantain
Plantago eriopoda	Torr.	**FAC**	Red-Woolly Plantain
Plantago heterophylla	Nutt.	**FACW**	Slender Plantain
Plantago lanceolata	L.	**FACU**	English Plantain
Plantago major	L.	**FACU**	Great Plantain
Plantago maritima	L.	**FACW**	Goosetongue
Plantago pusilla	Nutt.	**FACU**	Dwarf Plantain
Plantago rugelii	Dcne.	**FAC**	Black-Seed Plantain
Plantago virginica	L.	**FACU**	Pale-Seed Plantain
Platanthera X andrewsii	(M. White) Luer	**OBL**	
Platanthera X enigma	P.M. Brown	**FACW**	
Platanthera aquilonis	Sheviak	**FACW**	Bog Orchid
Platanthera blephariglottis	(Willd.) Lindl.	**OBL**	White Fringed Orchid
Platanthera ciliaris	(L.) Lindl.	**FACW**	Yellow Fringed Orchid
Platanthera clavellata	(Michx.) Luer	**FACW**	Green Woodland Orchid
Platanthera cristata	(Michx.) Lindl.	**FACW**	Crested Yellow Orchid
Platanthera fissa	(R. Br.) Lindl.	**FACW**	Pride-of-the-Peak
Platanthera flava	(L.) Lindl.	**FACW**	Pale-Green Orchid
Platanthera grandiflora	(Bigelow) Lindl.	**FACW**	Greater Purple Fringed Orchid
Platanthera hookeri	(Torr. ex Gray) Lindl.	**FAC**	Hooker's Orchid
Platanthera huronensis	(Nutt.) Lindl.	**FACW**	Lake Huron Green Orchid
Platanthera lacera	(Michx.) G. Don	**FACW**	Green Fringed Orchid
Platanthera leucophaea	(Nutt.) Lindl.	**FACW**	Prairie White Fringed Orchid
Platanthera macrophylla	(Goldie) P.M. Brown	**FAC**	Greater Round-Leaf Orchid
Platanthera obtusata	(Banks ex Pursh) Lindl.	**FACW**	Blunt-Leaf Orchid
Platanthera orbiculata	(Pursh) Lindl.	**FAC**	Lesser Round-Leaf Orchid
Platanthera psycodes	(L.) Lindl.	**FACW**	Lesser Purple Fringed Orchid
Platanthera rotundifolia	(Banks ex Pursh) Lindl.	**OBL**	Round-Leaf Orchid

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Platanus occidentalis	L.	FACW	American Sycamore
Pleopeltis polypodioides	(L.) Andrews & Windham	UPL	Resurrection Fern
Pluchea camphorata	(L.) DC.	FACW	Plowman's-Wort
Pluchea odorata	(L.) Cass.	OBL	Sweetscent
Poa alpina	L.	FACU	Alpine Blue Grass
Poa alsodes	Gray	FAC	Grove Blue Grass
Poa annua	L.	FACU	Annual Blue Grass
Poa arida	Vasey	FAC	Prairie Blue Grass
Poa autumnalis	Muhl. ex Ell.	FAC	Autumn Blue Grass
Poa bulbosa	L.	FACU	Bulbous Blue Grass
Poa chapmaniana	Scribn.	FACU	Chapman's Blue Grass
Poa compressa	L.	FACU	Flat-Stem Blue Grass
Poa interior	Rydb.	FAC	Inland Blue Grass
Poa nemoralis	L.	FACU	Forest Blue Grass
Poa paludigena	Fern. & Wieg.	OBL	Bog Blue Grass
Poa palustris	L.	FACW	Fowl Blue Grass
Poa pratensis	L.	FACU	Kentucky Blue Grass
Poa secunda	J. Presl	FACU	Curly Blue Grass
Poa sylvestris	Gray	FAC	Woodland Blue Grass
Poa trivialis	L.	FACW	Rough-Stalk Blue Grass
Podophyllum peltatum	L.	FACU	May-Apple
Podostemum ceratophyllum	Michx.	OBL	Horn-Leaf Riverweed
Pogonia ophioglossoides	(L.) Ker-Gawl.	OBL	Snake-Mouth Orchid
Polanisia dodecandra	(L.) DC.	UPL	Red-Whisker Clammyweed
Polemonium caeruleum	L.	FACW	Charity
Polemonium micranthum	Benth.	FACU	Annual Jacob's-Ladder
Polemonium occidentale	Greene	FACW	Western Jacob's-Ladder
Polemonium reptans	L.	FAC	Greek-Valerian
Polemonium vanbruntiae	Britt.	FACW	Bog Jacob's-Ladder
Polygala ambigua	Nutt.	FACU	Alternate Milkwort
Polygala brevifolia	Nutt.	OBL	Little-Leaf Milkwort
Polygala cruciata	L.	FACW	Drumheads
Polygala incarnata	L.	FACU	Procession-Flower
Polygala lutea	L.	FACW	Orange Milkwort
Polygala mariana	P. Mill.	FACW	Maryland Milkwort
Polygala nuttallii	Torr. & Gray	FAC	Nuttall's Milkwort
Polygala polygama	Walt.	FACU	Racemed Milkwort
Polygala sanguinea	L.	FACU	Purple Milkwort
Polygala senega	L.	FACU	Seneca-Snakeroot
Polygala verticillata	L.	UPL	Whorled Milkwort
Polygaloides paucifolia	(Willd.) J.R. Abbott	FACU	Gaywings
Polygonatum biflorum	(Walt.) Ell.	FACU	King Solomon's-Seal
Polygonatum pubescens	(Willd.) Pursh	FACU	Hairy Solomon's-Seal
Polygonum achoreum	Blake	FACU	Leathery Knotweed
Polygonum argyrocoleon	Steud. ex Kunze	FAC	Silver-Sheath Knotweed
Polygonum aviculare	L.	FACU	Yard Knotweed
Polygonum douglasii	Greene	FACU	Douglas' Knotweed
Polygonum erectum	L.	FACU	Erect Knotweed
Polygonum fowleri	B.L. Robins.	FACW	Fowler's Knotweed
Polygonum glaucum	Nutt.	FACU	Seaside Knotweed
Polygonum patulum	Bieb.	FACU	Bellard's Knotweed
Polygonum raii	Bab.	FAC	Ray's Knotweed
Polygonum ramosissimum	Michx.	FAC	Yellow-Flower Knotweed
Polypogon interruptus	Kunth	FACW	Ditch Rabbit's-Foot Grass
Polypogon monspeliensis	(L.) Desf.	OBL	Annual Rabbit's-Foot Grass
Polypogon viridis	(Gouan) Breistr.	FACW	Beardless Rabbit's-Foot Grass
Polystichum acrostichoides	(Michx.) Schott	FACU	Christmas Fern
Polystichum lonchitis	(L.) Roth	UPL	Northern Holly Fern
Polystichum munitum	(Kaulfuss) K. Presl	FACU	Pineland Sword Fern
Pontederia cordata	L.	OBL	Pickerelweed
Populus balsamifera	L.	FACW	Balsam Poplar
Populus deltoides	Bartr. ex Marsh.	FAC	Eastern Cottonwood
Populus grandidentata	Michx.	FACU	Big-Tooth Aspen
Populus heterophylla	L.	OBL	Swamp Cottonwood
Populus tremula	L.	FAC	European Aspen
Populus tremuloides	Michx.	FACU	Quaking Aspen
Portulaca grandiflora	Hook.	UPL	Rose-Moss
Portulaca oleracea	L.	FACU	Little-Hogweed
Potamogeton X absconditus	Z. Kaplan, Fehrer & Hellquist	OBL	
Potamogeton X aemulans	Z. Kaplan, Hellquist & Fehrer	OBL	
Potamogeton X argutulus	Hagstr.	OBL	
Potamogeton X faxonii	Morong (pro sp.)	OBL	
Potamogeton X griffithii	Benn. (pro sp.)	OBL	
Potamogeton X hagstroemii	Benn. (pro sp.)	OBL	
Potamogeton X haynesii	Hellquist & Crow	OBL	

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Potamogeton X mirabilis	Z. Kaplan, Hellquist & Fehrer	**OBL**	
Potamogeton X mysticus	Morong (pro sp.)	**OBL**	
Potamogeton X nericus	Hagstr.	**OBL**	
Potamogeton X nitens	G.H. Weber (pro sp.)	**OBL**	
Potamogeton X prussicus	Hagstr.	**OBL**	
Potamogeton X rectifolius	Benn.	**OBL**	
Potamogeton X scoliophyllus	Hagstr.	**OBL**	
Potamogeton X sparganiifolius	Laestad. ex Fries (pro sp.)	**OBL**	
Potamogeton X spathuliformis	(J.W. Robbins) Morong (pro sp.)	**OBL**	
Potamogeton X subdentatus	Hagstr.	**OBL**	
Potamogeton X subobtusus	Hagstr.	**OBL**	
Potamogeton X subsessilis	Hagstr.	**OBL**	
Potamogeton X undulatus	Wolfgang	**OBL**	
Potamogeton X versicolor	Z. Kaplan, Hellquist & Fehrer	**OBL**	
Potamogeton alpinus	Balbis	**OBL**	Reddish Pondweed
Potamogeton amplifolius	Tuckerman	**OBL**	Large-Leaf Pondweed
Potamogeton berchtoldii	Fieber	**OBL**	Little Aguja Pondweed
Potamogeton bicupulatus	Fern.	**OBL**	Snail-Seed Pondweed
Potamogeton confervoides	Reichenb.	**OBL**	Tuckerman's Pondweed
Potamogeton crispus	L.	**OBL**	Curly Pondweed
Potamogeton diversifolius	Raf.	**OBL**	Waterthread
Potamogeton epihydrus	Raf.	**OBL**	Ribbon-Leaf Pondweed
Potamogeton foliosus	Raf.	**OBL**	Leafy Pondweed
Potamogeton friesii	Rupr.	**OBL**	Flat-Stalk Pondweed
Potamogeton gramineus	L.	**OBL**	Grassy Pondweed
Potamogeton hillii	Morong	**OBL**	Hill's Pondweed
Potamogeton illinoensis	Morong	**OBL**	Illinois Pondweed
Potamogeton natans	L.	**OBL**	Broad-Leaf Pondweed
Potamogeton nodosus	Poir.	**OBL**	Long-Leaf Pondweed
Potamogeton oakesianus	J.W. Robbins	**OBL**	Oakes' Pondweed
Potamogeton oblongus	Viviani	**OBL**	Cinnamon-Spot Pondweed
Potamogeton obtusifolius	Mert. & Koch	**OBL**	Blunt-Leaf Pondweed
Potamogeton ogdenii	Hellquist & Hilton	**OBL**	Ogden's Pondweed
Potamogeton perfoliatus	L.	**OBL**	Clasping-Leaf Pondweed
Potamogeton praelongus	Wulfen	**OBL**	White-Stem Pondweed
Potamogeton pulcher	Tuckerman	**OBL**	Spotted Pondweed
Potamogeton pusillus	L.	**OBL**	Small Pondweed
Potamogeton richardsonii	(Benn.) Rydb.	**OBL**	Red-Head Pondweed
Potamogeton robbinsii	Oakes	**OBL**	Fern Pondweed
Potamogeton spirillus	Tuckerman	**OBL**	Spiral Pondweed
Potamogeton strictifolius	Benn.	**OBL**	Straight-Leaf Pondweed
Potamogeton tennesseensis	Fern.	**OBL**	Tennessee Pondweed
Potamogeton vaseyi	J.W. Robbins	**OBL**	Vasey's Pondweed
Potamogeton zosteriformis	Fern.	**OBL**	Flat-Stem Pondweed
Potentilla anserina	L.	**FACW**	Silverweed
Potentilla argentea	L.	**FACU**	Silver-Leaf Cinquefoil
Potentilla gracilis	Dougl. ex Hook.	**FAC**	Graceful Cinquefoil
Potentilla indica	(Andr.) T. Wolf	**FACU**	Indian-Strawberry
Potentilla litoralis	Rydb.	**FACU**	Coastal Cinquefoil
Potentilla norvegica	L.	**FAC**	Norwegian Cinquefoil
Potentilla pensylvanica	L.	**FACU**	Pennsylvania Cinquefoil
Potentilla pulcherrima	Lehm.	**FAC**	Soft Cinquefoil
Potentilla rivalis	Nutt.	**FACW**	Brook Cinquefoil
Potentilla simplex	Michx.	**FACU**	Oldfield Cinquefoil
Potentilla supina	L.	**FACW**	Bushy Cinquefoil
Poterium sanguisorba	L.	**FAC**	
Primula laurentiana	Fern.	**FAC**	Bird-Eye Primrose
Primula mistassinica	Michx.	**FACW**	Lake Mistassini Primrose
Proboscidea louisiana	(P. Mill.) Thellung	**FAC**	Ram's-Horn
Prosartes trachycarpa	S. Wats.	**UPL**	Rough-Fruit Fairybells
Proserpinaca intermedia	Mackenzie	**OBL**	Intermediate Mermaidweed
Proserpinaca palustris	L.	**OBL**	Marsh Mermaidweed
Proserpinaca pectinata	Lam.	**OBL**	Comb-Leaf Mermaidweed
Prunella vulgaris	L.	**FAC**	Common Selfheal
Prunus americana	Marsh.	**UPL**	American Plum
Prunus avium	(L.) L.	**FACU**	Sweet Cherry
Prunus nigra	Ait.	**FACU**	Canadian Plum
Prunus padus	L.	**UPL**	European Bird Cherry
Prunus pensylvanica	L. f.	**FACU**	Fire Cherry
Prunus serotina	Ehrh.	**FACU**	Black Cherry
Prunus virginiana	L.	**FACU**	Choke Cherry
Pseudognaphalium luteoalbum	(L.) Hilliard & Burtt	**FAC**	Jersey Rabbit-Tobacco
Pseudognaphalium stramineum	(Kunth) A. Anderb.	**FAC**	Cotton-Batting-Plant
Pseudolycopodiella caroliniana	(L.) Holub	**FACW**	Carolina False Clubmoss
Pseudotsuga menziesii	(Mirbel) Franco	**FACU**	Douglas-Fir

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Ptelea trifoliata	L.	**FACU**	Common Hoptree
Pteridium aquilinum	(L.) Kuhn	**FACU**	Northern Bracken Fern
Ptilimnium capillaceum	(Michx.) Raf.	**OBL**	Herbwilliam
Puccinellia distans	(Jacq.) Parl.	**FACW**	Spreading Alkali Grass
Puccinellia fasciculata	(Torr.) Bickn.	**OBL**	Saltmarsh Alkali Grass
Puccinellia maritima	(Huds.) Parl.	**OBL**	Seaside Alkali Grass
Puccinellia nutkaensis	(J. Presl) Fern. & Weatherby	**FACW**	Nootka Alkali Grass
Puccinellia nuttalliana	(J.A. Schultes) A.S. Hitchc.	**OBL**	Nuttall's Alkali Grass
Puccinellia tenella	(Lange) Holmb. ex Porsild	**FACW**	Tundra Alkali Grass
Pueraria montana	(Lour.) Merr.	**UPL**	Kudzu
Pycnanthemum muticum	(Michx.) Pers.	**FAC**	Clustered Mountain-Mint
Pycnanthemum tenuifolium	Schrad.	**FAC**	Narrow-Leaf Mountain-Mint
Pycnanthemum verticillatum	(Michx.) Pers.	**FAC**	Whorled Mountain-Mint
Pycnanthemum virginianum	(L.) T. Dur. & B.D. Jackson ex B.L. Robins. & Fern.	**FACW**	Virginia Mountain-Mint
Pyrola americana	Sweet	**FAC**	American Wintergreen
Pyrola asarifolia	Michx.	**FACW**	Pink Wintergreen
Pyrola chlorantha	Sw.	**FACU**	Green-Flower Wintergreen
Pyrola elliptica	Nutt.	**FACU**	Shinleaf
Pyrola minor	L.	**FAC**	Snowline Wintergreen
Pyrularia pubera	Michx.	**UPL**	Buffalo-Nut
Pyxidanthera barbulata	Michx.	**FACU**	Flowering Pixie-Moss
Quercus alba	L.	**FACU**	Northern White Oak
Quercus bicolor	Willd.	**FACW**	Swamp White Oak
Quercus falcata	Michx.	**FACU**	Southern Red Oak
Quercus imbricaria	Michx.	**FACU**	Shingle Oak
Quercus laurifolia	Michx.	**FACW**	Laurel Oak
Quercus macrocarpa	Michx.	**FACU**	Burr Oak
Quercus michauxii	Nutt.	**FACW**	Swamp Chestnut Oak
Quercus montana	Willd.	**UPL**	Chestnut Oak
Quercus muehlenbergii	Engelm.	**FACU**	Chinkapin Oak
Quercus pagoda	Raf.	**FACW**	Cherry-Bark Oak
Quercus palustris	Muenchh.	**FACW**	Pin Oak
Quercus phellos	L.	**FACW**	Willow Oak
Quercus prinoides	Willd.	**FACU**	Dwarf Chinkapin Oak
Quercus rubra	L.	**FACU**	Northern Red Oak
Quercus shumardii	Buckl.	**FACW**	Shumard's Oak
Quercus stellata	Wangenh.	**FACU**	Post Oak
Ranunculus abortivus	L.	**FAC**	Kidney-Leaf Buttercup
Ranunculus acris	L.	**FAC**	Tall Buttercup
Ranunculus allegheniensis	Britt.	**FAC**	Allegheny Mountain Buttercup
Ranunculus ambigens	S. Wats.	**OBL**	Water-Plantain Spearwort
Ranunculus arvensis	L.	**FAC**	Hungerweed
Ranunculus bulbosus	L.	**FAC**	St. Anthony's-Turnip
Ranunculus fascicularis	Muhl. ex Bigelow	**FACU**	Early Buttercup
Ranunculus flabellaris	Raf.	**OBL**	Greater Yellow Water Buttercup
Ranunculus flammula	L.	**FACW**	Greater Creeping Spearwort
Ranunculus gmelinii	DC.	**FACW**	Lesser Yellow Water Buttercup
Ranunculus hispidus	Michx.	**FAC**	Bristly Buttercup
Ranunculus longirostris	Godr.	**OBL**	Long-Beak Water-Crowfoot
Ranunculus macounii	Britt.	**OBL**	Macoun's Buttercup
Ranunculus micranthus	Nutt.	**FACU**	Rock Buttercup
Ranunculus parviflorus	L.	**FAC**	Small-Flower Buttercup
Ranunculus pensylvanicus	L. f.	**OBL**	Pennsylvania Buttercup
Ranunculus pusillus	Poir.	**OBL**	Low Spearwort
Ranunculus recurvatus	Poir.	**FACW**	Blisterwort
Ranunculus repens	L.	**FAC**	Creeping Buttercup
Ranunculus sardous	Crantz	**FAC**	Hairy Buttercup
Ranunculus sceleratus	L.	**OBL**	Cursed Buttercup
Ranunculus subrigidus	W. Drew	**OBL**	Short-Beak Water-Crowfoot
Ranunculus trichophyllus	Chaix	**OBL**	Thread-Leaf Water-Crowfoot
Reynoutria X bohemica	Chrtek & Chrtková	**FACU**	
Reynoutria japonica	Houtt.	**FACU**	Japanese-Knotweed
Reynoutria sachalinensis	(F. Schmidt) Nakai	**UPL**	Giant-Knotweed
Rhamnus alnifolia	L'Hér.	**OBL**	Alder-Leaf Buckthorn
Rhamnus cathartica	L.	**FAC**	European Buckthorn
Rhamnus lanceolata	Pursh	**FACW**	Lance-Leaf Buckthorn
Rhexia mariana	L.	**OBL**	Maryland Meadow-Beauty
Rhexia virginica	L.	**OBL**	Handsome-Harry
Rhinanthus minor	L.	**FAC**	Little Yellow-Rattle
Rhodiola integrifolia	Raf.	**UPL**	Entire-Leaf Rosewort
Rhodiola rosea	L.	**FACU**	King's-Crown
Rhododendron arborescens	(Pursh) Torr.	**FAC**	Smooth Azalea
Rhododendron canadense	(L.) Torr.	**FACW**	Rhodora
Rhododendron canescens	(Michx.) Sweet	**FACW**	Mountain Azalea
Rhododendron catawbiense	Michx.	**FACU**	Catawba Rosebay

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Rhododendron groenlandicum	(Oeder) K.A. Kron & Judd	**OBL**	Rusty Labrador-Tea
Rhododendron lapponicum	(L.) Wahlenb.	**FACW**	Lapland Rhododendron
Rhododendron maximum	L.	**FAC**	Great-Laurel
Rhododendron periclymenoides	(Michx.) Shinners	**FAC**	Pink Azalea
Rhododendron prinophyllum	(Small) Millais	**FAC**	Early Azalea
Rhododendron vaseyi	Gray	**FACW**	Pink-Shell Azalea
Rhododendron viscosum	(L.) Torr.	**FACW**	Clammy Azalea
Rhus aromatica	Ait.	**UPL**	Fragrant Sumac
Rhus copallinum	L.	**UPL**	Winged Sumac
Rhynchospora alba	(L.) Vahl	**OBL**	White Beak Sedge
Rhynchospora capillacea	Torr.	**OBL**	Needle Beak Sedge
Rhynchospora capitellata	(Michx.) Vahl	**OBL**	Brownish Beak Sedge
Rhynchospora careyana	Fern.	**OBL**	Broad-Fruit Horned Beak Sedge
Rhynchospora cephalantha	Gray	**OBL**	Bunched Beak Sedge
Rhynchospora chalarocephala	Fern. & Gale	**OBL**	Loose-Head Beak Sedge
Rhynchospora fusca	(L.) Ait. f.	**OBL**	Brown Beak Sedge
Rhynchospora globularis	(Chapman) Small	**FACW**	Globe Beak Sedge
Rhynchospora glomerata	(L.) Vahl	**OBL**	Clustered Beak Sedge
Rhynchospora gracilenta	Gray	**OBL**	Slender Beak Sedge
Rhynchospora inundata	(Oakes) Fern.	**OBL**	Narrow-Fruit Horned Beak Sedge
Rhynchospora macrostachya	Torr. ex Gray	**OBL**	Tall Horned Beak Sedge
Rhynchospora nitens	(Vahl) Gray	**OBL**	Short-Beak Beak Sedge
Rhynchospora pallida	M.A. Curtis	**OBL**	Pale Beak Sedge
Rhynchospora recognita	(Gale) Kral	**FACW**	Coarse Globe Beak Sedge
Rhynchospora scirpoides	(Torr.) Griseb.	**OBL**	Long-Beak Beak Sedge
Rhynchospora torreyana	Gray	**FACW**	Torrey's Beak Sedge
Ribes americanum	P. Mill.	**FACW**	Wild Black Currant
Ribes aureum	Pursh	**FACU**	Golden Currant
Ribes cynosbati	L.	**FACU**	Eastern Prickly Gooseberry
Ribes glandulosum	Grauer	**FACW**	Skunk Currant
Ribes hirtellum	Michx.	**FACW**	Hairy-Stem Gooseberry
Ribes hudsonianum	Richards.	**OBL**	Northern Black Currant
Ribes lacustre	(Pers.) Poir.	**FACW**	Bristly Black Gooseberry
Ribes oxyacanthoides	L.	**FACU**	Canadian Gooseberry
Ribes triste	Pallas	**OBL**	Swamp Red Currant
Ricinus communis	L.	**FACU**	Castor-Bean
Robinia pseudoacacia	L.	**FACU**	Black Locust
Rorippa X prostrata	(Bergeret) Schinz & Thellung (pro sp.)	**FAC**	
Rorippa amphibia	(L.) Bess.	**FACW**	Great Yellowcress
Rorippa aquatica	(Eat.) Palmer & Steyermark	**OBL**	Lakecress
Rorippa austriaca	(Crantz) Bess.	**FAC**	Austrian Yellowcress
Rorippa curvipes	Greene	**FACW**	Blunt-Leaf Yellowcress
Rorippa dubia	(Pers.) Hara	**FACW**	
Rorippa indica	(L.) Hiern.	**FACW**	Variable-Leaf Yellowcress
Rorippa palustris	(L.) Bess.	**OBL**	Bog Yellowcress
Rorippa sessiliflora	(Nutt.) A.S. Hitchc.	**OBL**	Stalkless Yellowcress
Rorippa sinuata	(Nutt.) A.S. Hitchc.	**FACW**	Spreading Yellowcress
Rorippa sylvestris	(L.) Bess.	**OBL**	Creeping Yellowcress
Rosa acicularis	Lindl.	**FACU**	Prickly Rose
Rosa arkansana	Porter	**FACU**	Prairie Rose
Rosa blanda	Ait.	**FACU**	Smooth Rose
Rosa carolina	L.	**FACU**	Carolina Rose
Rosa micrantha	Borrer ex Sm.	**FACU**	Small-Flower Sweetbrier
Rosa multiflora	Thunb. ex Murr.	**FACU**	Rambler Rose
Rosa nitida	Willd.	**FACW**	Shining Rose
Rosa palustris	Marsh.	**OBL**	Swamp Rose
Rosa rubiginosa	L.	**FACU**	Sweetbrier
Rosa rugosa	Thunb.	**FACU**	Rugosa Rose
Rosa setigera	Michx.	**FACU**	Climbing Rose
Rosa virginiana	P. Mill.	**FAC**	Virginia Rose
Rosa woodsii	Lindl.	**FACU**	Woods' Rose
Rotala ramosior	(L.) Koehne	**OBL**	Lowland Toothcup
Rubus allegheniensis	Porter	**FACU**	Allegheny Blackberry
Rubus alumnus	Bailey	**FACU**	Oldfield Blackberry
Rubus arcticus	L.	**FACW**	Northern Blackberry
Rubus argutus	Link	**FACU**	Saw-Tooth Blackberry
Rubus armeniacus	Focke	**UPL**	Himalayan Blackberry
Rubus baileyanus	Britt.	**FACU**	Bailey's Dewberry
Rubus caesius	L.	**FACU**	European Dewberry
Rubus chamaemorus	L.	**FACW**	Cloudberry
Rubus cuneifolius	Pursh	**UPL**	Sand Blackberry
Rubus dalibarda	L.	**FAC**	Robin-Run-Away
Rubus flagellaris	Willd.	**FACU**	Whiplash Dewberry
Rubus floricomus	Blanch.	**FAC**	Many-Flower Blackberry
Rubus hispidoides	Bailey	**FACW**	Bog Dewberry

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Rubus hispidus	L.	**FACW**	Bristly Dewberry
Rubus idaeus	L.	**FACU**	Common Red Raspberry
Rubus inclinis	Bailey	**FACW**	Marshland Blackberry
Rubus laciniatus	Willd.	**UPL**	Cut-Leaf Blackberry
Rubus lawrencei	Bailey	**FAC**	Adirondack Blackberry
Rubus longii	Fern.	**FAC**	Long's Blackberry
Rubus missouricus	Bailey	**FACU**	Missouri Dewberry
Rubus multiformis	Blanch.	**FAC**	Variable Blackberry
Rubus paganus	Bailey	**FACW**	St. Lawrence Dewberry
Rubus paludivagus	Fern.	**FAC**	Cape Cod Blackberry
Rubus parviflorus	Nutt.	**FACU**	Western Thimble-Berry
Rubus pensilvanicus	Poir.	**FACU**	Pennsylvania Blackberry
Rubus pergratus	Blanch.	**FACU**	Upland Blackberry
Rubus phoenicolasius	Maxim.	**FACU**	Wine Raspberry
Rubus plus	Bailey	**FAC**	Hairy-Leaf Dewberry
Rubus pubescens	Raf.	**FACW**	Dwarf Red Raspberry
Rubus schoolcraftianus	Bailey	**FAC**	Schoolcraft's Dewberry
Rubus semisetosus	Blanch.	**FAC**	Swamp Blackberry
Rubus setosus	Bigelow	**FACW**	Setose Blackberry
Rubus spectabilis	Pursh	**FACW**	Salmon Raspberry
Rubus spectatus	Bailey	**OBL**	Sphagnum Blackberry
Rubus stipulatus	Bailey	**FAC**	Big Horseshoe Lake Dewberry
Rubus tardatus	Blanch.	**FAC**	Wet-Thicket Dewberry
Rubus trivialis	Michx.	**FACU**	Southern Dewberry
Rubus uvidus	Bailey	**FAC**	Kalamazoo Dewberry
Rubus wheeleri	(Bailey) Bailey	**FAC**	Wheeler's Blackberry
Rudbeckia fulgida	Ait.	**OBL**	Orange Coneflower
Rudbeckia hirta	L.	**FACU**	Black-Eyed-Susan
Rudbeckia laciniata	L.	**FACW**	Green-Head Coneflower
Rudbeckia subtomentosa	Pursh	**FACU**	Sweet Coneflower
Rudbeckia triloba	L.	**FACU**	Brown-Eyed-Susan
Ruellia humilis	Nutt.	**FACU**	Fringe-Leaf Wild Petunia
Ruellia strepens	L.	**FAC**	Limestone Wild Petunia
Rumex acetosa	L.	**UPL**	Garden Sorrel
Rumex acetosella	L.	**FACU**	Common Sheep Sorrel
Rumex altissimus	Wood	**FACW**	Pale Dock
Rumex britannica	L.	**OBL**	Greater Water Dock
Rumex conglomeratus	Murr.	**FACW**	Sharp Dock
Rumex crispus	L.	**FAC**	Curly Dock
Rumex dentatus	L.	**FACU**	Toothed Dock
Rumex floridanus	Meisn.	**FACW**	Florida Dock
Rumex fueginus	Phil.	**FACW**	Tierra del Fuego Dock
Rumex hastatulus	Baldw.	**FACU**	Heart-Wing Sorrel
Rumex longifolius	DC.	**FAC**	Door-Yard Dock
Rumex maritimus	L.	**FACW**	Golden Dock
Rumex mexicanus	Meisn.	**FACW**	Mexican Dock
Rumex obtusifolius	L.	**FAC**	Bitter Dock
Rumex occidentalis	S. Wats.	**OBL**	Western Dock
Rumex pallidus	Bigelow	**FACW**	Seaside Dock
Rumex persicarioides	L.	**FACW**	Coastal Dock
Rumex pulcher	L.	**FACU**	Fiddle Dock
Rumex stenophyllus	Ledeb.	**FACW**	Narrow-Leaf Dock
Rumex thyrsiflorus	Fingerhuth	**FAC**	Narrow-Leaf Sorrel
Rumex triangulivalvis	(Danser) Rech. f.	**FAC**	Triangular-Valved Dock
Rumex venosus	Pursh	**UPL**	Veiny Dock
Rumex verticillatus	L.	**OBL**	Swamp Dock
Rumex violascens	Rech. f.	**FACW**	Violet Dock
Ruppia cirrhosa	(Petag.) Grande	**OBL**	Spiral Ditch-Grass
Ruppia maritima	L.	**OBL**	Beaked Ditch-Grass
Sabatia angularis	(L.) Pursh	**FAC**	Rose-Pink
Sabatia campanulata	(L.) Torr.	**FACW**	Slender Rose-Gentian
Sabatia campestris	Nutt.	**FACU**	Texas-Star
Sabatia dodecandra	(L.) B.S.P.	**OBL**	Marsh Rose-Gentian
Sabatia kennedyana	Fern.	**OBL**	Plymouth Rose-Gentian
Sabatia stellaris	Pursh	**FACW**	Rose-of-Plymouth
Saccharum alopecuroides	(L.) Nutt.	**FACU**	Silver Plume Grass
Saccharum giganteum	(Walt.) Pers.	**FACW**	Giant Plume Grass
Saccharum ravennae	(L.) L.	**UPL**	Ranenna Grass
Sacciolepis striata	(L.) Nash	**OBL**	American Cupscale
Sagina decumbens	(Ell.) Torr. & Gray	**FAC**	Trailing Pearlwort
Sagina maxima	Gray	**FACU**	Sticky-Stem Pearlwort
Sagina nodosa	(L.) Fenzl	**FACU**	Knotted Pearlwort
Sagina procumbens	L.	**FAC**	Bird-Eye Pearlwort
Sagittaria ambigua	J.G. Sm.	**OBL**	Kansas Arrowhead
Sagittaria australis	(J.G. Sm.) Small	**OBL**	Long-Beak Arrowhead

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Sagittaria brevirostra	Mackenzie & Bush	**OBL**	Short-Beak Arrowhead
Sagittaria calycina	Engelm.	**OBL**	Hooded Arrowhead
Sagittaria cristata	Engelm.	**OBL**	Crested Arrowhead
Sagittaria cuneata	Sheldon	**OBL**	Arum-Leaf Arrowhead
Sagittaria engelmanniana	J.G. Sm.	**OBL**	Engelmann's Arrowhead
Sagittaria filiformis	J.G. Sm.	**OBL**	Narrow-Leaf Arrowhead
Sagittaria graminea	Michx.	**OBL**	Grass-Leaf Arrowhead
Sagittaria latifolia	Willd.	**OBL**	Duck-Potato
Sagittaria platyphylla	(Engelm.) J.G. Sm.	**OBL**	Delta Arrowhead
Sagittaria rigida	Pursh	**OBL**	Sessile-Fruit Arrowhead
Sagittaria spathulata	(J.G. Sm.) Buch.	**OBL**	Spoon-Shape Arrowhead
Sagittaria subulata	(L.) Buch.	**OBL**	Awl-Leaf Arrowhead
Sagittaria teres	S. Wats.	**OBL**	Slender Arrowhead
Salicornia bigelovii	Torr.	**OBL**	Dwarf Saltwort
Salicornia depressa	Standl.	**OBL**	Woody Saltwort
Salicornia maritima	Wolff & Jefferies	**OBL**	Sea Saltwort
Salicornia rubra	A. Nels.	**OBL**	Red Saltwort
Salix X fragilis	L.	**FAC**	
Salix X glatfelteri	Schneid.	**FACW**	
Salix X pendulina	Wenderoth	**FACW**	
Salix X sepulcralis	Simonkai	**FACW**	
Salix alba	L.	**FACW**	White Willow
Salix amygdaloides	Anderss.	**FACW**	Peach-Leaf Willow
Salix arctophila	Cockerell ex Heller	**FACW**	Northern Willow
Salix argyrocarpa	Anderss.	**FACU**	Labrador Willow
Salix atrocinerea	Brot.	**FACW**	Smooth-Twig Gray Willow
Salix bebbiana	Sarg.	**FACW**	Gray Willow
Salix candida	Flueggé ex Willd.	**OBL**	Sage Willow
Salix caprea	L.	**FAC**	Goat Willow
Salix caroliniana	Michx.	**OBL**	Carolina Willow
Salix cinerea	L.	**FACW**	Large Gray Willow
Salix cordata	Michx.	**FAC**	Heart-Leaf Willow
Salix daphnoides	Vill.	**FAC**	Violet Willow
Salix discolor	Muhl.	**FACW**	Pussy Willow
Salix elaeagnos	Scop.	**FACW**	Elaeagnus Willow
Salix eriocephala	Michx.	**FACW**	Missouri Willow
Salix famelica	(Ball) Argus	**FACW**	
Salix humilis	Marsh.	**FACU**	Prairie Willow
Salix interior	Rowlee	**FACW**	Sandbar Willow
Salix lucida	Muhl.	**FACW**	Shining Willow
Salix maccalliana	Rowlee	**OBL**	Mccalla's Willow
Salix myricoides	Muhl.	**FACW**	Bayberry Willow
Salix myrsinifolia	Salisb.	**OBL**	Dark-Leaf Willow
Salix nigra	Marsh.	**OBL**	Black Willow
Salix pedicellaris	Pursh	**OBL**	Bog Willow
Salix pellita	(Anderss.) Bebb	**FACW**	Satiny Willow
Salix petiolaris	Sm.	**FACW**	Meadow Willow
Salix planifolia	Pursh	**OBL**	Tea-Leaf Willow
Salix pseudomonticola	Ball	**FACW**	False Mountain Willow
Salix purpurea	L.	**FACW**	Purple Willow
Salix pyrifolia	Anderss.	**FACW**	Balsam Willow
Salix sericea	Marsh.	**OBL**	Silky Willow
Salix serissima	(Bailey) Fern.	**OBL**	Autumn Willow
Salix triandra	L.	**FACW**	Almond-Leaf Willow
Salix viminalis	L.	**FACW**	Basket Willow
Salsola kali	L.	**FACU**	Russian-Thistle
Salsola tragus	L.	**FACU**	Prickly Russian-Thistle
Salvia lyrata	L.	**FACW**	Lyre-Leaf Sage
Salvinia minima	Baker	**OBL**	Water-Spangles
Sambucus nigra	L.	**FACW**	Black Elder
Sambucus racemosa	L.	**FACU**	Red Elder
Samolus parviflorus	Raf.	**OBL**	
Sanguinaria canadensis	L.	**FACU**	Bloodroot
Sanguisorba canadensis	L.	**FACW**	Canadian Burnet
Sanguisorba officinalis	L.	**FACW**	Great Burnet
Sanicula canadensis	L.	**FACU**	Canadian Black-Snakeroot
Sanicula marilandica	L.	**FACU**	Maryland Black-Snakeroot
Sanicula odorata	(Raf.) K.M. Pryer & L.R. Phillippe	**FAC**	Clustered Black-Snakeroot
Saponaria officinalis	L.	**FACU**	Bouncing-Bett
Sarcocornia ambigua	(Michx.) M.A.Alonso & M.B.Crespo	**OBL**	Chickenclaws
Sarracenia flava	L.	**OBL**	Yellow Pitcherplant
Sarracenia purpurea	L.	**OBL**	Purple Pitcherplant
Sassafras albidum	(Nutt.) Nees	**FACU**	Sassafras
Saururus cernuus	L.	**OBL**	Lizard's-Tail
Saxifraga aizoides	L.	**FACW**	Yellow Mountain Saxifrage

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Saxifraga cernua	L.	FACW	Nodding Saxifrage
Saxifraga oppositifolia	L.	FAC	Purple Mountain Saxifrage
Saxifraga paniculata	P. Mill.	FAC	White Mountain Saxifrage
Saxifraga rivularis	L.	FACW	Alpine-Brook Saxifrage
Saxifraga tricuspidata	Rottb.	UPL	Prickly Saxifrage
Sceptridium biternatum	(Sav.) Lyon	FAC	Sparse-Lobe Grape Fern
Sceptridium dissectum	(Spreng.) Lyon	FAC	Cut-Leaf Grape Fern
Sceptridium multifidum	(Gmel.) Nishida ex Tagawa	FACU	Leathery Grape Fern
Sceptridium oneidense	(Gilbert) Holub	FAC	Blunt-Lobe Grape Fern
Schedonorus arundinaceus	(Schreb.) Dumort.	FACU	Tall False Rye Grass
Schedonorus giganteus	(L.) Holub	FACU	Giant False Rye Grass
Schedonorus pratensis	(Huds.) Beauv.	FACU	Meadow False Rye Grass
Schenkia spicata	(L.) G.Mans.	FACW	Mediterranean Schenkia
Scheuchzeria palustris	L.	OBL	Rannoch-Rush
Schizachne purpurascens	(Torr.) Swallen	FACU	False Melic Grass
Schizachyrium littorale	(Nash) Bickn.	FACW	Dune False Bluestem
Schizachyrium scoparium	(Michx.) Nash	FACU	Little False Bluestem
Schizaea pusilla	Pursh	OBL	Little Curly-Grass Fern
Schoenoplectus X steinmetzii	(Fern.) S.G. Sm.	OBL	
Schoenoplectus acutus	(Muhl. ex Bigelow) A.& D. Löve	OBL	Hard-Stem Club-Rush
Schoenoplectus americanus	(Pers.) Volk. ex Schinz & R. Keller	OBL	Chairmaker's Club-Rush
Schoenoplectus etuberculatus	(Steud.) Soják	OBL	Canby's Club-Rush
Schoenoplectus fluviatilis	(Torr.) M.T. Strong	OBL	River Club-Rush
Schoenoplectus glaucus	(Lam.) Kartesz	OBL	Tuberous Club-Rush
Schoenoplectus hallii	(Gray) S.G. Sm.	OBL	Hall's Club-Rush
Schoenoplectus heterochaetus	(Chase) Soják	OBL	Pale Great Club-Rush
Schoenoplectus lacustris	(L.) Palla	OBL	Common Club-Rush
Schoenoplectus maritimus	(L.) Lye	OBL	Saltmarsh Club-Rush
Schoenoplectus mucronatus	(L.) Palla	OBL	Bog Club-Rush
Schoenoplectus novae-angliae	(Britt.) M.T. Strong	OBL	New England Club-Rush
Schoenoplectus pungens	(Vahl) Palla	OBL	Three-Square
Schoenoplectus purshianus	(Fern.) M.T. Strong	OBL	Weak-Stalk Club-Rush
Schoenoplectus robustus	(Pursh) M.T. Strong	OBL	Seaside Club-Rush
Schoenoplectus smithii	(Gray) Soják	OBL	Smith's Club-Rush
Schoenoplectus subterminalis	(Torr.) Soják	OBL	Swaying Club-Rush
Schoenoplectus tabernaemontani	(K.C. Gmel.) Palla	OBL	Soft-Stem Club-Rush
Schoenoplectus torreyi	(Olney) Palla	OBL	Torrey's Club-Rush
Schwalbea americana	L.	FACU	Chaffseed
Scilla luciliae	(Boiss.) Speta	FAC	Boissier's Glory-of-the-Snow
Scirpoides holoschoenus	(L.) Soják	OBL	Round-Head Club-Rush
Scirpus X peckii	Britt. (pro sp.)	OBL	
Scirpus ancistrochaetus	Schuyler	OBL	Barbed-Bristle Bulrush
Scirpus atrocinctus	Fern.	OBL	Black-Girdle Bulrush
Scirpus atrovirens	Willd.	OBL	Dark-Green Bulrush
Scirpus cyperinus	(L.) Kunth	OBL	Cottongrass Bulrush
Scirpus expansus	Fern.	OBL	Woodland Bulrush
Scirpus georgianus	Harper	OBL	Georgia Bulrush
Scirpus hattorianus	Makino	OBL	Mosquito Bulrush
Scirpus longii	Fern.	OBL	Long's Bulrush
Scirpus microcarpus	J.& K. Presl	OBL	Red-Tinge Bulrush
Scirpus pallidus	(Britt.) Fern.	OBL	Pale Bulrush
Scirpus pedicellatus	Fern.	OBL	Stalked Bulrush
Scirpus pendulus	Muhl.	OBL	Rufous Bulrush
Scirpus polyphyllus	Vahl	OBL	Leafy Bulrush
Scleranthus annuus	L.	FACU	Annual Knawel
Scleria minor	W. Stone	FACW	Slender Nut-Rush
Scleria muehlenbergii	Steud.	FACW	Muehlenberg's Nut-Rush
Scleria oligantha	Michx.	FAC	Little-Head Nut-Rush
Scleria pauciflora	Muhl. ex Willd.	FACU	Few-Flower Nut-Rush
Scleria reticularis	Michx.	OBL	Netted Nut-Rush
Scleria triglomerata	Michx.	FAC	Whip Nut-Rush
Scleria verticillata	Muhl. ex Willd.	OBL	Low Nut-Rush
Sclerolepis uniflora	(Walt.) B.S.P.	OBL	Pink Bogbutton
Scolochloa festucacea	(Willd.) Link	OBL	Common River Grass
Scorzoneroides autumnalis	(L.) Moench	FACU	August-Flower
Scrophularia lanceolata	Pursh	FACU	Lance-Leaf Figwort
Scrophularia marilandica	L.	FACU	Carpenter's-Square
Scutellaria X churchilliana	Fern. (pro sp.)	FACW	
Scutellaria galericulata	L.	OBL	Hooded Skullcap
Scutellaria integrifolia	L.	FACW	Helmet-Flower
Scutellaria lateriflora	L.	OBL	Mad Dog Skullcap
Scutellaria nervosa	Pursh	FAC	Veiny Skullcap
Scutellaria ovata	Hill	FACU	Heart-Leaf Skullcap
Scutellaria parvula	Michx.	FACU	Small Skullcap
Sedum ternatum	Michx.	FACU	Woodland Stonecrop

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Selaginella apoda	(L.) Spring	**FACW**	Meadow Spike-Moss
Selaginella eclipes	Buck	**FACW**	Hidden Spike-Moss
Selaginella selaginoides	(L.) Beauv. ex Mart. & Schrank	**FACW**	Northern Spike-Moss
Senecio eremophilus	Richards.	**FACW**	Desert Ragwort
Senecio hieraciifolius	L.	**FACU**	American Burnweed
Senecio integerrimus	Nutt.	**FAC**	Lamb-Tongue Ragwort
Senecio pseudoarnica	Less.	**FACU**	Seaside Ragwort
Senecio suaveolens	(L.) Elliott	**FACW**	False Indian-Plantain
Senecio sylvaticus	L.	**UPL**	Woodland Ragwort
Senecio vulgaris	L.	**FACU**	Old-Man-in-the-Spring
Senna hebecarpa	(Fern.) Irwin & Barneby	**FACW**	American Wild Sensitive-Plant
Senna marilandica	(L.) Link	**FACW**	Maryland Wild Sensitive-Plant
Senna obtusifolia	(L.) Irwin & Barneby	**FACU**	Coffeeweed
Senna occidentalis	(L.) Link	**UPL**	Septicweed
Sesbania herbacea	(P. Mill.) McVaugh	**FACW**	Peatree
Sesuvium maritimum	(Walt.) B.S.P.	**FACW**	Slender Sea-Purslane
Setaria X ambigua	(Guss.) Guss.	**FACU**	
Setaria faberi	Herrm.	**FACU**	Japanese Bristle Grass
Setaria italica	(L.) Beauv.	**FACU**	Italian Bristle Grass
Setaria parviflora	(Poir.) Kerguélen	**FAC**	Marsh Bristle Grass
Setaria pumila	(Poir.) Roemer & J.A. Schultes	**FAC**	Yellow Bristle Grass
Setaria verticillata	(L.) Beauv.	**FACU**	Rough Bristle Grass
Setaria verticilliformis	Dumort.	**FAC**	Foreward-Barb Bristle Grass
Shepherdia argentea	(Pursh) Nutt.	**FACU**	Silver Buffalo-Berry
Shepherdia canadensis	(L.) Nutt.	**UPL**	Russet Buffalo-Berry
Shortia galacifolia	Torr. & Gray	**FACU**	Oconee-Bells
Sibbaldia procumbens	L.	**FACU**	Creeping-Glow-Wort
Sibbaldia tridentata	(Ait.) Paule & Soják	**FACU**	Shrubby-Fivefingers
Sicyos angulatus	L.	**FACW**	One-Seed Burr-Cucumber
Sida acuta	Burm. f.	**FACU**	Common-Wireweed
Sida hermaphrodita	(L.) Rusby	**FACU**	Virginia Fanpetals
Sida spinosa	L.	**FACU**	Prickly Fanpetals
Sidalcea oregana	(Nutt. ex Torr. & Gray) Gray	**FACW**	Oregon Checkerbloom
Silene acaulis	(L.) Jacq.	**UPL**	Cushion-Pink
Silene flos-cuculi	(L.) Clairv.	**FACU**	Ragged-Robin
Silene nivea	(Nutt.) Muhl. ex Otth	**FACW**	Snowy Catchfly
Silphium integrifolium	Michx.	**FAC**	Entire-Leaf Rosinweed
Silphium perfoliatum	L.	**FACW**	Cup-Plant
Silphium terebinthinaceum	Jacq.	**FAC**	Prairie Rosinweed
Sinapis alba	L.	**FACU**	White-Mustard
Sisymbrium altissimum	L.	**FACU**	Tall Hedge-Mustard
Sisyrinchium albidum	Raf.	**FACU**	White Blue-Eyed-Grass
Sisyrinchium angustifolium	P. Mill.	**FAC**	Narrow-Leaf Blue-Eyed-Grass
Sisyrinchium atlanticum	Bickn.	**FACW**	Eastern Blue-Eyed-Grass
Sisyrinchium fuscatum	Bickn.	**FACU**	Coastal-Plain Blue-Eyed-Grass
Sisyrinchium montanum	Greene	**FAC**	Strict Blue-Eyed-Grass
Sisyrinchium mucronatum	Michx.	**FAC**	Needle-Tip Blue-Eyed-Grass
Sisyrinchium strictum	Bickn.	**FAC**	
Sium carsonii	Dur. ex Gray	**OBL**	Carson's Water-Parsnip
Sium suave	Walt.	**OBL**	Hemlock Water-Parsnip
Smilax glauca	Walt.	**FACU**	Sawbrier
Smilax herbacea	L.	**FAC**	Smooth Carrion-Flower
Smilax hispida	Muhl. ex Torr.	**FAC**	Chinaroot
Smilax pseudochina	L.	**FAC**	Bamboovine
Smilax pulverulenta	Michx.	**FACU**	Downy Carrion-Flower
Smilax rotundifolia	L.	**FAC**	Horsebrier
Solandra grandiflora	Sw.	**FACU**	Showy Chalicevine
Solanum carolinense	L.	**FACU**	Carolina Horse-Nettle
Solanum dulcamara	L.	**FAC**	Climbing Nightshade
Solanum nigrum	L.	**FACU**	European Black Nightshade
Solanum ptychanthum	Dunal	**FACU**	Eastern Black Nightshade
Solenostemon scutellarioides	(L.) Codd	**FACU**	Painted-Nettle
Solidago X asperula	Desf. (pro sp.)	**FACW**	
Solidago altissima	L.	**FACU**	Tall Goldenrod
Solidago arguta	Ait.	**FACU**	Atlantic Goldenrod
Solidago caesia	L.	**FACU**	Wreath Goldenrod
Solidago canadensis	L.	**FACU**	Canadian Goldenrod
Solidago fistulosa	P. Mill.	**FACW**	Pine-Barren Goldenrod
Solidago flexicaulis	L.	**FACU**	Zigzag Goldenrod
Solidago gigantea	Ait.	**FACW**	Late Goldenrod
Solidago houghtonii	Torr. & Gray	**OBL**	Houghton's Goldenrod
Solidago latissimifolia	P. Mill.	**OBL**	Elliott's Goldenrod
Solidago lepida	DC.	**FACU**	Western Canada Goldenrod
Solidago multiradiata	Ait.	**FACU**	Rocky Mountain Goldenrod
Solidago ohioensis	Riddell	**OBL**	Ohio Goldenrod

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Solidago patula	Muhl. ex Willd.	**OBL**	Round-Leaf Goldenrod
Solidago puberula	Nutt.	**FACU**	Downy Goldenrod
Solidago riddellii	Frank	**OBL**	Riddell's Goldenrod
Solidago rigida	L.	**FACU**	Hard-Leaf Flat-Top-Goldenrod
Solidago rugosa	P. Mill.	**FAC**	Wrinkle-Leaf Goldenrod
Solidago sempervirens	L.	**FACW**	Seaside Goldenrod
Solidago simplex	Kunth	**FACU**	Mt. Albert Goldenrod
Solidago uliginosa	Nutt.	**OBL**	Bog Goldenrod
Sonchus arvensis	L.	**FACU**	Field Sow-Thistle
Sonchus asper	(L.) Hill	**FACU**	Spiny-Leaf Sow-Thistle
Sonchus oleraceus	L.	**FACU**	Common Sow-Thistle
Sorbus americana	Marsh.	**FAC**	American Mountain-Ash
Sorbus decora	(Sarg.) Schneid.	**FACU**	Northern Mountain-Ash
Sorghastrum nutans	(L.) Nash	**FACU**	Yellow Indian Grass
Sorghum bicolor	(L.) Moench	**UPL**	Broom-Corn
Sorghum halepense	(L.) Pers.	**FACU**	Johnson Grass
Sparganium americanum	Nutt.	**OBL**	American Burr-Reed
Sparganium androcladum	(Engelm.) Morong	**OBL**	Branched Burr-Reed
Sparganium angustifolium	Michx.	**OBL**	Narrow-Leaf Burr-Reed
Sparganium emersum	Rehmann	**OBL**	European Burr-Reed
Sparganium eurycarpum	Engelm. ex Gray	**OBL**	Broad-Fruit Burr-Reed
Sparganium fluctuans	(Engelm. ex Morong) B.L. Robins.	**OBL**	Floating Burr-Reed
Sparganium glomeratum	(Beurling ex Laestad.) L. Neum.	**OBL**	Clustered Burr-Reed
Sparganium natans	L.	**OBL**	Arctic Burr-Reed
Spartina X caespitosa	A.A. Eat. (pro sp.)	**OBL**	
Spartina alterniflora	Loisel.	**OBL**	Saltwater Cord Grass
Spartina cynosuroides	(L.) Roth	**OBL**	Big Cord Grass
Spartina gracilis	Trin.	**FACW**	Alkali Cord Grass
Spartina patens	(Ait.) Muhl.	**FACW**	Salt-Meadow Cord Grass
Spartina pectinata	Bosc ex Link	**FACW**	Freshwater Cord Grass
Spergularia canadensis	(Pers.) G. Don	**OBL**	Canadian Sandspurry
Spergularia marina	(L.) Griseb.	**FACW**	Saltmarsh Sandspurry
Spergularia media	(L.) K. Presl ex Griseb.	**FACU**	Satin-Flower
Spergularia rubra	(L.) J.& K. Presl	**FACU**	Ruby Sandspurry
Sphenopholis X pallens	(Biehler) Scribn. (pro sp.)	**FAC**	
Sphenopholis intermedia	(Rydb.) Rydb.	**FAC**	Slender Wedgescale
Sphenopholis nitida	(Biehler) Scribn.	**UPL**	Shiny Wedgescale
Sphenopholis obtusata	(Michx.) Scribn.	**FAC**	Prairie Wedgescale
Sphenopholis pensylvanica	(L.) A.S. Hitchc.	**OBL**	Swamp Wedgescale
Spinulum annotinum	(L.) A. Haines	**FAC**	Interrupted Club-Moss
Spiraea alba	Du Roi	**FACW**	White Meadowsweet
Spiraea betulifolia	Pallas	**FACU**	Shiny-Leaf Meadowsweet
Spiraea japonica	L. f.	**UPL**	Japanese Meadowsweet
Spiraea latifolia	(Ait.) Borkh.	**FACW**	Broad-Leaf Meadowsweet
Spiraea salicifolia	L.	**OBL**	Willow-Leaf Meadowsweet
Spiraea tomentosa	L.	**FACW**	Steeplebush
Spiranthes cernua	(L.) L.C. Rich.	**FACW**	White Nodding Ladies'-Tresses
Spiranthes lacera	(Raf.) Raf.	**FAC**	Northern Slender Ladies'-Tresses
Spiranthes laciniata	(Small) Ames	**OBL**	Lace-Lip Ladies'-Tresses
Spiranthes lucida	(H.H. Eat.) Ames	**FACW**	Shining Ladies'-Tresses
Spiranthes magnicamporum	Sheviak	**FACU**	Great Plains Ladies'-Tresses
Spiranthes odorata	(Nutt.) Lindl.	**OBL**	Marsh Ladies'-Tresses
Spiranthes ovalis	Lindl.	**FAC**	October Ladies'-Tresses
Spiranthes praecox	(Walt.) S. Wats.	**OBL**	Green-Vein Ladies'-Tresses
Spiranthes romanzoffiana	Cham.	**OBL**	Hooded Ladies'-Tresses
Spiranthes tuberosa	Raf.	**UPL**	Little Ladies'-Tresses
Spiranthes vernalis	Engelm. & Gray	**FAC**	Spring Ladies'-Tresses
Spirodela polyrhiza	(L.) Schleid.	**OBL**	Common Duckmeat
Sporobolus airoides	(Torr.) Torr.	**FAC**	Alkali-Sacaton
Sporobolus cryptandrus	(Torr.) Gray	**FACU**	Sand Dropseed
Sporobolus heterolepis	(Gray) Gray	**FACU**	Prairie Dropseed
Sporobolus indicus	(L.) R. Br.	**FACU**	Smut Grass
Sporobolus neglectus	Nash	**FACU**	Small Dropseed
Sporobolus pyramidatus	(Lam.) A.S. Hitchc.	**UPL**	Target Dropseed
Stachys aspera	Michx.	**FACW**	Gritty Hedge-Nettle
Stachys clingmanii	Small	**FACU**	Clingman's Hedge-Nettle
Stachys cordata	Riddell	**FAC**	Heart-Leaf Hedge-Nettle
Stachys hyssopifolia	Michx.	**FACW**	Hyssop-Leaf Hedge-Nettle
Stachys palustris	L.	**OBL**	Woundwort
Stachys pilosa	Nutt.	**FACW**	Hairy Hedge-Nettle
Stachys tenuifolia	Willd.	**FACW**	Smooth Hedge-Nettle
Staphylea trifolia	L.	**FAC**	American Bladdernut
Stellaria alsine	Grimm	**OBL**	Bog Chickweed
Stellaria borealis	Bigelow	**FACW**	Boreal Starwort
Stellaria crassifolia	Ehrh.	**FACW**	Fleshy Starwort

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Stellaria graminea	L.	**UPL**	Grass-Leaf Starwort
Stellaria humifusa	Rottb.	**OBL**	Saltmarsh Starwort
Stellaria longifolia	Muhl. ex Willd.	**FACW**	Long-Leaf Starwort
Stellaria longipes	Goldie	**FAC**	Long-Stalk Starwort
Stellaria media	(L.) Vill.	**FACU**	Common Chickweed
Stellaria palustris	Ehrh. ex Hoffmann	**FAC**	European Water Starwort
Stenanthium gramineum	(Ker-Gawl.) Morong	**FAC**	Eastern Featherbells
Stenanthium leimanthoides	(Gray) Zomlefer & Judd	**OBL**	Pine-Barren Featherbells
Streptopus amplexifolius	(L.) DC.	**FAC**	Clasping Twistedstalk
Streptopus lanceolatus	(Ait.) Reveal	**FACU**	Lance-Leaf Twistedstalk
Strophostyles helvola	(L.) Ell.	**FAC**	Trailing Fuzzy-Bean
Strophostyles umbellata	(Muhl. ex Willd.) Britt.	**FACU**	Pink Fuzzy-Bean
Stuckenia X suecica	(Richter) Holub	**OBL**	
Stuckenia filiformis	(Pers.) Börner	**OBL**	Slender-Leaf False Pondweed
Stuckenia pectinata	(L.) Böerner	**OBL**	Sago False Pondweed
Stuckenia vaginata	(Turcz.) Holub	**OBL**	Sheathed False Pondweed
Styrax americanus	Lam.	**OBL**	American Snowbell
Suaeda calceoliformis	(Hook.) Moq.	**FACW**	Paiuteweed
Suaeda linearis	(Ell.) Moq.	**OBL**	Annual Seepweed
Suaeda maritima	(L.) Dumort.	**OBL**	Herbaceous Seepweed
Subularia aquatica	L.	**OBL**	American Water-Awlwort
Succisella inflexa	(Kluk) G. Beck	**FACW**	Frosted Pearls
Symphoricarpos albus	(L.) Blake	**FACU**	Common Snowberry
Symphoricarpos occidentalis	Hook.	**FACU**	Western Snowberry
Symphoricarpos orbiculatus	Moench	**FACU**	Coral-Berry
Symphyotrichum boreale	(Torr. & Gray) A.& D. Löve	**OBL**	Boreal American-Aster
Symphyotrichum ciliatum	(Ledeb.) Nesom	**FAC**	Alkali American-Aster
Symphyotrichum dumosum	(L.) Nesom	**FAC**	Rice Button American-Aster
Symphyotrichum ericoides	(L.) Nesom	**FACU**	White Heath American-Aster
Symphyotrichum falcatum	(Lindl.) Nesom	**FAC**	Rough White Prairie American-Aster
Symphyotrichum frondosum	(Nutt.) Nesom	**FACW**	Leafy American-Aster
Symphyotrichum laeve	(L.) A.& D. Löve	**FACU**	Smooth Blue American-Aster
Symphyotrichum lanceolatum	(Willd.) Nesom	**FACW**	White Panicled American-Aster
Symphyotrichum lateriflorum	(L.) A.& D. Löve	**FAC**	Farewell-Summer
Symphyotrichum novae-angliae	(L.) Nesom	**FACW**	New England American-Aster
Symphyotrichum novi-belgii	(L.) Nesom	**FACW**	New Belgium American-Aster
Symphyotrichum ontarionis	(Wieg.) Nesom	**FAC**	Ontario American-Aster
Symphyotrichum pilosum	(Willd.) Nesom	**FACU**	White Oldfield American-Aster
Symphyotrichum praealtum	(Poir.) Nesom	**FACW**	Willow-Leaf American-Aster
Symphyotrichum prenanthoides	(Muhl. ex Willd.) Nesom	**FAC**	Crooked-Stem American-Aster
Symphyotrichum puniceum	(L.) A.& D. Löve	**OBL**	Purple-Stem American-Aster
Symphyotrichum racemosum	(Ell.) Nesom	**FACW**	Fragile-Stem American-Aster
Symphyotrichum robynsianum	(Rouss.) L. Brouillet & Labrecque	**FACW**	Robyns' American-Aster
Symphyotrichum subulatum	(Michx.) Nesom	**FACW**	Seaside American-Aster
Symphyotrichum tenuifolium	(L.) Nesom	**OBL**	Perennial Saltmarsh American-Aster
Symphyotrichum tradescantii	(L.) Nesom	**FACW**	Tradescant's American-Aster
Symphytum asperum	Lepechin	**UPL**	Prickly Comfrey
Symplocarpus foetidus	(L.) Salisb. ex Nutt.	**OBL**	Skunk-Cabbage
Symplocos tinctoria	(L.) L'Hér.	**FAC**	Horsesugar
Tamarix chinensis	Lour.	**FAC**	Five-Stamen Tamarisk
Tamarix parviflora	DC.	**FAC**	Small-Flower Tamarisk
Tanacetum vulgare	L.	**FACU**	Common Tansy
Taraxacum ceratophorum	(Ledeb.) DC.	**FAC**	Horned Dandelion
Taraxacum officinale	G.H. Weber ex Wiggers	**FACU**	Common Dandelion
Tarenaya hassleriana	(Chod.) Iltis	**FACU**	Pinkqueen
Taxodium distichum	(L.) L.C. Rich.	**OBL**	Southern Bald-Cypress
Taxus canadensis	Marsh.	**FACU**	American Yew
Tephroseris palustris	(L.) Reichenb.	**FACW**	Clustered Marsh Squaw-Weed
Teucrium canadense	L.	**FACW**	American Germander
Thalictrum dasycarpum	Fisch. & Avé-Lall.	**FACW**	Purple Meadow-Rue
Thalictrum dioicum	L.	**FACU**	Early Meadow-Rue
Thalictrum pubescens	Pursh	**FACW**	King-of-the-Meadow
Thalictrum revolutum	DC.	**FAC**	Waxy-Leaf Meadow-Rue
Thalictrum thalictroides	(L.) Eames & Boivin	**FACU**	Rue-Anemone
Thalictrum venulosum	Trel.	**FACW**	Veiny-Leaf Meadow-Rue
Thaspium barbinode	(Michx.) Nutt.	**UPL**	Hairy-Joint Meadow-Parsnip
Thelypteris palustris	Schott	**FACW**	Eastern Marsh Fern
Thermopsis rhombifolia	(Nutt. ex Pursh) Nutt. ex Richards.	**FACU**	Prairie Golden-Banner
Thinopyrum pycnanthum	(Godr.) Barkworth	**FACW**	Tick Quack Grass
Thlaspi arvense	L.	**UPL**	Field Pennycress
Thuja occidentalis	L.	**FACW**	Eastern Arborvitae
Tiarella cordifolia	L.	**FACU**	Heart-Leaf Foamflower
Tilia americana	L.	**FACU**	American Basswood
Tipularia discolor	(Pursh) Nutt.	**FACU**	Crippled-Cranefly
Tofieldia pusilla	(Michx.) Pers.	**FACW**	Scotch Featherling

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Torreyochloa pallida	(Torr.) Church	**OBL**	Pale False Manna Grass
Toxicodendron radicans	(L.) Kuntze	**FAC**	Eastern Poison Ivy
Toxicodendron rydbergii	(Small ex Rydb.) Greene	**FAC**	Western Poison Ivy
Toxicodendron vernix	(L.) Kuntze	**OBL**	Poison-Sumac
Tradescantia bracteata	Small	**FACU**	Long-Bract Spiderwort
Tradescantia occidentalis	(Britt.) Smyth	**UPL**	Prairie Spiderwort
Tradescantia ohiensis	Raf.	**FACU**	Bluejacket
Tradescantia virginiana	L.	**UPL**	Virginia Spiderwort
Trapa natans	L.	**OBL**	Water-Chestnut
Triantha glutinosa	(Michx.) Baker	**OBL**	Sticky False Asphodel
Trichophorum alpinum	(L.) Pers.	**OBL**	Alpine Leafless-Bulrush
Trichophorum caespitosum	(L.) Hartman	**OBL**	Tufted Leafless-Bulrush
Trichophorum clintonii	(Gray) S.G. Sm.	**FACU**	Clinton's Leafless-Bulrush
Trichostema dichotomum	L.	**UPL**	Forked Bluecurls
Tridens flavus	(L.) A.S. Hitchc.	**UPL**	Tall Redtop
Tridens strictus	(Nutt.) Nash	**FACU**	Long-Spike Fluff Grass
Trientalis borealis	Raf.	**FAC**	Maystar
Trifolium depauperatum	Desv.	**UPL**	Balloon Sack Clover
Trifolium dubium	Sibthorp	**FACU**	Suckling Clover
Trifolium fragiferum	L.	**FACU**	Strawberry-Head Clover
Trifolium fucatum	Lindl.	**UPL**	Sour Clover
Trifolium hybridum	L.	**FACU**	Alsike Clover
Trifolium pratense	L.	**FACU**	Red Clover
Trifolium repens	L.	**FACU**	White Clover
Trifolium resupinatum	L.	**UPL**	Reversed Clover
Triglochin gaspensis	Lieth & D. Löve	**OBL**	Gaspe Peninsula Arrow-Grass
Triglochin maritima	L.	**OBL**	Seaside Arrow-Grass
Triglochin palustris	L.	**OBL**	Marsh Arrow-Grass
Trillium cernuum	L.	**FAC**	Whip-Poor-Will-Flower
Trillium erectum	L.	**FACU**	Stinking-Benjamin
Trillium flexipes	Raf.	**FAC**	Nodding Trillium
Trillium recurvatum	Beck	**FACU**	Bloody-Butcher
Trillium sessile	L.	**FACU**	Toadshade
Trillium undulatum	Willd.	**FACU**	Painted Trillium
Triodanis perfoliata	(L.) Nieuwl.	**FACU**	Clasping-Leaf Venus'-Looking-Glass
Triosteum angustifolium	L.	**FAC**	Yellow-Fruit Horse-Gentian
Triphora trianthophoros	(Sw.) Rydb.	**FACU**	Threebirds
Tripleurospermum maritimum	(L.) W.D.J. Koch	**FAC**	False Mayweed
Tripsacum dactyloides	(L.) L.	**FAC**	Eastern Mock Grama
Trisetum spicatum	(L.) Richter	**FAC**	Narrow False Oat
Trollius laxus	Salisb.	**OBL**	American Globeflower
Tropaeolum majus	L.	**UPL**	Garden-Nasturtium
Tropaeolum minus	L.	**FACU**	Bush-Nasturtium
Tsuga canadensis	(L.) Carr.	**FACU**	Eastern Hemlock
Tussilago farfara	L.	**FACU**	Colt's-Foot
Typha X glauca	Godr. (pro sp.)	**OBL**	
Typha angustifolia	L.	**OBL**	Narrow-Leaf Cat-Tail
Typha domingensis	Pers.	**OBL**	Southern Cat-Tail
Typha latifolia	L.	**OBL**	Broad-Leaf Cat-Tail
Ulex europaeus	L.	**FACU**	Common Gorse
Ulmus americana	L.	**FACW**	American Elm
Ulmus glabra	Huds.	**FACU**	Wych Elm
Ulmus parvifolia	Jacq.	**UPL**	Chinese Elm
Ulmus pumila	L.	**FACU**	Siberian Elm
Ulmus rubra	Muhl.	**FAC**	Slippery Elm
Ulmus thomasii	Sarg.	**FAC**	Rock Elm
Urochloa plantaginea	(Link) R. Webster	**FAC**	Plantain Liverseed Grass
Urtica chamaedryoides	Pursh	**FACU**	Heart-Leaf Nettle
Urtica dioica	L.	**FAC**	Stinging Nettle
Utricularia cornuta	Michx.	**OBL**	Horned Bladderwort
Utricularia geminiscapa	Benj.	**OBL**	Hidden-Fruit Bladderwort
Utricularia gibba	L.	**OBL**	Humped Bladderwort
Utricularia inflata	Walt.	**OBL**	Swollen Bladderwort
Utricularia intermedia	Hayne	**OBL**	Flat-Leaf Bladderwort
Utricularia juncea	Vahl	**OBL**	Southern Bladderwort
Utricularia macrorhiza	Le Conte	**OBL**	Greater Bladderwort
Utricularia minor	L.	**OBL**	Lesser Bladderwort
Utricularia ochroleuca	R.W. Hartman	**OBL**	Dwarf Bladderwort
Utricularia purpurea	Walt.	**OBL**	Eastern Purple Bladderwort
Utricularia radiata	Small	**OBL**	Little Floating Bladderwort
Utricularia resupinata	B.D. Greene ex Bigelow	**OBL**	Lavender Bladderwort
Utricularia striata	Le Conte ex Torr.	**OBL**	Striped Bladderwort
Utricularia subulata	L.	**OBL**	Zigzag Bladderwort
Uvularia perfoliata	L.	**FACU**	Perfoliate Bellwort
Uvularia puberula	Michx.	**FACU**	Mountain Bellwort

2016 NWPL - National Wetland Plant List for Wetland Region = NCNE.

Scientific Name	Authorship	NCNE	Common Name
Uvularia sessilifolia	L.	**FACU**	Sessile-Leaf Bellwort
Vaccaria hispanica	(P. Mill.) Rauschert	**UPL**	Cowcockle
Vaccinium X marianum	S. Wats. (pro sp.)	**FACW**	
Vaccinium angustifolium	Ait.	**FACU**	Late Lowbush Blueberry
Vaccinium caesariense	Mackenzie	**OBL**	New Jersey Blueberry
Vaccinium caespitosum	Michx.	**FACU**	Dwarf Blueberry
Vaccinium corymbosum	L.	**FACW**	Highbush Blueberry
Vaccinium formosum	Andr.	**FACW**	Southern Blueberry
Vaccinium fuscatum	Ait.	**FACW**	Black Blueberry
Vaccinium macrocarpon	Ait.	**OBL**	Large Cranberry
Vaccinium membranaceum	Dougl. ex Torr.	**UPL**	Square-Twig Blueberry
Vaccinium myrtilloides	Michx.	**FACW**	Velvet-Leaf Blueberry
Vaccinium ovalifolium	Sm.	**FACU**	Oval-Leaf Blueberry
Vaccinium oxycoccos	L.	**OBL**	Small Cranberry
Vaccinium stamineum	L.	**FACU**	Deerberry
Vaccinium uliginosum	L.	**FAC**	Alpine Blueberry
Vaccinium vitis-idaea	L.	**FAC**	Northern Mountain-Cranberry
Vahlodea atropurpurea	(Wahlenb.) Fries ex Hartman	**FACW**	Arctic-Hair Grass
Valeriana dioica	L.	**FACW**	Marsh Valerian
Valeriana edulis	Nutt. ex Torr. & Gray	**FACW**	Tobacco-Root
Valeriana pauciflora	Michx.	**FACW**	Large-Flower Valerian
Valeriana uliginosa	(Torr. & Gray) Rydb.	**OBL**	Mountain Valerian
Valerianella chenopodiifolia	(Pursh) DC.	**FAC**	Goose-Foot Cornsalad
Valerianella radiata	(L.) Dufr.	**FAC**	Beaked Cornsalad
Valerianella umbilicata	(Sullivant) Wood	**FACW**	Navel Cornsalad
Vallisneria americana	Michx.	**OBL**	American Eel-Grass
Veratrum latifolium	(Desr.) Zomlefer	**FACU**	Slender Bunchflower
Veratrum virginicum	(L.) Ait. f.	**FACW**	Virginia Bunchflower
Veratrum viride	Ait.	**FACW**	American False Hellebore
Verbascum blattaria	L.	**FACU**	White Moth Mullein
Verbascum thapsus	L.	**UPL**	Great Mullein
Verbena X engelmannii	Moldenke	**FAC**	
Verbena X rydbergii	Moldenke	**FACW**	
Verbena bonariensis	L.	**FACU**	Purple-Top Vervain
Verbena bracteata	Cav. ex Lag. & Rodr.	**FACU**	Carpet Vervain
Verbena hastata	L.	**FACW**	Simpler's-Joy
Verbena lasiostachys	Link	**FAC**	Western Vervain
Verbena officinalis	L.	**FACU**	Herb-of-the-Cross
Verbena urticifolia	L.	**FAC**	White Vervain
Verbesina alternifolia	(L.) Britt. ex Kearney	**FACW**	Wingstem
Verbesina encelioides	(Cav.) Benth. & Hook. f. ex Gray	**FAC**	Golden Crownbeard
Vernonia arkansana	DC.	**FAC**	Arkansas Ironweed
Vernonia baldwinii	Torr.	**UPL**	Western Ironweed
Vernonia fasciculata	Michx.	**FACW**	Prairie Ironweed
Vernonia gigantea	(Walt.) Trel. ex Branner & Coville	**FAC**	Giant Ironweed
Vernonia missurica	Raf.	**FAC**	Missouri Ironweed
Vernonia noveboracensis	(L.) Michx.	**FACW**	New York Ironweed
Veronica americana	Schwein. ex Benth.	**OBL**	American-Brooklime
Veronica anagallis-aquatica	L.	**OBL**	Blue Water Speedwell
Veronica arvensis	L.	**FACU**	Corn Speedwell
Veronica beccabunga	L.	**OBL**	European Speedwell
Veronica chamaedrys	L.	**UPL**	Germander Speedwell
Veronica officinalis	L.	**FACU**	Common Gypsyweed
Veronica peregrina	L.	**FAC**	Neckweed
Veronica prostrata	L.	**FAC**	Prostrate Speedwell
Veronica scutellata	L.	**OBL**	Grass-Leaf Speedwell
Veronica serpyllifolia	L.	**FAC**	Thyme-Leaf Speedwell
Veronica wormskjoldii	Roemer & J.A. Schultes	**FAC**	American Alpine Speedwell
Veronicastrum virginicum	(L.) Farw.	**FAC**	Culver's-Root
Viburnum acerifolium	L.	**UPL**	Maple-Leaf Arrow-Wood
Viburnum dentatum	L.	**FAC**	Southern Arrow-Wood
Viburnum edule	(Michx.) Raf.	**FACW**	Squashberry
Viburnum lantanoides	Michx.	**FACU**	Hobblebush
Viburnum lentago	L.	**FAC**	Nanny-Berry
Viburnum nudum	L.	**FACW**	Possumhaw
Viburnum opulus	L.	**FACW**	Highbush-Cranberry
Viburnum prunifolium	L.	**FACU**	Smooth Blackhaw
Viburnum recognitum	Fern.	**FAC**	Smooth Arrow-Wood
Vicia americana	Muhl. ex Willd.	**FACU**	American Purple Vetch
Vicia caroliniana	Walt.	**UPL**	Carolina Vetch
Vicia sativa	L.	**FACU**	Garden Vetch
Vigna luteola	(Jacq.) Benth.	**FACW**	Wild Cow-Pea
Viola X bernardii	Greene (Greene)	**FACU**	
Viola X champlainensis	House	**FACU**	
Viola X dissita	House	**FAC**	

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Scientific Name	Authorship	NCNE	Common Name
Viola X greenmanii	House	**FAC**	
Viola X insessa	House	**FACW**	
Viola X melissifolia	Greene	**FAC**	
Viola X mistura	House (pro sp.)	**FACU**	
Viola X napae	House	**FAC**	
Viola X porteriana	Pollard (pro sp.)	**FACW**	
Viola X subaffinis	House	**FACW**	
Viola X viarum	Pollard	**FACU**	
Viola adunca	Sm.	**FACU**	Hook-Spur Violet
Viola affinis	Le Conte	**FACW**	Sand Violet
Viola bicolor	Pursh	**FACU**	Field Pansy
Viola blanda	Willd.	**FACW**	Sweet White Violet
Viola brittoniana	Pollard	**FAC**	Northern Coastal Violet
Viola canadensis	L.	**FACU**	Canadian White Violet
Viola cucullata	Ait.	**OBL**	Marsh Blue Violet
Viola hastata	Michx.	**UPL**	Halberd-Leaf Yellow Violet
Viola hirsutula	Brainerd	**FACU**	Southern Woodland Violet
Viola labradorica	Schrank	**FAC**	Alpine Violet
Viola lanceolata	L.	**OBL**	Bog White Violet
Viola macloskeyi	Lloyd	**OBL**	Smooth White Violet
Viola missouriensis	Greene	**FAC**	Missouri Violet
Viola nephrophylla	Greene	**FACW**	Northern Bog Violet
Viola novae-angliae	House	**OBL**	New England Blue Violet
Viola palmata	L.	**FACU**	Three-Lobe Violet
Viola palustris	L.	**FACW**	Alpine-Marsh Violet
Viola pedata	L.	**UPL**	Bird-Foot Violet
Viola pedatifida	G. Don	**FACU**	Crow-Foot Violet
Viola primulifolia	L.	**FACW**	Primroseleaf Violet
Viola pubescens	Ait.	**FACU**	Downy Yellow Violet
Viola renifolia	Gray	**FACW**	Kidney-Leaf White Violet
Viola rostrata	Pursh	**FACU**	Long-Spur Violet
Viola rotundifolia	Michx.	**FAC**	Round-Leaf Yellow Violet
Viola sagittata	Ait.	**FAC**	Arrow-Leaf Violet
Viola septemloba	Le Conte	**FACW**	Southern Coastal Violet
Viola septentrionalis	Greene	**FACU**	Northern Woodland Violet
Viola sororia	Willd.	**FAC**	Hooded Blue Violet
Viola striata	Ait.	**FACW**	Striped Cream Violet
Viola subsinuata	Greene	**FACU**	Early Blue Violet
Viola walteri	House	**FACU**	Prostrate Blue Violet
Vitis X labruscana	Bailey	**FACU**	
Vitis X novae-angliae	Fern. (pro sp.)	**FAC**	
Vitis aestivalis	Michx.	**FACU**	Summer Grape
Vitis cinerea	(Engelm.) Engelm. ex Millard	**FACW**	Gray-Bark Grape
Vitis labrusca	L.	**FACU**	Fox Grape
Vitis palmata	Vahl	**OBL**	Catbird Grape
Vitis riparia	Michx.	**FAC**	River-Bank Grape
Vitis vulpina	L.	**FAC**	Frost Grape
Vulpia bromoides	(L.) S.F. Gray	**UPL**	Brome Six-Weeks Grass
Vulpia myuros	(L.) K.C. Gmel.	**FACU**	Rat-Tail Six-Weeks Grass
Vulpia octoflora	(Walt.) Rydb.	**FACU**	Eight-Flower Six-Weeks Grass
Wisteria frutescens	(L.) Poir.	**FACW**	American Wisteria
Wolffia borealis	(Engelm. ex Hegelm.) Landolt ex Landolt & Wildi	**OBL**	Northern Watermeal
Wolffia brasiliensis	Weddell	**OBL**	Brazilian Watermeal
Wolffia columbiana	Karst.	**OBL**	Columbian Watermeal
Wolffia globosa	(Roxb.) den Hartog & Plas	**OBL**	Asian Watermeal
Wolffiella gladiata	(Hegelm.) Hegelm.	**OBL**	Sword Bogmat
Woodwardia areolata	(L.) T. Moore	**OBL**	Netted Chain Fern
Woodwardia virginica	(L.) Sm.	**OBL**	Virginia Chain Fern
X Elyhordeum macounii	(Vasey) Barkworth & D.R. Dewey	**FACU**	
Xanthium spinosum	L.	**FACU**	Spiny Cockleburr
Xanthium strumarium	L.	**FAC**	Rough Cockleburr
Xanthorhiza simplicissima	Marsh.	**FACW**	Shrub Yellowroot
Xyris difformis	Chapman	**OBL**	Bog Yellow-Eyed-Grass
Xyris jupicai	L.C. Rich.	**OBL**	Richard's Yellow-Eyed-Grass
Xyris montana	Ries	**OBL**	Northern Yellow-Eyed-Grass
Xyris smalliana	Nash	**OBL**	Small's Yellow-Eyed-Grass
Xyris torta	Sm.	**OBL**	Slender Yellow-Eyed-Grass
Youngia japonica	(L.) DC.	**FACU**	Oriental False Hawk's-Beard
Zannichellia palustris	L.	**OBL**	Horned-Pondweed
Zanthoxylum americanum	P. Mill.	**FACU**	Toothachetree
Zizania aquatica	L.	**OBL**	Indian Wild Rice
Zizania palustris	L.	**OBL**	Northern Wild Rice
Zizia aptera	(Gray) Fern.	**FACU**	Heart-Leaf Alexanders
Zizia aurea	(L.) W.D.J. Koch	**FAC**	Golden Alexanders
Zostera marina	L.	**OBL**	Seawrack

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US Army Corps of Engineers®
Engineer Research and Development Center

Wetlands Regulatory Assistance Program

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(Version 2.0)

U.S. Army Corps of Engineers

January 2012

Environmental Laboratory

Approved for public release; distribution is unlimited.

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U.S. Army Corps of Engineers

U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

Prepared for Headquarters, U.S. Army Corps of Engineers
Washington, DC 20314-1000

Abstract: This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual, which provides technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The development of Regional Supplements is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. This supplement is applicable to the Northcentral and Northeast Region, which consists of all or portions of 15 states: Connecticut, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin.

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Preface

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual. It was developed by the U.S. Army Engineer Research and Development Center (ERDC) at the request of Headquarters, U.S. Army Corps of Engineers (USACE), with funding provided through the Wetlands Regulatory Assistance Program (WRAP). This is Version 2.0 of the Northcentral and Northeast Regional Supplement; it replaces the "interim" version, which was published in October 2009.

This document was developed in cooperation with the Northcentral and Northeast Regional Working Group, whose members contributed their time and expertise to the project over a period of many months. Working Group meetings were held in Hanover, NH, on 6-8 November 2007 and Madison, WI, on 15-17 April 2008. Members of the Regional Working Group and contributors to this document were:

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Independent peer reviews were performed in accordance with Office of Management and Budget guidelines. The peer-review team consisted of Barry Isaacs (chair), USDA Natural Resources Conservation Service, Harrisburg, PA; Richard Bostwick, Maine Department of Transportation, Environmental Office, Augusta, ME; Mallory Gilbert, M. N. Gilbert Environmental Consulting and Planning Services, Troy, NY; Ingeborg Hegemann, BSC Group, Inc., Worcester, MA; Allyz Kramer, Short Elliott Hendrickson, Inc., St. Paul, MN; Peter Miller, Wenck Associates, Inc., Maple Plain, MN; Kelly Rice, JF New and Associates, Inc., West Olive, MI; and Barbara Walther, SRF Consulting Group, Inc., Minneapolis, MN.

Technical editors for this Regional Supplement were Dr. James S. Wakeley, Robert W. Lichvar, Chris V. Noble, and Jacob F. Berkowitz, ERDC. Karen C. Mulligan was the project proponent and coordinator at Headquarters, USACE. During the conduct of this work, R. Daniel Smith was Acting Chief of the Wetlands and Coastal Ecology Branch; Dr. Edmond Russo was Chief, Ecosystem Evaluation and Engineering Division; Sally Yost was Acting Program Manager, WRAP; and Dr. Elizabeth Fleming was Director, EL.

COL Kevin J. Wilson was Commander of ERDC. Dr. Jeffery P. Holland was Director.

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1 Introduction

Purpose and use of this regional supplement

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual (hereafter called the Corps Manual). The Corps Manual provides technical guidance and procedures, from a national perspective, for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act (33 U.S.C. 1344) or Section 10 of the Rivers and Harbors Act (33 U.S.C. 403). According to the Corps Manual, identification of wetlands is based on a three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. This Regional Supplement presents wetland indicators, delineation guidance, and other information that is specific to the Northcentral and Northeast Region.

This Regional Supplement is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. Regional differences in climate, geology, soils, hydrology, plant and animal communities, and other factors are important to the identification and functioning of wetlands. These differences cannot be considered adequately in a single national manual. The development of this supplement follows National Academy of Sciences recommendations to increase the regional sensitivity of wetland-delineation methods (National Research Council 1995). The intent of this supplement is to bring the Corps Manual up to date with current knowledge and practice in the region and not to change the way wetlands are defined or identified. The procedures given in the Corps Manual, in combination with wetland indicators and guidance provided in this supplement, can be used to identify wetlands for a number of purposes, including resource inventories, management plans, and regulatory programs. The determination that a wetland is subject to regulatory jurisdiction under Section 404 or Section 10 must be made independently of procedures described in this supplement.

This Regional Supplement is designed for use with the current version of the Corps Manual (Environmental Laboratory 1987) and all subsequent versions. Where differences in the two documents occur, this Regional Supplement takes precedence over the Corps Manual for applications in the Northcentral and Northeast Region. Table 1 identifies specific sections of the Corps Manual that are replaced by this supplement. Other guidance and procedures given in this supplement and not listed in Table 1 are intended to augment the Corps Manual but not necessarily to replace it. The Corps of Engineers has final authority over the use and interpretation of the Corps Manual and this supplement in the Northcentral and Northeast Region.

Table 1. Sections of the Corps Manual replaced by this Regional Supplement for applications in the Northcentral and Northeast Region.

Item	Replaced Portions of the Corps Manual (Environmental Laboratory 1987)	Replacement Guidance (this Supplement)
Hydrophytic Vegetation Indicators	Paragraph 35, all subparts, and all references to specific indicators in Part IV.	Chapter 2
Hydric Soil Indicators	Paragraphs 44 and 45, all subparts, and all references to specific indicators in Part IV.	Chapter 3
Wetland Hydrology Indicators	Paragraph 49(b), all subparts, and all references to specific indicators in Part IV.	Chapter 4
Growing Season Definition	Glossary	Chapter 4, Growing Season; Glossary
Hydrology Standard for Highly Disturbed or Problematic Wetland Situations	Paragraph 48, including Table 5 and the accompanying User Note in the online version of the Manual	Chapter 5, Wetlands that Periodically Lack Indicators of Wetland Hydrology, Procedure item 3(f)

Indicators and procedures given in this Supplement are designed to identify wetlands as defined jointly by the Corps of Engineers (33 CFR 328.3) and Environmental Protection Agency (40 CFR 230.3). Wetlands are a subset of the "waters of the United States" that may be subject to regulation under Section 404. One key feature of the definition of wetlands is that, under normal circumstances, they support "a prevalence of vegetation typically adapted for life in saturated soil conditions." Many waters of the United States are unvegetated and thus are excluded from the Corps/EPA definition of wetlands, although they may still be subject to Clean Water Act regulation. Other potential waters of the United States in the region include, but are not limited to, tidal flats and shorelines along the Atlantic coast, in estuaries, and along the shores of the Great Lakes; unvegetated temporary pools; ponds; lakes; mud flats; and perennial, intermittent, and ephemeral stream channels. Delineation of these waters is based on the high tide line, the "ordinary high water mark" (33 CFR 328.3e), or other criteria and is beyond the scope of this Regional Supplement.

Amendments to this document will be issued periodically in response to new scientific information and user comments. Between published versions, Headquarters, U.S. Army Corps of Engineers may provide updates to this document and any other supplemental information used to make wetland determinations under Section 404 and Section 10. Wetland delineators should use the most recent approved versions of this document and supplemental information. See the Corps of Engineers Headquarters regulatory web site for information and updates (http://www.usace.army.mil/-CECW/Pages/reg_supp.aspx). The Corps of Engineers has established an interagency National Advisory Team for Wetland Delineation. The Team's role is to review new data and make recommendations for changes in wetland-delineation procedures to Headquarters, U.S. Army Corps of Engineers. Items for consideration should include full documentation and supporting data and should be submitted to:

National Advisory Team for Wetland Delineation
Regulatory Branch (Attn: CECW-CO)
U.S. Army Corps of Engineers
441 G Street, N.W.
Washington, DC 20314-1000

Applicable region and subregions

This supplement is applicable to the Northcentral and Northeast Region, which consists of all or portions of 15 states: Connecticut, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin (Figure 1). The region encompasses considerable topographic and climatic diversity, but is differentiated from surrounding regions mainly by the combination of a humid temperate climate with cold, snowy winters, short growing seasons, and seasonally frozen soils in many areas; glacially sculpted landscape; hardwood, conifer, mixed-forest, and hardwood-savanna natural vegetation; and the preponderance of forest, crop, pasture, and developed land uses (Bailey 1995, USDA Natural Resources Conservation Service 2006).

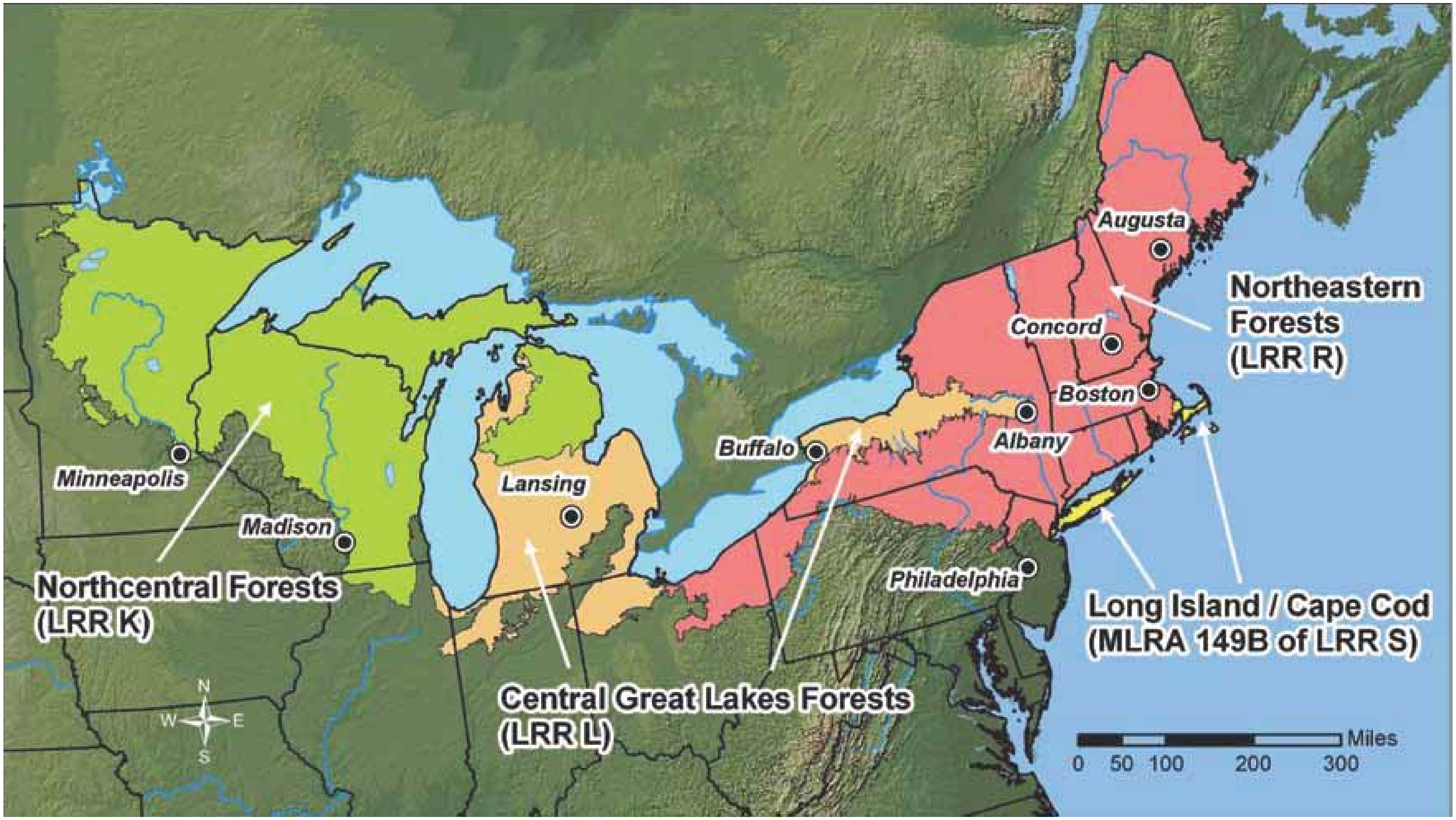


Figure 1. Approximate boundaries of the Northcentral and Northeast Region. Subregions used in this supplement correspond to USDA Land Resource Regions (LRR). This supplement is applicable throughout the highlighted areas, although some indicators may be restricted to specific subregions or smaller areas. See text for details.

The approximate spatial extent of the Northcentral and Northeast Region is shown in Figure 1. The region map is based on a combination of Land Resource Regions (LRR) K, L, and R, and Major Land Resource Area (MLRA) 149B in LRR S, as recognized by the U.S. Department of Agriculture (USDA Natural Resources Conservation Service 2006). Most of the wetland indicators presented in this supplement are applicable throughout the entire Northcentral and Northeast Region. However, some indicators are restricted to specific subregions (i.e., LRRs) or smaller areas (i.e., MLRAs).

Region and subregion boundaries are depicted in Figure 1 as sharp lines. However, climatic conditions and the physical and biological characteristics of landscapes do not change abruptly at the boundaries. In reality, regions and subregions often grade into one another in broad transition zones that may be tens or hundreds of miles wide. The lists of wetland indicators presented in these Regional Supplements may differ between adjoining regions or subregions. In transitional areas, the investigator must use experience and good judgment to select the supplement and indicators that are appropriate to the site based on its physical and biological characteristics. Wetland boundaries are not likely to differ between two supplements in transitional areas, but one supplement may provide more detailed treatment of certain problem situations encountered on the site. If in doubt about which supplement to use in a transitional area, apply both supplements and compare the results. For additional guidance, contact the appropriate Corps of Engineers District Regulatory Office. Contact information for District regulatory offices is available at the Corps Headquarters web site (http://www.usace.army.mil/CECW/Pages/reg_districts.aspx).

Physical and biological characteristics of the region

The Northcentral and Northeast Region is a vast area of nearly level to mountainous terrain, ranging from sea level to 6,288 ft (1,917 m) at Mount Washington in New Hampshire. During the Wisconsinan stage of Pleistocene glaciation, nearly all of the region was covered by continental ice sheets. It is a region of warm summers and cold, snowy winters, with average annual temperatures ranging from 39 to 49 °F (4 to 10 °C) except along the immediate coast. Average annual precipitation varies from 26 to 62 in. (660 to 1,575 mm), depending upon location, and exceeds annual evapotranspiration. In general, precipitation increases across the region from west to east. In Minnesota and Wisconsin, most precipitation occurs in spring and summer; in the rest of the region, precipitation is more evenly distributed throughout the year (Bailey 1995, USDA Natural Resources Conservation Service 2006). The combination of relatively abundant rainfall, low evapotranspiration, and varied topography has created a region rich in perennial, intermittent, and ephemeral streams, natural lakes, and wetlands.

Soil parent materials in the Northcentral and Northeast Region are predominantly the result of Pleistocene glaciations. Glaciers and meltwater shaped the landscape of the region and deposited the debris as glacial landforms, including moraines, drumlins, eskers, outwash plains, kettles, lake plains, deltas, and other features (Embleton and King 1968). Nearly every landscape in the region has been smoothed by glacial ice and has some sort of glacial material on its surface.

Glacial features can be categorized into two broad groups: ice-contact deposits and glaciofluvial or meltwater deposits. Till is the most extensive ice-contact deposit in the region. It is an unsorted mixture of fine particles, sand, gravel, cobbles, and boulders that was scoured and redeposited by ice (Embleton and King 1968). Deposits are generally thickest in valleys and thinnest over highlands. The properties of glacial till are directly related to the source materials. Till from granitic bedrock is commonly rocky, sandy, and acidic. Till from Mesozoic rocks can be reddish in color, and that derived from former lake plains can be very clayey. Ground moraine is a landform of low relief consisting of basal till deposited by receding ice. The topography is often gently rolling, with numerous shallow depressions. Terminal and lateral moraines are ridges or chains of hills that formed at the ends and sides of glaciers, respectively. For example, Long Island in New York was formed, in part, by the terminal moraine marking the southernmost extent of Wisconsinan glaciers. Drumlins are elongated, streamlined hills of glacial till. They occur in groups oriented parallel to the direction of glacial flow and number in the thousands in some areas. Extensive drumlin fields are found in northwestern New York, east-central Wisconsin, and south-central New England. Slope wetlands are associated with drumlins and other ice-contact deposits throughout the region as a result of water perching in the spring over dense glacial till. Eskers are long narrow ridges composed of stratified sand and gravel deposited by streams flowing through tunnels within and beneath glaciers (Embleton and King 1968; Martini et al. 2001).

Glaciofluvial deposits are formed of materials transported by glacial meltwater. They tend to be sorted by particle size, forming stratified deposits. Meltwater emerging from beneath a glacier often forms braided streams that deposit sand and gravel over a broad area, producing an outwash plain. As glaciers recede, blocks of ice may be isolated and partly buried in the accumulating sediments. As these blocks melt, the unsupported glacial sediments collapse and form depressions called kettles (Embleton and King 1968). Walden Pond in Massachusetts is one example. Some outwash plains are dotted with numerous kettles and are known as pitted outwash. In the Northcentral and Northeast Region, numerous wetlands exist today where kettle holes intercept the regional water table. The finer particles in glacial meltwater may be deposited farther downstream and in the still waters of glacial lakes. Lake (lacustrine) deposits include horizontal strata of silts and clays that accumulate on lake bottoms, and deltas of sandy materials deposited at the mouths of incoming streams. Lacustrine deposits in some areas support complexes of small, rainwater-fed depressional wetlands (Stone and Ashley 1992). In other areas, such as in northern Minnesota, extensive organic soils have formed on glacial lake plains.

Post-glacial, clayey, marine deposits exist in the Champlain Valley of Vermont and along the Atlantic coast from southeastern Massachusetts north to Canada. In Maine, marine deposits occur at elevations up to 420 ft (128 m) above sea level, as a result of post-glacial isostatic (crustal) rebound (Maine Geological Survey 2005). These clayey deposits can be somewhat confusing for wetland delineation as they commonly have gray, lithochromic (inherited from parent material) colors. In addition, windblown deposits of silt and fine sand (loess) form a surface cap over glacial materials in some soils in the region. Other parent materials in the region include sand dunes adjacent to the Great Lakes and the Atlantic coast, and recent alluvial deposits along the Mississippi, Hudson, Connecticut, and other rivers.

The Northcentral and Northeast Region occupies the transition zone between the boreal forest to the north and broadleaf deciduous forest to the south. Individual forest stands may consist primarily of conifers, hardwoods, or a mixture of the two. Pines (*Pinus* spp.) and other conifers often dominate in areas with nutrient-poor soils or recent disturbance by fire or human activity. Areas with nutrient-rich soils are often dominated by hardwoods, such as sugar maple (*Acer saccharum*), American basswood (*Tilia americana*), and American beech (*Fagus grandifolia*) (Bailey 1995).

In the mountainous areas of New York and the New England states, there is distinct altitudinal zonation of forest types.

The Northcentral and Northeast Region is composed of three major subregions: Northcentral Forests (corresponds to LRR K), Central Great Lakes Forests (LRR L), and Northeastern Forests (LRR R). In addition, the Long Island/Cape Cod area (MLRA 149B in LRR S) has been included in this region because of its similar climate, geologic history, and soil parent materials (Figure 1). Important characteristics of each subregion are described briefly below; further details can be found in USDA Natural Resources Conservation Service (2006). Wetland indicators presented in this Regional Supplement are applicable across all subregions unless otherwise noted.

Northcentral Forests (LRR K)

This subregion lies mainly south and west of the western Great Lakes in Minnesota, Wisconsin, Michigan, and Illinois (Figure 1) and is covered mostly by level to gently rolling deposits of glacial till, loess, outwash, and glacial lake sediments. The subregion receives 26 to 34 in. (660 to 865 mm) of precipitation each year. The area is largely forested, with lesser amounts of cropland, grassland, and urban development. Common tree species in higher landscape positions include eastern white pine (*Pinus strobus*), red pine (*P. resinosa*), jack pine (*P. banksiana*), eastern hemlock (*Tsuga canadensis*), American beech, yellow birch (*Betula alleghaniensis*), paper birch (*B. papyrifera*), northern red oak (*Quercus rubra*), white oak (*Q. alba*), sugar maple, white ash (*Fraxinus americana*), and quaking aspen (*Populus tremuloides*). Lowlands are dominated mainly by black spruce (*Picea mariana*), tamarack (*Larix laricina*), northern white cedar or arborvitae (*Thuja occidentalis*), balsam fir (*Abies balsamea*), black ash (*Fraxinus nigra*), green ash (*F. pennsylvanica*), silver maple (*Acer saccharinum*), red maple (*A. rubrum*), American elm (*Ulmus americana*), and swamp white oak (*Q. bicolor*) (USDA Natural Resources Conservation Service 2006).

Central Great Lakes Forests (LRR L)

This subregion contains most of Lower Michigan along with portions of Illinois, Indiana, Ohio, Pennsylvania, and New York (Figure 1). It consists of nearly level to gently rolling glacial plains covered by till, outwash, and glacial lake sediments with scattered moraine hills. Most of the area receives 30 to 41 in. (760 to 1,040 mm) of precipitation each year, with higher amounts in the small area southeast of Lake Erie. The subregion supports mainly broadleaf deciduous forests dominated by bitternut hickory (*Carya cordiformis*), shagbark hickory (*C. ovata*), white oak, northern red oak, black oak (*Quercus velutina*), sugar maple, red maple, American beech, American elm, and American basswood. Eastern white pine, red pine, and jack pine are common species in the portion of the subregion in northwestern Lower Michigan (USDA Natural Resources Conservation Service 2006).

Northeastern Forests (LRR R)

This large subregion extends from northern Ohio to New Jersey to Maine (Figure 1) and encompasses a variety of landforms, including rugged mountains and highly dissected plateaus and plains. Most of the area is covered by a mantle of glacial till, outwash sands and gravels, and glacial lake sediments. Eskers, kames, and drumlins are common features in some areas. Deposits of recent alluvium are present along major rivers, and marine sediments are common along the coast and in the lower portions of river valleys. In the mountains, some areas are dominated by talus and exposed igneous and metamorphic bedrock. Average annual precipitation mostly ranges from 34 to 62 in. (865 to 1,575 mm), but is more than 100 in. (2,540 mm) on the highest peaks in Vermont and New Hampshire, and in the area of lake-effect snows east of Lake Ontario. The subregion supports a mosaic of northern hardwood, spruce, fir, and pine forests. Common species include American beech, paper birch, yellow birch, sugar maple, oaks, eastern hemlock, balsam fir, red spruce (*Picea rubens*), black spruce, eastern white pine, and quaking aspen (USDA Natural Resources Conservation Service 2006).

Long Island/Cape Cod (MLRA 149B)

This area is restricted to New York, Massachusetts, and Rhode Island and is part of LRR S, but is included in the Northcentral and Northeast Region (Figure 1). The area is formed of deep glacial outwash deposits of sand and gravel, mostly covered by a layer of glacial till. Moraines form scattered low hills and ridges. The area receives 41 to 48 in. (1,040 to 1,220 mm) of precipitation each year. Much of the area is developed. Native forests support pitch pine (*Pinus rigida*), eastern white pine, northern red oak, red maple, American beech, yellow birch, and other tree species (USDA Natural Resources Conservation Service 2006).

Types and distribution of wetlands

The Northcentral and Northeast Region is rich in wetlands, due in large part to plentiful precipitation, low evapotranspiration, and diverse landscapes resulting from its recent glacial history. Some of the places where wetlands have formed include (1) shores of the region's many lakes and ponds, (2) broad flats on former glacial lake plains, (3) kettle depressions where ice blocks were left on the landscape as the glaciers retreated, (4) depressions and blocked drainages formed by morainal deposits, (5) outwash deposits of sand and gravel where groundwater discharges or is often near the surface, and (6) deposits of unsorted glacial till that have created relatively impermeable subsoils on flats and slopes. The region also contains large river systems that periodically flood low-lying areas, creating floodplain wetlands of various types. Coastal marshes and dune/swale wetlands have also formed along the Atlantic coast, in estuaries, and along the shores of the Great Lakes. Generalized descriptions of the region's wetlands can be found in Curtis (1971), Eggers and Reed (1997), and Tiner (2005). Additional details on wetland plant communities are given in state natural heritage program reports (e.g., Reschke 1990, Minnesota Department of Natural Resources 2003, and Sperduto 2005) and National Wetlands Inventory (NWI) state reports for Rhode Island and Connecticut (Tiner 1989; Metzler and Tiner 1992). Specific wetland types are described by Johnson (1985), Wright et al. (1992), Tiner (2008), and many others.

Wetlands in the region can be divided broadly into freshwater and saltwater wetlands. Most saltwater wetlands in the region are dominated by herbaceous emergent plants. Freshwater wetlands, on the other hand, can be categorized as forested, shrub-dominated, or herbaceous, and further subdivided by soil type (e.g., mineral or organic) and hydrology. For example, various types of bogs are common in the region. Bogs are peat-forming wetlands with acidic soils that support relatively few species of acid-loving plants, such as *Sphagnum* mosses, and develop in areas where precipitation is the primary water source. Other peat-forming wetlands, called fens, have circumneutral to alkaline soils that range from mineral-poor to mineral-rich. Their hydrology is driven predominantly by groundwater discharge and their plant communities can be very diverse.

Forested wetlands are the most abundant wetlands in the region and represent many different types. Boreal coniferous forested wetlands occur in the more northerly parts of the region and at higher elevations in more southerly areas. They may support black spruce, tamarack, balsam fir, northern white cedar, Atlantic white cedar (*Chamaecyparis thyoides*), or red spruce. Coniferous forested bogs include tamarack and black spruce bogs, and usually have a continuous carpet of *Sphagnum*. Those forming on neutral to alkaline peat soils, such as northern white cedar swamps, lack the carpet of *Sphagnum* but may have a rich understory of other bryophytes. Forested fens with similar mineral-rich peat soils often support northern white cedar and tamarack. Eastern hemlock, eastern white pine, and pitch pine also dominate coniferous forested wetlands in various parts of the region.

Deciduous forested wetlands are common throughout much of the region in depressions, on floodplains, on flats on glacial lake plains, and along lake shores. Dominant swamp trees include red maple, black ash, green ash, and pin oak (*Quercus palustris*). Skunk cabbage (*Symplocarpus foetidus*), several species of ferns (e.g., cinnamon [*Osmunda cinnamomea*], royal [*O. regalis*], sensitive [*Onoclea sensibilis*], and eastern marsh fern [*Thelypteris palustris*]), and numerous shrubs (e.g., highbush blueberry [*Vaccinium corymbosum*], alders [*Alnus* spp.], arrowwood [*Viburnum dentatum*], withe-rod [*V. nudum* var. *cassinoides*], red-osier dogwood [*Cornus sericea = C. stolonifera*] and silky dogwood [*C. amomum*]) are common in many swamps. Floodplain forests occupy lowlands adjacent to the larger rivers in the region. Silver maple, eastern cottonwood (*Populus deltoides*), American sycamore (*Platanus occidentalis*), American elm, black willow (*Salix nigra*), and balsam poplar (*Populus balsamifera*) are characteristic bottomland trees, while ostrich fern (*Matteuccia struthiopteris*), false nettle (*Boehmeria cylindrica*), and Canadian woodnettle (*Laportea canadensis*) are common herbs. Other important wetland trees include yellow birch, black gum (*Nyssa sylvatica*), swamp white oak, and quaking aspen. Wet flatwoods occur on broad, glacial lake plains, such as those along Lake Ontario. These wetlands are dominated by typical swamp species, but are not flooded as long as most swamps. Instead, they have seasonally high or perched water tables that may persist from winter to early summer.

Shrub bogs are prominent in northern areas, while deciduous shrub swamps are common throughout the region. Typical shrub-bog species that grow on acidic peat soils in association with a mat of *Sphagnum* mosses include evergreen members of the heath family, such as leatherleaf (*Chamaedaphne calyculata*), bog laurel (*Kalmia polifolia*), bog rosemary

(*Andromeda polifolia* var. *glaucophylla* = *A. glaucophylla*), Labrador tea (*Ledum groenlandicum*), and cranberries (*Vaccinium macrocarpon* and *V. oxycoccos*), as well as sweetgale (*Myrica gale*), black spruce, tamarack, purple pitcher plant (*Sarracenia purpurea*), sundews (*Drosera* spp.), bog aster (*Oclemena nemoralis* = *Aster nemoralis*), bog goldenrod (*Solidago uliginosa*), and threeleaf false lily-of-the-valley (*Maianthemum trifolium* = *Smilacina trifolia*). Characteristic species of deciduous shrub swamps are alders (*Alnus incana* and *A. serrulata*), willows (*Salix* spp.), dogwoods, swamp rose (*Rosa palustris*), steeplebush (*Spiraea tomentosa*), white meadowsweet (*Spiraea alba*), and buttonbush (*Cephalanthus occidentalis*). The ground layer can be composed of a diversity of ferns, sedges, rushes, and forbs, such as those listed below in the paragraph describing wet meadows. The ground layer in disturbed, deciduous shrub swamps may be composed of reed canarygrass (*Phalaris arundinacea*) or other invasive species.

Herbaceous wetlands include marshes, wet meadows, and fens. Two basic types of marshes are found in the region – freshwater and saline marshes. The former occur throughout the region in lakes, ponds, shallow slow-flowing rivers, and isolated depressions, while the latter are found in the intertidal zone of estuaries.

Freshwater marshes, both tidal and nontidal, are generally represented by cattails (*Typha latifolia* and *T. angustifolia*), pickerelweed (*Pontederia cordata*), arrowheads (*Sagittaria* spp.), yellow pond-lily (*Nuphar lutea*), white waterlily (*Nymphaea odorata*), softstem bulrush (*Schoenoplectus tabernaemontani* = *Scirpus validus*), bur-reeds (*Sparganium* spp.), and wild rice (*Zizania aquatica* and *Z. palustris*). Bayonet rush (*Juncus militaris*) grows in shallow water along sandy lake shores. Common reed (*Phragmites australis*) dominates many disturbed freshwater and brackish marshes.

Salt and brackish marshes are dominated by halophytes or salt-tolerant species. Smooth cordgrass (*Spartina alterniflora*) occupies the low marsh that is flooded at least daily by the tides. The high marsh is more diverse, with saltmeadow cordgrass (*Spartina patens*), salt grass (*Distichlis spicata*), and black grass (*Juncus gerardii*) being most common, while switch grass (*Panicum virgatum*) and the shrubby marsh-elder (*Iva frutescens*) often form the marsh border. Other species characteristic of salt marshes include seaside goldenrod (*Solidago sempervirens*), saltmarsh aster (*Symphyotrichum tenuifolium* = *Aster tenuifolius*), saltmarsh bulrush (*Schoenoplectus robustus* = *Scirpus robustus*), and rose mallow (*Hibiscus moscheutos*); these species become more abundant and dominate brackish marshes upstream.

Herbaceous fens occur in northern portions of the region and elsewhere at higher altitudes where they are less common. Fen species at the most mineral-rich end of the gradient include many calciphiles that thrive in soils with higher pH. They include numerous herbs, such as marsh muhly (*Muhlenbergia glomerata*), bluejoint grass (*Calamagrostis canadensis*), twig rush (*Cladium mariscoides*), several sedges (*Carex flava*, *C. sterilis*, *C. lasiocarpa*, *C. lacustris*, *C. stricta*, and *C. utriculata*), thinleaf cotton-sedge (*Eriophorum viridicarinatum*), moor rush (*Juncus stygius*), grass-of-Parnassus (*Parnassia glauca*), purple avens (*Geum rivale*), white lady's slipper (*Cypripedium candidum*), and marsh cinquefoil (*Comarum palustre* = *Potentilla palustris*), plus several shrubs including shrubby cinquefoil (*Dasiphora fruticosa* ssp. *floribunda* = *Potentilla fruticosa*), alderleaf buckthorn (*Rhamnus alnifolia*), sageleaf willow (*Salix candida*), autumn willow (*S. serissima*), bog birch (*Betula pumila*), sweetgale, speckled alder (*Alnus incana*), and red-osier dogwood. Minerotrophic moss species (e.g., *Drapanocladus aduncus* and *Campylium stellatum*) may or may not be present.

Wet meadows occur on seasonally saturated mineral or organic soils that may be associated with high water tables and/or surface water inputs. They may be characterized by (1) a single species, such as reed canary-grass, bluejoint grass, or sweetflag (*Acorus calamus*); (2) various sedges, such as tussock sedge (*Carex stricta*), lake sedge (*C. lacustris*), green bulrush (*Scirpus atrovirens*), and woolgrass (*Scirpus cyperinus*), that can be described as a sedge-meadow subtype; or (3) a diverse assemblage of plants including many flowering herbs. Among the more common flowering herbs are Joe-Pye-weeds (*Eupatoriadelphus* spp.), boneset (*Eupatorium perfoliatum*), square-stem monkeyflower (*Mimulus ringens*), asters (e.g., *Symphyotrichum puniceum* [= *Aster puniceus*], *S. lateriflorum*, *S. lanceolatum*, *S. novi-belgii*, *Doellingeria umbellata* [= *Aster umbellatus*]), goldenrods (*Euthamia* spp. and *Solidago* spp.), fringed loosestrife (*Lysimachia ciliata*), swamp candles (*L. terrestris*), irises (*Iris* spp.), jewelweed (*Impatiens capensis* and *I. pallida*), beggar-ticks (*Bidens* spp.), swamp milkweed (*Asclepias incarnata*), blue vervain (*Verbena hastata*), ironweeds (*Vernonia* spp.), and willow-herbs (*Epilo-*

bium spp.). Many wet meadows occur in agricultural areas where they are often used as pasture.

Many wetlands are used for agricultural purposes, including commercial cranberry bogs, farmed mucklands, wild rice impoundments, farmed floodplains, and sod fields. Commercial cranberry bogs generally were constructed from existing wetlands but, more recently, have been created in sandy uplands by excavating to a depth where the water table is at or near the surface for extended periods. These bogs are diked and water levels controlled by irrigation or dewatering. Farmed mucklands were created from hardwood swamps, tamarack swamps, and sedge meadows. After removing natural vegetation, diking, and draining through the use of pumps and siphons, their productive organic soils are planted with a variety of crops including onions, lettuce, celery, and carrots. In Minnesota, wetlands have been converted to impoundments for cultivating wild rice (*Zizania palustris*). Many floodplains in the region have been converted to row crops (e.g., corn or soybeans) and some of these are flooded often enough and long enough to meet wetland standards. Sod fields managed to produce lawn or turf grasses, predominantly Kentucky bluegrass (*Poa pratensis*), are often constructed in wetlands where the surface water is drained by ditches and groundwater levels are closely managed.

Numerous nonnative and/or invasive species have replaced native species and reduced plant diversity in one or more wetland types in the region. Among the problematic herbs are common reed, reed canarygrass, cattails (e.g., *Typha × glauca*), purple loosestrife (*Lythrum salicaria*), Japanese stiltgrass (*Microstegium vimineum* = *Eulalia viminea*), garlic mustard (*Alliaria petiolata*), and Japanese knotweed (*Fallopia japonica* = *Polygonum cuspidatum*) plus three aquatic species – water chestnut (*Trapa natans*), curly pondweed (*Potamogeton crispus*), and Eurasian watermilfoil (*Myriophyllum spicatum*). Major invasive woody plants include common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Frangula alnus* = *Rhamnus frangula*), multiflora rose (*Rosa multiflora*), non-native honeysuckles (*Lonicera* spp.), and Japanese barberry (*Berberis thunbergii*).

2 Hydrophytic Vegetation Indicators

Introduction

The Corps Manual defines hydrophytic vegetation as the community of macrophytes that occurs in areas where inundation or soil saturation is either permanent or of sufficient frequency and duration to influence plant occurrence. The manual uses a plant-community approach to evaluate vegetation. Hydrophytic vegetation decisions are based on the assemblage of plant species growing on a site, rather than the presence or absence of particular indicator species. Hydrophytic vegetation is present when the plant community is dominated by species that require or can tolerate prolonged inundation or soil saturation during the growing season. Hydrophytic vegetation in the Northcentral and Northeast Region is identified by using the indicators described in this chapter.

Many factors besides site wetness affect the composition of the plant community in an area, including regional climate, local weather patterns, topography, soils, natural and human-caused disturbances, and current and historical plant distributional patterns at various spatial scales. Braun (1950) described the vegetation of this region as "… a complex vegetation unit most conspicuously characterized by the prevalence of the deciduous habit of most of its woody constituents. This gives to it a certain uniformity of physiognomy, with alternating summer green and winter leafless aspects. Evergreen species, both broad-leaved and needle-leaved, occur in the arboreal and shrub layers, particularly in seral stages and in marginal and transitional areas." The vegetation reflects the region's glacial past and the most recent retreat of continental glaciers about 10,000 years ago. Freshly exposed tills and bedrock areas were originally dominated by boreal coniferous forest (Davis 1981), which was later replaced mostly by deciduous forests from the west and south of the region and by prairies penetrating eastward (Barbour and Billings 1988). The migration of past and present vegetation across this topographically and climatically varied region has resulted in a highly diverse flora. The regional flora contains more than 4,000 vascular plant species (Stein et al. 2000), of which approximately 2,800 species occur in wetlands to some degree (Reed 1988).

Human disturbances and land-use patterns have affected some parts of the region more than others. Prior to European settlement, Native Americans used fire to clear underbrush in forested areas and woody vegetation from grasslands, but their activities had little long-lasting impact (Russell 1983). Greater impacts occurred in the 1800s due to extensive logging for pine and hemlock, clearing of forests for homesteading and grazing, and the beginning of a long-term trend in conversion of forest to agriculture and urban development. These major land-use changes have increased the number and occurrence of "weedy" species in the flora. More than 30 percent of the flora in many parts of the region now consists of non-native species (Stuckey and Barkley 1993).

The characteristics of wetland plant communities in the region are also affected by seasonal changes in availability of water, short- and long-term droughts, and natural and human-caused disturbances (e.g., floods, fires, grazing). Wetlands subject to seasonal hydrology in the region include wet meadows, springs, seeps, seasonal ponds, vernal pools, and floodplain forested wetlands. These wetlands often exhibit seasonal shifts in vegetation composition, potentially changing the status of the community from hydrophytic during the wet season to non-hydrophytic during the dry season. Long-term climatic fluctuations (e.g., multi-year droughts) and fluctuations in lake and sea levels can also change the composition of plant communities over longer periods (Barkley 1986). Woody shrubs and trees in wetlands are often resistant to droughts, while herbaceous vegetation may show dramatic turnover in species composition from drought years to pluvial years. See Chapter 5 for discussions of these and other problematic vegetation situations in the region.

Hydrophytic vegetation decisions are based on the wetland indicator status (Reed [1988] or current approved list) of species that make up the plant community. Species in the facultative categories (FACW, FAC, and FACU) are recognized as occurring in both wetlands and uplands to varying degrees. Although most wetlands are dominated mainly by species rated OBL, FACW, and FAC, some wetland communities may be dominated primarily by FACU species and cannot be identified by dominant species alone. In those cases, other indicators of hydrophytic vegetation must also be considered, particularly where indicators of hydric soils and wetland hydrology are present. This situation is not necessarily due to inaccurate wetland indicator ratings; rather, it is due to the broad tolerances of certain plant species that allow them to be widely distributed across the moisture gradient. Therefore, for some species, it is difficult to assign a single indicator status rating that encompasses all of the various landscape and ecological settings it can occupy.

Hydrophytic vegetation indicators and procedures presented in this chapter are designed to identify the majority of wetland plant communities in the region. However, some wetland communities may lack any of these indicators. These situations are considered in Chapter 5 (Difficult Wetland Situations in the Northcentral and Northeast Region).

Guidance on vegetation sampling and analysis

General guidance on sampling of vegetation for wetland-delineation purposes is given in the Corps Manual. Those procedures are intended to be flexible and may need to be modified for application in a given region or on a particular site. Vegetation sampling done as part of a routine wetland delineation is designed to characterize the site in question rapidly. A balance must be established between the need to accomplish the work quickly and the need to characterize the site's heterogeneity accurately and at an appropriate scale. The following guidance on vegetation sampling is intended to supplement the Corps Manual for applications in the Northcentral and Northeast Region.

The first step is to identify the major landscape or vegetation units so that they can be evaluated separately. This may be done in advance using an aerial photograph or topographic map, or by walking the site. In general, routine wetland determinations are based on visual estimates of percent cover of plant species that can be made either (1) within the vegetation unit as a whole, or (2) within one or more sampling plots established in representative locations within each unit. Percent cover estimates are more accurate and repeatable if taken within a defined plot. This also facilitates field verification of another delineator's work. The sizes and shapes of plots, if used, may be modified as appropriate to adapt to site conditions and should be recorded on the field data form. When sampling near a plant community boundary, and particularly near the wetland boundary, it may be necessary to adjust plot size or shape to avoid overlapping the boundary and extending into an adjacent community having different vegetation, soils, or hydrologic conditions.

If it is not possible to locate one or a few plots in a way that adequately represents the vegetation unit being sampled, then percent cover estimates for each species can be made during a meandering survey of the broader community. If additional quantification of cover estimates is needed, then the optional procedure for point-intercept sampling along transects (see Appendix B) or other sampling procedures may be used to characterize the vegetation unit. To use either of these sampling methods, soil and hydrologic conditions must be uniform across the sampled area.

Definitions of strata

Vegetation strata within the sampled area or plot are sampled separately when evaluating indicators of hydrophytic vegetation. In this region, the vegetation strata described in the Corps Manual are recommended (see below). Unless otherwise noted, a stratum for sampling purposes is defined as having 5 percent or more total plant cover. If a stratum has less than 5 percent cover during the peak of the growing season, then those species and their cover values should be recorded on the data form but should not be used in the calculations for the dominance test, unless it is the only stratum present.

1. *Tree stratum* – Consists of woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.
2. *Sapling/shrub stratum* – Consists of woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.
3. *Herb stratum* – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants less than 3.28 ft tall.
4. *Woody vines* – Consists of all woody vines greater than 3.28 ft in height.

Plot and sample sizes

Hydrophytic vegetation determinations under the Corps Manual are based on samples taken in representative locations within each community. Random sampling of the vegetation is not required, except for certain sampling approaches in comprehensive determinations or in rare cases where representative sampling might give misleading results. For routine determinations in fairly uniform vegetation, one or more plots in each community are usually sufficient for an accurate determination. Sampling of a multi-layered community is usually accomplished using a graduated series of plots, one for each stratum, or a number of small plots nested within the largest plot (Figure 2). Nested plots to sample the herb stratum can be helpful in forested areas with highly variable understories or in very diverse communities. Plant abundance data are averaged across the multiple small plots.

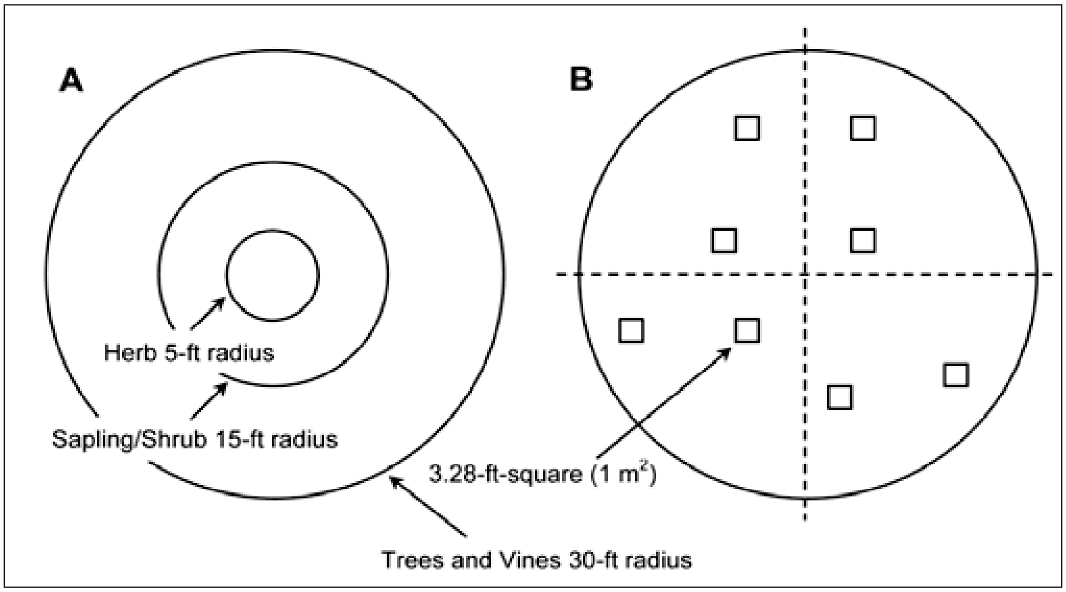


Figure 2. Suggested plot arrangements for vegetation sampling. (A) Single plots in graduated sizes. (B) Nested 3.28- by 3.28-ft square (1-m^2) plots for herbs within the 30-ft radius plot.

The appropriate size and shape for a sample plot depend on the type of vegetation (i.e., trees, shrubs, herbaceous plants, etc.) and the size or shape of the plant community or patch being sampled. The size of a plot needs to be large enough to include adequate numbers of individuals in all strata, but small enough so that plant species or individuals can be separated and measured without duplication or omission, and the sampling can be done in a timely fashion (Cox 1990, Barbour et al. 1999). For hydrophytic vegetation determinations, the abundance of each species is determined by using areal cover estimates. Plot sizes should make visual sampling both accurate and efficient. In this region, the following plot sizes are suggested.

1. Tree stratum – 30-ft (9.1-m) radius
2. Sapling/shrub stratum – 15-ft (4.6-m) radius
3. Herb stratum – 5-ft (1.5-m) radius
4. Woody vines – 30-ft (9.1-m) radius

The sampling plot should not be allowed to extend beyond the edges of the plant community being sampled or to overlap an adjacent community having different vegetation, soil, or hydrologic conditions. This may happen if vegetation patches are small or occur as narrow bands or zones along a topographic gradient. In such cases, plot sizes and shapes should be adjusted to fit completely within the vegetation patch or zone. For example, in linear riparian communities where the width of a standard plot may exceed the width of the plant community, an elongated rectangular plot or belt transect that follows the stream is recommended. If possible, the area sampled should be equivalent to the 30-ft-radius plot (2,827 ft^2 [263 m^2]) for the tree stratum or the 15-ft-radius plot (707 ft^2 [65.7 m^2]) for the sapling/shrub stratum. Thus the sapling/shrub stratum could be sampled using a 10- by 71-ft (3.1- by 21.6-m) plot lying completely within the riparian fringe. An alternative approach involves sampling a series of small subplots (e.g., 5 by 5 ft [1.5 by 1.5 m], or 10 by 10 ft [3.1 by 3.1 m]) in the riparian community and averaging the data across subplots.

A 30-ft radius tree plot works well in most forests but can be increased to 35 ft (10.7 m) or 40 ft (12.2 m) or more in a nonlinear forest stand if tree diversity is high or diameters are large. Highly diverse or patchy communities of herbs or other low vegetation may be sampled with nested 3.28- by 3.28-ft (1-m^2) quadrats randomly located within a 30-ft radius (Figure 2B). Furthermore, point-intercept sampling performed along a transect is an alternative to plot-based methods that can improve the accuracy and repeatability of vegetation sampling in diverse or heterogeneous communities (see Appendix B). To use this method, soil and hydrologic conditions must be uniform across the area where transects are located.

Vegetation sampling guidance presented here should be adequate for hydrophytic vegetation determinations in most situations. However, many variations in vegetation structure, diversity, and spatial arrangement exist on the landscape that are not addressed in this supplement. A list of references is given in Table 2 for more complex sampling situations. If alternative sampling techniques are used, they should be derived from the scientific literature and described in field notes or in the delineation report. The basic data must include abundance values for each species present. Typical abundance measures include basal area for tree species, percent areal cover, stem density, or frequency based on point-intercept sampling. In any case, the data must be in a format that can be used in the dominance test or prevalence index for hydrophytic vegetation (see the section on Hydrophytic Vegetation Indicators).

In this supplement, absolute percent cover is the preferred abundance measure for all species. For percent cover estimates, plants do not need to be rooted in the plot as long as they are growing under the same soil and hydrologic conditions. It may be necessary to exclude plants that overhang the plot if they are rooted in areas having different soil and hydrologic conditions, particularly when sampling near the wetland boundary.

Table 2. Selected references to additional vegetation sampling approaches that could be used in wetland delineation.

Reference	Comment
Brohman, R. J., and L. D. Bryant, eds. 2005. *Existing vegetation classification and mapping technical guide, Version 1.0.* General Technical Report WO-67. Washington, DC: U.S. Department of Agriculture Forest Service.	Contains a brief summary of vegetation sampling methods.
Kent, M., and P. Coker. 1992. *Vegetation description and analysis: A practical approach.* New York, NY: Wiley.	Contains simple and clear methods for setting up a study and collecting and analyzing the data. Initial chapters are helpful for data collection and sampling approaches in wetland delineation.
Mueller-Dombois, D., and H. Ellenberg. 1974. *Aims and methods of vegetation ecology*. New York, NY: Wiley.	A standard text in vegetation ecology, sampling, and analysis. This reference provides many sampling and analytical methods that are helpful in complex delineations.
Tiner, R. W. 1999. *Wetland indicators: A guide to wetland delineation, classification, and mapping.* Boca Raton, FL: CRC Press.	Includes reviews of various sampling techniques and provides a list of vegetation references.
U.S. Department of the Interior (USDI), Bureau of Land Management. 1996. *Sampling vegetation attributes.* BLM/RS/ST-96/002+1730. Denver, CO.	Describes many aspects of vegetation sampling, including sampling protocols, data collection, and analysis.

Basal area is an alternative abundance measure for species in the tree stratum. Basal area of each species in a stand can be estimated quickly and efficiently with a basal-area prism or angle gauge. In this region, a prism with a basal-area factor (BAF) of 10 works well. Basal-area estimates can be used to select dominant species from the tree stratum for use in the dominance test for hydrophytic vegetation (see Hydrophytic Vegetation Indicators). However, basal-area estimates cannot be used to calculate a prevalence index, which is based on absolute percent cover of species in each stratum. Therefore, if basal-area estimates are used initially to evaluate the tree stratum but the dominance test is inconclusive, then the use of the prevalence index will require that the tree stratum be resampled to estimate absolute percent cover of each species.

Seasonal considerations and cautions

To the extent possible, the hydrophytic vegetation decision should be based on the plant community that is normally present during the wet portion of the growing season in a normal rainfall year. However, wetland determinations must often be performed at other times of year, or in years with unusual or atypical weather conditions. The Northcentral and Northeast Region has a temperate climate with cold, snowy winters. Vegetation sampling for a wetland determination can be challenging when some plants are covered by snow or die back due to freezing temperatures or other factors. At these times, experience and professional judgment may be required to adapt the vegetation sampling scheme or use other sources of information to determine the plant community that is normally present.

When an on-site evaluation of the vegetation is impractical due to snow and ice or other factors, one option is to use existing off-site data sources, such as National Wetlands Inventory (NWI) maps, soil surveys, and aerial photographs, to make a preliminary hydrophytic vegetation determination. These sources may be supplemented with limited on-site data, including those plant species that can be observed and identified. Later, when conditions are favorable, an on-site investigation should be made to verify the preliminary determination and complete the wetland delineation.

Other factors can alter the plant community on a site and affect a hydrophytic vegetation determination, including seasonal changes in species composition, intensive grazing, wildfires and other natural disturbances, and human land-use practices. These factors are considered in Chapter 5.

Hydrophytic vegetation indicators

The following indicators should be applied in the sequence presented. The stepwise procedure is designed to reduce field effort by requiring that only one or two indicators — variations of the dominance test — be evaluated in the majority of wetland determinations. However, hydrophytic vegetation is present if any of the indicators is satisfied. All of these indicators are applicable throughout the entire Northcentral and Northeast Region.

Indicators of hydrophytic vegetation involve looking up the wetland indicator status of plant species on the wetland plant list (Reed [1988] or current list). For the purposes of this supplement, only the five basic levels of wetland indicator status (i.e., OBL, FACW, FAC, FACU, and UPL) are used in hydrophytic vegetation indicators. Plus (+) and minus (–) modifiers are not used (e.g., FAC–, FAC, and FAC+ plants are all considered to be FAC). For species listed as NI (reviewed but given no regional indicator) or NO (no known occurrence in the region at the time the list was compiled), apply the indicator status assigned to the species in the nearest adjacent region. If the species is listed as NI or NO but no adjacent regional indicator is assigned, do not use the species to calculate hydrophytic vegetation indicators. In general, species that are not listed on the wetland plant list are assumed to be upland (UPL) species. However, recent changes in plant nomenclature have resulted in a number of species that are not listed by Reed (1988) but are not necessarily UPL plants. Procedures described in Chapter 5, in the section on Problematic Hydrophytic Vegetation, can be used if it is believed that individual FACU, NI, NO, or unlisted plant species are functioning as hydrophytes on a particular site. For Clean Water Act purposes, wetland delineators should use the latest plant lists approved by Headquarters, U.S. Army Corps of Engineers (Figure 3) (http://www.usace.army.mil/CECW/Pages/reg_supp.aspx).

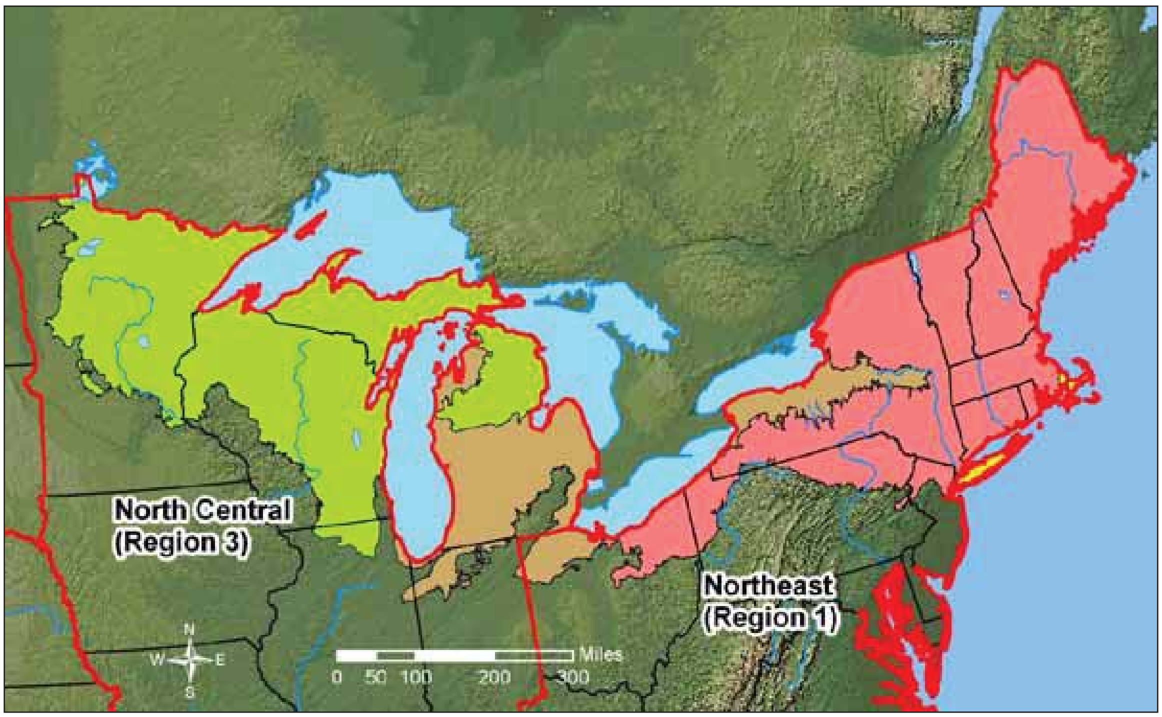


Figure 3. Plant list regional boundaries (red lines) currently used by the U.S. Fish and Wildlife Service, National Wetlands Inventory, in the Northcentral and Northeast Region.

Evaluation of vegetation can begin with a rapid field test for hydrophytic vegetation to determine if there is a need to collect more detailed vegetation data. The rapid test for hydrophytic vegetation (Indicator 1) is met if all dominant species across all strata are OBL or FACW, or a combination of the two, based on a visual assessment. If the site is not dominated solely by OBL and FACW species, proceed to the standard dominance test (Indicator 2), which is the basic hydrophytic vegetation indicator. Either Indicator 1 or 2 should be applied in every wetland determination. Most wetlands in the Northcentral and Northeast Region have plant communities that will meet one or both of these indicators. These are the only indicators that need to be considered in most situations. However, some wetland plant communities may fail a test based only on dominant species. Therefore, in those cases where indicators of hydric soil and wetland hydrology are present, the vegetation should be re-evaluated with the prevalence index (Indicator 3), which takes non-dominant plant species into consideration, or by observing plant morphological adaptations for life in wetlands (Indicator 4). Finally, certain disturbed or problematic wetland situations may lack any of these indicators and are described in Chapter 5.

Procedure

The procedure for using hydrophytic vegetation indicators is as follows:

1. Apply Indicator 1 (Rapid Test for Hydrophytic Vegetation).
   a. If the plant community passes the rapid test for hydrophytic vegetation, then the vegetation is hydrophytic and no further vegetation analysis is required.
   b. If the rapid test for hydrophytic vegetation is not met, then proceed to step 2.

2. Apply Indicator 2 (Dominance Test).
   a. If the plant community passes the dominance test, then the vegetation is hydrophytic and no further vegetation analysis is required.
   b. If the plant community fails the dominance test, and indicators of hydric soil and/or wetland hydrology are absent, then hydrophytic vegetation is absent unless the site meets requirements for a problematic wetland situation (see Chapter 5).
   c. If the plant community fails the dominance test, but indicators of hydric soil and wetland hydrology are both present, proceed to step 3.

3. Apply Indicator 3 (Prevalence Index). This and the following step assume that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present.
   a. If the plant community satisfies the prevalence index, then the vegetation is hydrophytic. No further vegetation analysis is required.
   b. If the plant community fails the prevalence index, proceed to step 4.

4. Apply Indicator 4 (Morphological Adaptations).
   a. If the indicator is satisfied, the vegetation is hydrophytic.
   b. If none of the indicators is satisfied, then hydrophytic vegetation is absent unless indicators of hydric soil and wetland hydrology are

present and the site meets the requirements for a problematic wetland situation (Chapter 5).

Indicator 1: Rapid test for hydrophytic vegetation

Description: All dominant species across all strata are rated OBL or FACW, or a combination of these two categories, based on a visual assessment.

User Notes: This test is intended as a quick confirmation in obvious cases that a site has hydrophytic vegetation, without the need for more intensive sampling. Dominant species are selected visually from each stratum of the community using the "50/20 rule" (see Indicator 2 – Dominance Test below) as a general guide but without the need to gather quantitative data. Only the dominant species in each stratum must be recorded on the data form.

Indicator 2: Dominance test

Description: More than 50 percent of the dominant plant species across all strata are rated OBL, FACW, or FAC.

User Notes: Use the 50/20 rule described below to select dominant species from each stratum of the community. Combine dominant species across strata and apply the dominance test to the combined list. Once a species is selected as a dominant, its cover value is not used in the dominance test; each dominant species is treated equally. Thus, a plant community with seven dominant species across all strata would need at least four dominant species that are OBL, FACW, or FAC to be considered hydrophytic by this indicator. Species that are dominant in two or more strata should be counted in each stratum where they are dominant.

Procedure for Selecting Dominant Species by the 50/20 Rule: Dominant plant species are the most abundant species in the community; they contribute more to the character of the community than do the other non-dominant species present. The 50/20 rule is a repeatable and objective procedure for selecting dominant plant species and is recommended when data are available for all species in the community. The rule can also be used to guide visual sampling of plant communities in rapid wetland determinations.

Dominant species are chosen independently from each stratum of the community. In general, dominants are the most abundant species that individually or collectively account for more than 50 percent of the total coverage of vegetation in the stratum, plus any other species that, by itself, accounts for at least 20 percent of the total. For the purposes of this regional supplement, absolute percent cover is the recommended abundance measure for plants in all vegetation strata. See Table 3 for an example application of the 50/20 rule in evaluating a plant community. Steps in selecting dominant species by the 50/20 rule are as follows:

1. Estimate the absolute percent cover of each species in the first stratum. Since the same data may be used later to calculate the prevalence index, the data should be recorded as absolute cover and not converted to relative cover.
2. Rank all species in the stratum from most to least abundant.
3. Calculate the total coverage of all species in the stratum (i.e., sum their individual percent cover values). Absolute cover estimates do not necessarily sum to 100 percent.
4. Calculate the 50-percent threshold for the stratum by multiplying the total cover of that stratum by 50 percent.
5. Calculate the 20-percent threshold for the stratum by multiplying the total cover of that stratum by 20 percent.
6. Select plant species from the ranked list, in decreasing order of coverage, until the cumulative coverage of selected species *exceeds* the threshold representing 50 percent of the total coverage for the stratum. If two or more species are equal in coverage (i.e., they are tied in rank), they should all be selected. The selected plant species are all considered to be dominants. All dominants must be identified to species.
7. In addition, select any other species that, by itself, is at least 20 percent of the total percent cover in the stratum. Any such species is also considered to be a dominant and must be accurately identified.
8. Repeat steps 1-7 for any other stratum present. Combine the lists of dominant species across all strata. Note that a species may be dominant in more than one stratum (e.g., a woody species may be dominant in both the tree and sapling/shrub strata). Species that are dominant in two or more strata should be counted in each stratum where they are dominant.

Table 3. Example of the selection of dominant species by the 50/20 rule and determination of hydrophytic vegetation by the dominance test.

Stratum	Species Name	Wetland Indicator Status (Region 1)	Absolute Percent Cover	Dominant?
Herb	*Impatiens capensis*	FACW	15	Yes
	Geranium carolinianum	UPL	7	Yes
	Toxicodendron radicans	FAC	5	No
	Lonicera tatarica	FACU	2	No
	Glyceria striata	OBL	2	No
	Parthenocissus quinquefolia	FACU	1	No
	Arisaema triphyllum	FACW	0.5	No
	Carex laxiflora	FACU	0.5	No
		Total cover	33.0	
		50/20 Thresholds: 50% of total cover = 16.5% 20% of total cover = 6.6%		
Sapling/shrub	*Carpinus caroliniana*	FAC	35	Yes
	Carya ovata	FACU	10	No
	Acer saccharum	FACU	5	No
	Quercus rubra	FACU	5	No
		Total cover	55.0	
		50/20 Thresholds: 50% of total cover = 27.5% 20% of total cover = 11.0%		
Tree	*Quercus bicolor*	FACW	40	Yes
	Fraxinus pennsylvanica	FACW	17	Yes
	Ulmus americana	FACW	10	No
	Carya ovata	FACU	8	No
		Total Cover	75.0	
		50/20 Thresholds: 50% of total cover = 37.5% 20% of total cover = 15.0%		
Woody vine	*Toxicodendron radicans*	FAC	1	No[1]
Hydrophytic Vegetation Determination	Total number of dominant species across all strata = 5. Percent of dominant species that are OBL, FACW, or FAC = 80%. Therefore, this community is hydrophytic by Indicator 2 (Dominance Test).			

[1] A stratum with less than 5 percent total cover is not considered in the dominance test, unless it is the only stratum present.

Indicator 3: Prevalence index

Description: The prevalence index is 3.0 or less.

User Notes: The prevalence index ranges from one to five. A prevalence index of 3.0 or less indicates that hydrophytic vegetation is present. If practical, all species in the plot should be identified and recorded on the data form. At a minimum, at least 80 percent of the total vegetation cover on the plot (summed across all strata) must be of species that have been correctly identified and have assigned wetland indicator statuses (Reed [1988] or current list) or are not listed and assumed to be UPL.

Procedure for Calculating a Plot-Based Prevalence Index: The prevalence index is a weighted-average wetland indicator status of all plant species in the sampling plot. All plants are given a numeric value based on indicator status (OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5) and their abundance (absolute percent cover) is used to calculate the prevalence index. It is a more comprehensive analysis of the hydrophytic status of the community than one based on just a few dominant species. It is particularly useful in (1) communities with only one or two dominants, (2) highly diverse communities where many species may be present at roughly equal coverage, and (3) cases where strata differ greatly in total plant cover (e.g., total herb cover is 80 percent but sapling/shrub cover is only 10 percent).

The following procedure is used to calculate a plot-based prevalence index. The method was described by Wentworth et al. (1988) and modified by Wakeley and Lichvar (1997). It uses the same field data (i.e., percent cover estimates for each plant species) that were used to select dominant species by the 50/20 rule, with the added constraint that at least 80 percent of the total vegetation cover on the plot must be of species that have been correctly identified and have an assigned indicator status (including UPL). For any species that occurs in more than one stratum, cover estimates are summed across strata. Steps for determining the prevalence index are as follows:

1. Identify and estimate the absolute percent cover of each species in each stratum of the community. Sum the cover estimates for any species that is present in more than one stratum.
2. Organize all species (across all strata) into groups according to their wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL) and sum their cover values within groups. Do not include species that were not identified.
3. Calculate the prevalence index using the following formula:

$$PI = \frac{A_{OBL} + 2A_{FACW} + 3A_{FAC} + 4A_{FACU} + 5A_{UPL}}{A_{OBL} + A_{FACW} + A_{FAC} + A_{FACU} + A_{UPL}}$$

where:

PI = Prevalence index
A_{OBL} = Summed percent cover values of obligate (OBL) plant species;
A_{FACW} = Summed percent cover values of facultative wetland (FACW) plant species;
A_{FAC} = Summed percent cover values of facultative (FAC) plant species;
A_{FACU} = Summed percent cover values of facultative upland (FACU) plant species;
A_{UPL} = Summed percent cover values of upland (UPL) plant species.

See Table 4 for an example calculation of the prevalence index using the same data set as in Table 3. The following web link provides free public-domain software for simultaneous calculation of the 50/20 rule, dominance test, and prevalence index: http://www.crrel.usace.army.mil/rsgisc/wetshed/wetdatashed.htm.

Table 4. Example of the Prevalence Index using the same data as in Table 3.

Indicator Status Group	Species Name	Absolute Percent Cover by Species	Total Cover by Group	Multiply by:[1]	Product
OBL species	*Glyceria striata*	2	2	1	2
FACW species	*Impatiens capensis* *Arisaema triphyllum* *Quercus bicolor* *Fraxinus pennsylvanica* *Ulmus americana*	15 0.5 40 17 10	82.5	2	165
FAC species	*Toxicodendron radicans*[2] *Carpinus caroliniana*	6 35	41	3	123
FACU species	*Lonicera tatarica* *Parthenocissus quinquefolia* *Carex laxiflora* *Carya ovata*[3] *Acer saccharum* *Quercus rubra*	2 1 0.5 18 5 5	31.5	4	126
UPL species	*Geranium carolinianum*	7	7	5	35
Sum			164 (A)		451 (B)
Hydrophytic Vegetation Determination		Prevalence Index = B/A = 451/164 = 2.75 Therefore, this community is hydrophytic by Indicator 3 (Prevalence Index).			

[1] Where OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5.

[2] A stratum with less than 5 percent cover is not considered in the dominance test but is included in the prevalence index. *Toxicodendron radicans* was recorded in two strata (see Table 3), so the cover estimates for this species were summed across strata.

[3] *Carya ovata* was recorded in two strata (see Table 3) so the cover estimates for this species were summed across strata.

Indicator 4: Morphological adaptations

Description: The plant community passes either the dominance test (Indicator 2) or the prevalence index (Indicator 3) after reconsideration of the indicator status of certain plant species that exhibit morphological adaptations for life in wetlands.

User Notes: Some hydrophytes in the Northcentral and Northeast Region develop easily recognized physical characteristics, or morphological adaptations, when they occur in wetland areas. Some of these adaptations may help them to survive prolonged inundation or saturation in the root zone; others may simply be a consequence of living under such wet conditions. Common morphological adaptations in the region include, but are not limited to, adventitious roots, hypertrophied lenticels, multi-stemmed trunks, and shallow root systems developed on or near the soil surface (Figure 4). Users need to be cautious that shallow roots were not caused by erosion, near-surface bedrock, or rocky till, and that multi-trunk plants were not the result of sprouting after logging or browsing. Morphological adaptations may develop on FACU species when they occur in wetlands, indicating that those individuals are functioning as hydrophytes in that setting.

To apply this indicator, these morphological features must be observed on more than 50 percent of the individuals of a FACU species living in an area where indicators of hydric soil and wetland hydrology are present. Follow this procedure:

1. Confirm that the morphological feature is present mainly in the potential wetland area and is not also common on the same species in the surrounding non-wetlands.
2. For each FACU species that exhibits morphological adaptations, estimate the percentage of individuals that have the features. Record this percentage on the data form.
3. If more than 50 percent of the individuals of a FACU species have morphological adaptations for life in wetlands, that species is considered to be a hydrophyte and its indicator status on that plot should be reassigned as FAC. All other species retain their published indicator statuses. Record any supporting information on the data sheet, including a description of the morphological adaptation(s) present and any other observations of the growth habit of the species in adjacent wetland and non-wetland locations (photo documentation is recommended).

4. Recalculate the dominance test (Indicator 2) and/or the prevalence index (Indicator 3) using a FAC indicator status for this species. The vegetation is hydrophytic if either test is satisfied.

Figure 4. Shallow roots of eastern hemlock are a response to high water tables in this forested wetland.

3 Hydric Soil Indicators

Introduction

The National Technical Committee for Hydric Soils (NTCHS) defines a hydric soil as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service 1994). Most hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation for more than a few days. Saturation or inundation, when combined with microbial activity in the soil, causes the depletion of oxygen. This anaerobiosis promotes certain biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, or accumulation of iron and other reducible elements. These processes result in distinctive characteristics that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils in the field (USDA Natural Resources Conservation Service 2010).

This chapter presents indicators that are designed to help identify hydric soils in the Northcentral and Northeast Region. Indicators are not intended to replace or relieve the requirements contained in the definition of a hydric soil. Therefore, a soil that meets the definition of a hydric soil is hydric whether or not it exhibits indicators. Guidance for identifying hydric soils that lack indicators can be found later in this chapter (see the sections on documenting the site and its soils) and in Chapter 5 (Difficult Wetland Situations in the Northcentral and Northeast Region).

This list of indicators is dynamic; changes and additions to the list are anticipated with new research and field testing. The indicators presented in this supplement are a subset of the NTCHS *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service [2010 or current version) that are commonly found in the region. Any change to the NTCHS *Field Indicators of Hydric Soils in the United States* represents a change to this subset of indicators for the Northcentral and Northeast Region. The current version of the indicators can be found on the NRCS hydric soils web site (http://soils.usda.gov/use/hydric). To use the indicators properly, a basic knowledge of soil/landscape relationships is necessary.

Most of the hydric soil indicators presented in this Supplement are applicable throughout the region; however, some are specific to certain subregions. As used in this supplement, subregions are equivalent to the Land Resource Regions (LRR) or Major Land Resource Areas (MLRA) recognized by the USDA Natural Resources Conservation Service (2006) (see Chapter 1, Figure 1). It is important to understand that boundaries between subregions are actually broad transition zones. Although an indicator may be noted as most relevant in a specific subregion, it may also be applicable in the transition to an adjacent subregion.

Concepts

Hydric soil indicators are formed predominantly by the accumulation or loss of iron, manganese, sulfur, or carbon compounds in a saturated and anaerobic environment. These processes and the features that develop are described in the following paragraphs.

Iron and manganese reduction, translocation, and accumulation

In an anaerobic environment, soil microbes reduce iron from the ferric (Fe^{3+}) to the ferrous (Fe^{2+}) form, and manganese from the manganic (Mn^{4+}) to the manganous (Mn^{2+}) form. Of the two, evidence of iron reduction is more commonly observed in soils. Areas in the soil where iron is reduced often develop characteristic bluish-gray or greenish-gray colors known as *gley.* Ferric iron is insoluble but ferrous iron easily enters the soil solution and may be moved or translocated to other areas of the soil. Areas that have lost iron typically develop characteristic gray or reddish-gray colors and are known as *redox depletions.* If a soil reverts to an aerobic state, iron that is in solution will oxidize and become concentrated in patches and along root channels and other pores. These areas of oxidized iron are called *redox concentrations.* Since water movement in these saturated or inundated soils can be multi-directional, redox depletions and concentrations can occur anywhere in the soil and have irregular shapes and sizes. Soils that are saturated and contain ferrous iron at the time of sampling may change color upon exposure to the air, as ferrous iron is rapidly converted to ferric iron in the presence of oxygen. Such soils are said to have a *reduced matrix* (Vepraskas 1992).

While indicators related to iron or manganese depletion or concentration are the most common in hydric soils, they cannot form in soils whose parent materials are low in Fe or Mn. Soils formed in such materials may have low-chroma colors that are not related to saturation and reduction. For such soils, features formed through accumulation of organic carbon may be present.

Sulfate reduction

Sulfur is one of the last elements to be reduced by microbes in an anaerobic environment. The microbes convert SO_4^{2-} to H_2S, or hydrogen sulfide gas. This results in a very pronounced “rotten egg” odor in some soils that are inundated or saturated for very long periods. In non-saturated or non-inundated soils, sulfate is not reduced and there is no rotten egg odor. The presence of hydrogen sulfide is a strong indicator of a hydric soil, but this indicator is found only in the wettest sites in soils that contain sulfur-bearing compounds.

Organic matter accumulation

Soil microbes use carbon compounds found in organic matter as an energy source. However, the rate at which organic carbon is utilized by soil microbes is considerably lower in a saturated and anaerobic environment than under aerobic conditions. Therefore, in saturated soils, partially decomposed organic matter may accumulate. The result in wetlands is often the development of thick organic surfaces, such as peat or muck, or dark organic-rich mineral surface layers.

Non-saturated or non-inundated organic soils. In northern regions, cool temperatures and acid conditions slow the decomposition of organic matter. Under these conditions, even some well-drained soils, under predominantly aerobic conditions, can develop thick organic surface layers called folistic epipedons. These layers are not necessarily related to wetness. Folistic layers are organic accumulations that are saturated less than 30 days cumulatively in normal years (USDA Natural Resources Conservation Service 1999). Most folistic layers consist of poorly decomposed organic material (i.e., fibric or hemic material; see the following section) although some consist of highly decomposed (i.e., sapric) material. Folistic surface layers may overlie rock, a mineral layer, or saturated organic layers, and are most commonly found on north- and east-facing slopes, in dense shade, and on nearly level, convex landforms in coniferous or mixed deciduous/coniferous forests in the colder, northern or high-elevation portions of the region. It may be necessary to involve a soil scientist with local knowledge to help distinguish folistic surface layers from saturated organic layers.

Determining the texture of soil materials high in organic carbon. Material high in organic carbon could fall into three categories: organic, mucky mineral, or mineral. In lieu of laboratory data, the following estimation method can be used for soil material that is wet or nearly saturated with water. This method may be inconclusive with loamy or clayey textured mineral soils. Gently rub the wet soil material between forefinger and thumb. If upon the first or second rub the material feels gritty, it is mineral soil material. If after the second rub the material feels greasy, it is either mucky mineral or organic soil material. Gently rub the material two or three more times. If after these additional rubs it feels gritty or plastic, it is mucky mineral soil material; if it still feels greasy, it is organic soil material. If the material is organic soil material a further division should be made, as follows.

Organic soil materials are classified as sapric, hemic, or fibric based on the percentage of visible fibers observable with a hand lens in an undisturbed state and after rubbing between thumb and fingers 10 times (Table 5). If there is a conflict between unrubbed and rubbed fiber content, rubbed content is used. *Live roots are not considered*. In saturated organic materials, the terms sapric, hemic, and fibric correspond to the textures muck, mucky peat, and peat, respectively (Table 5). The terms muck, mucky peat, and peat should only be used for organic accumulations associated with wetness.

Table 5. Proportion of sample consisting of fibers visible with a hand lens.

Unrubbed	Rubbed	Horizon Descriptor	Soil Texture (Saturated Organic Soils)
<33%	<17%	Sapric	Muck
33-67%	17-40%	Hemic	Mucky peat
>67%	>40%	Fibric	Peat

Adapted from USDA Natural Resources Conservation Service (1999).

Another field method for determining the degree of decomposition for organic materials is a system modified from a method originally developed by L. von Post and described in detail in ASTM standard D 5715-00 (http://www.astm.org/). This method is based on a visual examination of the color of the water that is expelled and the soil material remaining in the hand after a saturated sample is squeezed (Table 6). If a conflict occurs between results for sapric, hemic, or fibric material using percent visible fiber (Table 5) and degree of humification (Table 6), then percent visible fiber should be used.

Table 6. Determination of degree of decomposition of organic materials.

Degree of Humification	Nature of Material Extruded upon Squeezing	Nature of Plant Structure in Residue	Horizon Descriptor	Soil Texture
H1	Clear, colorless water; no organic solids squeezed out	Unaltered, fibrous, undecomposed	Fibric	Peat
H2	Yellowish water; no organic solids squeezed out	Almost unaltered, fibrous		
H3	Brown, turbid water; no organic solids squeezed out	Easily identifiable		
H4	Dark brown, turbid water; no organic solids squeezed out	Visibly altered but identifiable	Hemic	Mucky Peat
H5	Turbid water and some organic solids squeezed out	Recognizable but vague, difficult to identify		
H6	Turbid water; 1/3 of sample squeezed out	Indistinct, pasty		
H7	Very turbid water; 1/2 of sample squeezed out	Faintly recognizable; few remains identifiable, mostly amorphous	Sapric	Muck
H8	Thick and pasty; 2/3 of sample squeezed out	Very indistinct		
H9	No free water; nearly all of sample squeezed out	No identifiable remains		
H10	No free water; all of sample squeezed out	Completely amorphous		

Cautions

A soil that is artificially drained or protected (for instance, by dikes or levees) is still hydric if the soil in its undisturbed state would meet the definition of a hydric soil. To be identified as hydric, these soils should generally have one or more of the indicators. However, not all areas that have hydric soils will qualify as wetlands if they no longer have wetland hydrology or do not support hydrophytic vegetation.

Morphological features that do not reflect contemporary or recent conditions of saturation and anaerobiosis are called relict features. Contemporary and relict hydric soil features can be difficult to distinguish. For example, nodules and concretions that are actively forming often have gradual or diffuse boundaries, whereas relict or degrading nodules and concretions have sharp boundaries (Vepraskas 1992). Guidance for some of the most common problem hydric soils can be found in Chapter 5. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, it may be necessary to obtain the assistance of an experienced soil or wetland scientist to determine whether the soil is hydric.

Procedures for sampling soils

Observe and document the site

Before making any decision about the presence or absence of hydric soils, the overall site and how it interacts with the soil should be considered. The questions below, while not required to identify a hydric soil, can help to explain why a hydric soil is or is not present. Always look at the landscape features of the immediate site and compare them to the surrounding areas. Try to contrast the features of wet and dry sites that are in close proximity. When observing slope features, look first at the area immediately around the sampling point. For example, a nearly level bench or depression at the sampling point may be more important to site wetness than the overall landform on which it occurs. By understanding how water moves across the site, the reasons for the presence or absence of hydric soil indicators should be clear.

If one or more of the hydric soil indicators given later in this chapter is present, then the soil is hydric. If no hydric soil indicator is present, the additional site information below may be useful in documenting whether the soil is indeed non-hydric or if it might represent a "problem" hydric soil that meets the hydric soil definition despite the absence of indicators.

- *Hydrology*–Is standing water observed on the site or is water observed in the soil pit? What is the depth of the water table in the area? Is there indirect evidence of ponding or flooding?
- *Slope*–Is the site level or nearly level so that surface water does not run off readily, or is it steeper where surface water would run off from the soil?
- *Slope shape*–Is the surface concave (e.g., depressions), where water would tend to collect and possibly pond on the soil surface? On hillsides, are there convergent slopes (Figure 5), where surface or

groundwater may be directed toward a central stream or swale? Is the surface or slope shape convex, causing water to run off or disperse?

- *Landform*–Is the soil on a low terrace or floodplain that may be subject to seasonal high water tables or flooding? Is it at the toe of a slope (Figure 6) where runoff may tend to collect or groundwater emerge at or near the surface? Has the microtopography been altered by cultivation?
- *Soil materials*–Is there a restrictive layer in the soil that could slow or prevent the infiltration of water, perhaps resulting in a perched water table? Restrictive layers could include consolidated bedrock, fragipans, dense glacial till, layers of silt or substantial clay content, strongly contrasting soil textures (e.g., silt over sand), or cemented layers, such as ortstein. Or is there relatively loose soil material (sand, gravel, or rocks) or fractured bedrock that would allow the water to flow laterally down slope?
- *Vegetation*–Does the vegetation at the site indicate wetter conditions than at other nearby sites, or is it similar to what is found at nearby upland sites?

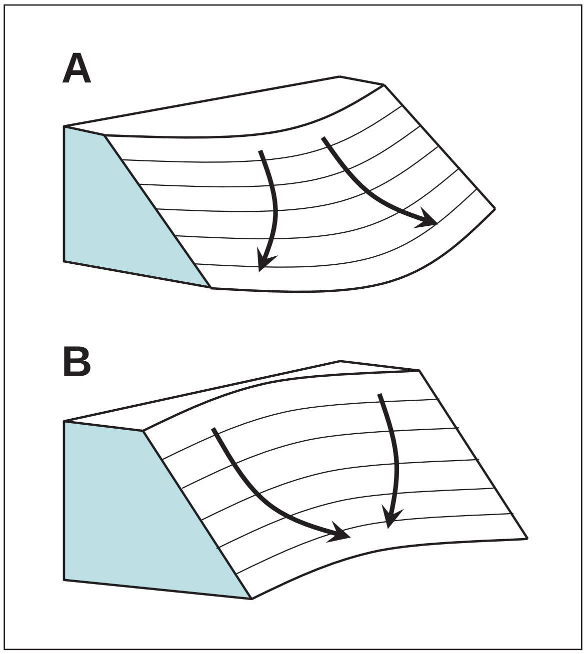


Figure 5. Divergent slopes (A) disperse surface water, whereas convergent slopes (B) concentrate water. Surface flow paths are indicated by the arrows.

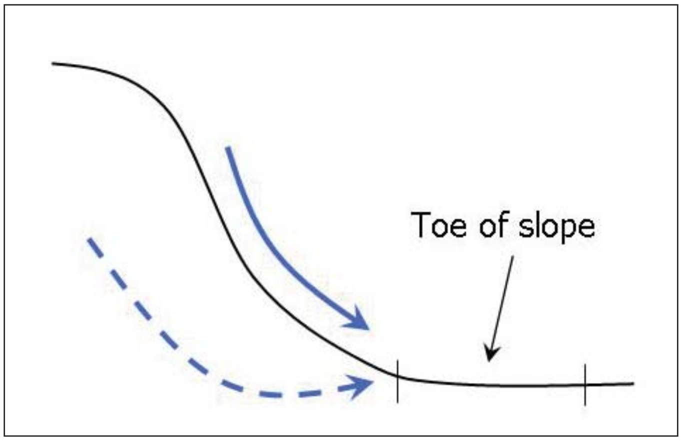


Figure 6. At the toe of a hill slope, the gradient is only slightly inclined or nearly level. Blue arrows represent flow paths of surface water (solid arrow) and groundwater (dashed arrow).

Observe and document the soil

To observe and document a hydric soil, first remove any loose leaves, needles, or bark from the soil surface. Do not remove the organic surface layers of the soil, which usually consist of plant remains in varying stages of decomposition. Dig a hole and describe the soil profile. In general, the hole should be dug to the depth needed to document an indicator or to confirm the absence of indicators. For most soils, the recommended excavation depth is approximately 20 in. (50 cm) from the soil surface, although a shallower soil pit may suffice for some indicators (e.g., A2 – Histic Epipedon). Digging may be difficult in some areas due to rocks and hardpans. Use the completed profile description to determine which hydric soil indicators have been met (USDA Natural Resources Conservation Service 2010).

For soils with deep, dark surface layers, deeper examination may be required when field indicators are not easily seen within 20 in. (50 cm) of the surface. The accumulation of organic matter in these soils may mask redoximorphic features in the surface layers. Examination to 40 in. (1 m) or more may be needed to determine whether they meet the requirements of indicator A12 (Thick Dark Surface). A soil auger or probe may be useful for sampling soil materials below 20 in.

Whenever possible, excavate the soil deep enough to determine if there are layers or materials present that might restrict soil drainage. This will help to understand why the soil may or may not be hydric. After a sufficient number of exploratory excavations have been made to understand the soil-hydrologic relationships at the site, subsequent excavations can be limited to the depth needed to identify hydric soil indicators. Consider taking photographs of both the soil and the overall site, including a clearly marked measurement scale in soil pictures.

The starting point for depth measurements used in the indicators varies by Land Resource Region (LRR). In LRR R (Figure 1), depths are measured from the mineral surface (underneath any and all fibric, hemic, and/or sapric material), except for indicators A1 (Histosol), A2 (Histic Epipedon), A3 (Black Histic), and S3 (Mucky Peat or Peat) for which measurements begin at the actual soil surface. In all other LRRs in the Northcentral and Northeast Region, measurements begin at the muck or mineral surface (underneath any fibric and/or hemic material), except for indicators A1, A2, A3, and S3 where they begin at the actual soil surface (USDA Natural Resources Conservation Service 2010).

All colors noted in this supplement refer to moist Munsell® colors (Gretag/Macbeth 2000). Do not attempt to determine colors while wearing sunglasses or tinted lenses. Colors must be determined under natural light and not under artificial light.

Soil colors specified in the indicators do not have decimal points (except for indicator A12); however, intermediate colors do occur between Munsell chips. Soil color should not be rounded to qualify as meeting an indicator. For example, a soil matrix with a chroma between 2 and 3 should be recorded as having a chroma of 2+. This soil material does not have a chroma of 2 and would not meet any indicator that requires a chroma of 2 or less.

Always examine soil matrix colors in the field immediately after sampling. Ferrous iron, if present, can oxidize rapidly and create colors of higher chroma or redder hue. In soils that are saturated at the time of sampling, redox concentrations may be absent or difficult to see, particularly in dark-colored soils. It may be necessary to let the soil dry to a moist state (5 to 30 minutes or more) for the iron or manganese to oxidize and redox features to become visible.

Particular attention should be paid to changes in microtopography over short distances. Small changes in elevation may result in repetitive sequences of hydric/non-hydric soils, making the delineation of individual areas of hydric and non-hydric soils difficult. Often the dominant condition (hydric or non-hydric) is the only reliable interpretation (also see the section on Wetland/Non-Wetland Mosaics in Chapter 5). The shape of the local landform can greatly affect the movement of water through the landscape. Significant changes in parent material or lithologic discontinuities in the soil can also affect the hydrologic properties of the soil.

Use of existing soil data

Soil surveys

Soil surveys are available for most areas of the Northcentral and Northeast Region and can provide useful information regarding soil properties and soil moisture conditions for an area. A list of available soil surveys is located at http://soils.usda.gov/survey/online_surveys/, and soil survey maps and data are available online from the Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/. Soil survey maps divide the landscape into areas called map units. Map units usually contain more than one soil type or component. They often contain several minor components or inclusions of soils with properties that may be similar to or quite different from the major component. Some of these inclusions may be hydric while the major component is not, and vice versa. Those soils that are hydric are noted in the *Hydric Soils List* published separately from the soil survey report. Soil survey information can be valuable for planning purposes, but it is not site-specific and does not preclude the need for an on-site investigation.

Hydric soils lists

Hydric Soils Lists are developed for each detailed soil survey. Using criteria approved by the NTCHS, these lists rate each soil component as either hydric or non-hydric based on soil property data. If the soil is rated as hydric, information is provided regarding which hydric criteria are met and on what landform the soil typically occurs. Hydric Soils Lists are useful as general background information for an on-site delineation. The hydric soils list should be used as a tool, indicating that hydric soil will likely be found within a given area. However, not all areas within a polygon identified as having hydric soils may be hydric.

Hydric Soils Lists developed for individual detailed soil surveys are known as Local Hydric Soils Lists. They are available from state or county NRCS offices and over the internet from the Soil Data Mart (http://soildatamart.nrcs.usda.gov/). Local Hydric Soils Lists have been compiled into a National Hydric Soils List available at http://soils.usda.gov/use/hydric/. However, use of Local Hydric Soils Lists is preferred since they are more current and reflect local variations in soil properties.

Hydric soil indicators

Many of the hydric soil indicators were developed specifically for wetland-delineation purposes. During the development of these indicators, soils in the interior of wetlands were not always examined; therefore, there are wetlands that lack any of the approved hydric soil indicators in the wettest interior portions. Wetland delineators and other users of the hydric soil indicators should concentrate their sampling efforts near the wetland edge and, if these soils are hydric, assume that soils in the wetter, interior portions of the wetland are also hydric, even if they lack an indicator.

Hydric soil indicators are presented in three groups. Indicators for “All Soils” are used in any soil regardless of texture. Indicators for “Sandy Soils” are used in soil layers with USDA textures of loamy fine sand or coarser. Indicators for “Loamy and Clayey Soils” are used with soil layers of loamy very fine sand and finer. Both sandy and loamy/clayey layers may be present in the same soil profile. Therefore, a soil that contains a loamy surface layer over sand is hydric if it meets all of the requirements of matrix color, amount and contrast of redox concentrations, depth, and thickness for a specific A (All Soils), F (Loamy and Clayey Soils), or S (Sandy Soils) indicator. Additional indicators for problematic hydric soils are presented on pages 71-79. These indicators are used in conjunction with the procedure given in Chapter 5.

It is permissible to combine certain hydric soil indicators if all requirements of the individual indicators are met except thickness (see Hydric Soil Technical Note 4, http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html). The most restrictive requirements for thickness of layers in any indicators used must be met. Not all indicators are possible candidates for combination. For example, indicator F2 (Loamy Gleyed Matrix) has no thickness requirement, so a site would either meet the requirements of this indicator or it would not. Table 7 lists the indicators that are the most likely candidates for combining in the region.

Table 7. Minimum thickness requirements for commonly combined indicators in the Northcentral and Northeast Region.

Indicator	Thickness Requirement
S5 – Sandy Redox	4 in. (10 cm) thick starting within 6 in. (15 cm) of the soil surface
S7 – Dark Surface	4 in. (10 cm) thick starting within 6 in. (15 cm) of the soil surface
F1 – Loamy Mucky Mineral	4 in. (10 cm) thick starting within 6 in. (15 cm) of the soil surface
F3 – Depleted Matrix	6 in. (15 cm) thick starting within 10 in. (25 cm) of the soil surface
F6 – Redox Dark Surface	4 in. (10 cm) thick entirely within the upper 12 in. (30 cm)
F7 – Depleted Dark Surface	4 in. (10 cm) thick entirely within the upper 12 in. (30 cm)

Table 8 presents an example of a soil in which a combination of layers meets the requirements for indicators F6 (Redox Dark Surface) and F3 (Depleted Matrix). The second layer meets the morphological characteristics of F6 and the third layer meets the morphological characteristics of F3, but neither meets the thickness requirement for its respective indicator. However, the combined thickness of the second and third layers meets the more restrictive conditions of thickness for F3 (i.e., 6 in. [15 cm] starting within 10 in. [25 cm] of the soil surface). Therefore, the soil is considered to be hydric based on the combination of indicators.

Table 8. Example of a soil that is hydric based on a combination of indicators F6 and F3.

Depth (inches)	Matrix Color	Redox Concentrations			Texture
		Color	Abundance	Contrast	
0 – 3	10YR 2/1	--	--	--	Loamy/clayey
3 – 6	10YR 3/1	7.5YR 5/6	3 percent	Prominent	Loamy/clayey
6 – 10	10YR 5/2	7.5YR 5/6	5 percent	Prominent	Loamy/clayey
10 – 14	2.5Y 4/2	--	--	--	Loamy/clayey

Another common situation in which it is appropriate to combine the characteristics of hydric soil indicators is when stratified textures of sandy (i.e., loamy fine sand and coarser) and loamy (i.e., loamy very fine sand and finer) material occur in the upper 12 in. of the soil. For example, the soil shown in Table 9 is hydric based on a combination of indicators F6 (Redox Dark Surface) and S5 (Sandy Redox). This soil meets the morphological characteristics of F6 in the first layer and S5 in the second layer, but neither layer by itself meets the thickness requirement for its respective indicator. However, the combined thickness of the two layers (6 in.) meets the more restrictive thickness requirement of either indicator (4 in.).

Table 9. Example of a soil that is hydric based on a combination of indicators F6 and S5.

Depth (inches)	Matrix Color	Redox Concentrations			Texture
		Color	Abundance	Contrast	
0 – 3	10YR 3/1	10YR 5/6	3 percent	Prominent	Loamy/clayey
3 – 6	10YR 4/1	10YR 5/6	3 percent	Prominent	Sandy
6 – 16	10YR 4/1	--	--	--	Loamy/clayey

All soils

"All soils" refers to soils with any USDA soil texture. Use the following indicators regardless of soil texture.

All mineral layers above any of the layers meeting an A indicator, except for indicator A16, must have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 must be less than 6 in. (15 cm) thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Indicator A1: Histosol

Technical Description: Classifies as a Histosol (except Folists)

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: In most Histosols, 16 in. (40 cm) or more of the upper 32 in. (80 cm) is organic soil material (Figure 7). Histosols also include soils that have organic soil material of any thickness over rock or fragmental soil material that has interstices filled with organic soil material (Figure 8). Organic soil material has an organic carbon content (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. The material includes muck (sapric soil material), mucky peat (hemic soil material), or peat (fibric soil material). See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2010) for definitions of muck, mucky peat, peat, and organic soil material. See the Concepts section of this chapter for field methods to identify organic soil materials, and Appendix A for the definition of fragmental soil material.

Figure 7. Example of a Histosol, in which muck (sapric soil material) is greater than 3 ft (0.9 m) thick.

Figure 8. This Histosol consists of only a few inches of organic soil material over bedrock in a shallow glacial groove.

Histosols are relatively abundant in the Northcentral and Northeast Region. They are often found in bogs, fens, and slope wetlands that are ponded or saturated to the surface nearly all of the growing season in most years. Use caution in areas that may have folistic surface layers (see the Concepts section of this chapter). Folistic layers do not meet the requirements of this indicator.

Indicator A2: Histic Epipedon

Technical Description: A histic epipedon underlain by mineral soil material with a chroma of 2 or less.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: Most histic epipedons are surface horizons 8 in. (20 cm) or more thick of organic soil material (Figure 9). Aquic conditions or artificial drainage are required (see *Soil Taxonomy*, USDA Natural Resources Conservation Service 1999); however, aquic conditions can be assumed if indicators of hydrophytic vegetation and wetland hydrology are present. See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2010) for definitions. See the Concepts section of this chapter for field methods to identify organic soil materials. See indicator A1 for organic carbon requirements. Slightly lower organic carbon contents are allowed in plowed soils.

Figure 9. In this soil, the organic surface layer is about 9 in. (23 cm) thick. Scale is in centimeters.

This indicator is common in the region. It is often found in bogs, fens, and slope wetlands that are ponded or saturated to the surface nearly all of the growing season in most years.

Indicator A3: Black Histic

Technical Description: A layer of peat, mucky peat, or muck 8 in. (20 cm) or more thick that starts within 6 in. (15 cm) of the soil surface; has a hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less; and is underlain by mineral soil material with a chroma of 2 or less.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This indicator does not require proof of aquic conditions or artificial drainage. See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2010) for definitions of peat, mucky peat, and muck. See the Concepts section of this chapter for field methods to identify organic soil materials. See indicator A1 for organic carbon requirements.

This indicator is common in the region. It is often found in bogs, fens, and slope wetlands that are ponded or saturated to the surface nearly all of the growing season in most years.

Indicator A4: Hydrogen Sulfide

Technical Description: A hydrogen sulfide (rotten egg) odor within 12 in. (30 cm) of the soil surface.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: Any time the soil smells of hydrogen sulfide (rotten egg odor), sulfur is currently being reduced and the soil is definitely in an anaerobic state. In some soils, the odor is pronounced; in others it is very fleeting as the gas dissipates rapidly. If in doubt, quickly open several small holes in the area of concern to determine if a hydrogen sulfide odor is really present. This indicator generally is not found at the boundaries between wetlands and non-wetlands. It is most commonly found in areas that are permanently saturated or inundated.

Indicator A5: Stratified Layers

Technical Description: Several stratified layers starting within 6 in. (15 cm) of the soil surface. At least one of the layers has a value of 3 or less with a chroma of 1 or less or it is muck, mucky peat, peat, or mucky modified mineral texture. The remaining layers have chromas of 2 or less (Figure 10). Any sandy material that constitutes the layer with a value of 3 or less and a chroma of 1 or less, when viewed with a 10- or 15-power hand lens, must have at least 70 percent of the visible soil particles masked with organic material (Figure 11). When viewed without a hand lens, the material appears to be nearly 100 percent masked.

Figure 10. Stratified layers in loamy material.

Figure 11. Stratified layers in sandy material.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: Use of this indicator may require assistance from a soil scientist with local experience. An undisturbed sample must be observed. Individual strata are dominantly less than 1 in. (2.5 cm) thick. A hand lens can aid in the identification of this indicator. Many alluvial soils have stratified layers at depths greater than 6 in. (15 cm); these do not fit this indicator. Many alluvial soils have stratified layers at the required depths but lack a chroma of 2 or less; these do not fit this indicator. Stratified layers occur in any type of soil material, generally in floodplains and other areas where wet soils are subject to rapid and repeated burial with thin deposits of sediment.

Indicator A11: Depleted Below Dark Surface

Technical Description: A layer with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less, starting within 12 in. (30 cm) of the soil surface, and having a minimum thickness of either:

- 6 in. (15 cm), or
- 2 in. (5 cm) if the 2 in. (5 cm) consists of fragmental soil material.

Loamy/clayey layer(s) above the depleted or gleyed matrix must have a value of 3 or less and chroma of 2 or less. Any sandy material above the depleted or gleyed matrix must have a value of 3 or less and chroma of 1 or less and, when viewed with a 10- or 15-power hand lens, must have at least 70 percent of the visible soil particles masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This indicator often occurs in hydric soils that have dark-colored surface layers, such as umbric epipedons and dark-colored ochric epipedons (Figure 12). For soils that have dark surface layers greater than 12 in. (30 cm) thick, use indicator A12. Two percent or more distinct or prominent redox concentrations, including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (Figure A1). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. See the Glossary (Appendix A) for definitions of depleted matrix, gleyed matrix, distinct and prominent features, and fragmental soil material.

Figure 12. In this soil, a depleted matrix starts immediately below the black surface layer at approximately 11 in. (28 cm).

In some places, the gleyed matrix may change color upon exposure to air (reduced matrix). This phenomenon is included in the concept of a gleyed matrix (USDA Natural Resources Conservation Service 2002).

This indicator is commonly found at the boundary of wetlands in Mollisols or other dark-colored soils. It is often found in soils formed on alluvial terraces along larger river systems in areas subject to ponding due to high water tables.

Indicator A12: Thick Dark Surface

Technical Description: A layer at least 6 in. (15 cm) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 12 in. (30 cm) of the surface. The layer(s) above the depleted or gleyed matrix must have a value of 2.5 or less and chroma of 1 or less to a depth of at least 12 in. (30 cm) and a value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix, when viewed with a 10- or

15-power hand lens, must have at least 70 percent of the visible soil particles masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: The soil has a depleted matrix or gleyed matrix below a black or very dark gray surface layer 12 in. (30 cm) or more thick (Figure 13). This indicator is most often associated with overthickened soils in concave landscape positions. Two percent or more distinct or prominent redox concentrations (Table A1), including iron/manganese soft masses, pore linings, or both, are required in soils that have matrix values/chromas of 4/1, 4/2, and 5/2 (Figure A1). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. See the Glossary (Appendix A) for the definitions of depleted and gleyed matrix.

In some places, the gleyed matrix may change color upon exposure to air (reduced matrix). This phenomenon is included in the concept of a gleyed matrix (USDA Natural Resources Conservation Service 2002).

This indicator is almost never found at the wetland/non-wetland boundary and is much less common than indicators A11 (Depleted Below Dark Surface), F3 (Depleted Matrix), and F6 (Redox Dark Surface).

Sandy soils

"Sandy soils" refers to soil materials with a USDA soil texture of loamy fine sand and coarser. Use the following indicators in soil layers consisting of sandy soil materials.

All mineral layers above any of the layers meeting an S indicator, except for indicator S6, must have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 must be less than 6 in. (15 cm) thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Figure 13. Deep observations may be necessary to identify the depleted or gleyed matrix below a thick, dark surface layer. In this example, the depleted matrix starts at 20 in. (50 cm).

Indicator S1: Sandy Mucky Mineral

Technical Description: A layer of mucky modified sandy soil material 2 in. (5 cm) or more thick starting within 6 in. (15 cm) of the soil surface (Figure 14).

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This indicator is uncommon but is found in localized areas in this region. *Mucky* is a USDA texture modifier for mineral soils. The organic carbon content is at least 5 percent and ranges up to 14 percent for sandy soils. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon

Figure 14. The mucky modified sandy layer is approximately 3 in. (7.5 cm) thick. Scale in inches on the right side of ruler.

requirement. See the glossary of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2010) for the definition of mucky modified mineral texture. A field procedure for identifying mucky mineral soil material is presented in the Concepts section of this chapter.

Indicator S4: Sandy Gleyed Matrix

Technical Description: A gleyed matrix that occupies 60 percent or more of a layer starting within 6 in. (15 cm) of the soil surface (Figure 15).

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: The gleyed matrix only has to be present within 6 in. (15 cm) of the surface. Soils with gleyed matrices are saturated for significant periods; therefore, *no minimum thickness of gleyed layer is required*. See the Glossary (Appendix A) for the definition of a gleyed matrix.

This indicator is most frequently found in tidal marshes and generally is not found at the boundaries between wetlands and non-wetlands.

Figure 15. In this example, the gleyed matrix begins at the soil surface.

Indicator S5: Sandy Redox

Technical Description: A layer starting within 6 in. (15 cm) of the soil surface that is at least 4 in. (10 cm) thick and has a matrix with 60 percent or more chroma of 2 or less with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings (Figure 16).

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: Distinct and prominent are defined in the Glossary (Appendix A). Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas 1992). Included within the concept of redox concentrations are iron/manganese bodies as soft masses with diffuse boundaries. Common (2 to less than 20 percent) to many (20 percent or more) redox concentrations (USDA Natural Resources Conservation Service 2002) are required. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible.

Figure 16. Redox concentrations (orange areas) in sandy soil material.

This is a very common indicator of hydric soils and is often used to identify the hydric/non-hydric boundary in sandy soils. This indicator is often associated with depressions or swales in dune/swale complexes.

Indicator S6: Stripped Matrix

Technical Description: A layer starting within 6 in. (15 cm) of the soil surface in which iron/manganese oxides and/or organic matter have been stripped from the matrix and the primary base color of the soil material has been exposed. The stripped areas and translocated oxides and/or organic matter form a faintly contrasting pattern of two or more colors with diffuse boundaries. The stripped zones are 10 percent or more of the volume and are rounded.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This indicator includes the indicator previously named streaking (Environmental Laboratory 1987). The stripped areas are typically 0.5 to 1 in. (1 to 3 cm) in size but may be larger or smaller. Commonly, the stripped areas have a value of 5 or more and chroma of 1 and/or 2 and unstripped areas have a chroma of 3 and/or 4 (Figure 17).

Figure 17. In this example, a faint splotchy pattern of stripped and unstripped areas lies beneath a thin dark surface layer.

However, there are no specific color requirements for this indicator. The mobilization and translocation of the oxides and/or organic matter are the important processes involved in this indicator and should result in splotchy coated and uncoated soil areas. A 10-power hand lens can be helpful in seeing stripped and unstripped areas. This may be a difficult pattern to recognize and is often more evident in a horizontal slice.

This is a very common indicator of hydric soils and is often used to identify the hydric/non-hydric boundary in sandy soils. This indicator is found in all wetland types and all wet landscape positions.

Indicator S7: Dark Surface

Technical Description: A layer 4 in. (10 cm) thick starting within 6 in. (15 cm) of the soil surface with a matrix value of 3 or less and chroma of 1 or less. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. The matrix color of the layer immediately below the dark layer must have the same colors as those described above or any color that has a chroma of 2 or less.

Applicable Subregions: Applicable to the Northeastern Forests Subregion (LRR R) (Figure 1) and the Long Island/Cape Cod Subregion (MLRA 149B of LRR S) (Figure 18). For testing in LRRs K, L, and M.

User Notes: If the dark layer is greater than 4 in. (10 cm) thick, then the indicator is met, because any dark soil material in excess of 4 in. (10 cm) meets the requirement that "the layer immediately below the dark layer must have the same colors as those described above… ." If the dark layer is exactly 4 in. (10 cm) thick, then the material immediately below must have a matrix chroma of 2 or less.

This indicator is applicable to interdunal swales along the Atlantic Ocean. The organic carbon content of this indicator is slightly less than that required for "mucky." An undisturbed sample must be observed (Figure 19). Many moderately wet soils have a ratio of about 50 percent of soil particles covered or coated with organic matter to about 50 percent uncoated or uncovered soil particles, giving the soil a salt-and-pepper appearance. Where the percent coverage by organic matter is less than 70 percent, the Dark Surface indicator is not present.

Indicator S8: Polyvalue Below Surface

Technical Description: A layer with a value of 3 or less and chroma of 1 or less starting within 6 in. (15 cm) of the soil surface. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles in this layer must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. Immediately below this layer, 5 percent or more of the soil volume has a value of 3 or less and chroma of 1 or less and the remainder of the soil volume has a value of 4 or more and chroma of 1 or less to a depth of 12 in. (30 cm) or to the spodic horizon, whichever is less.

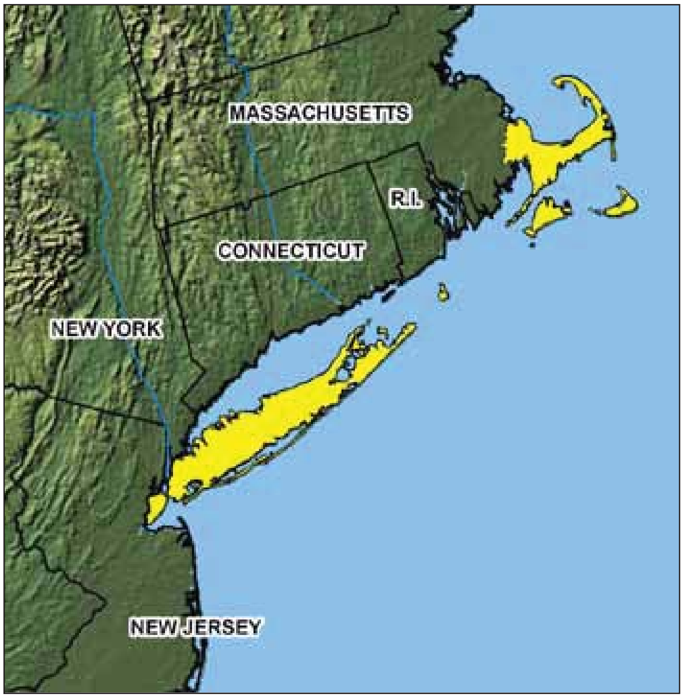


Figure 18. Location of MLRA 149B of LRR S.

Figure 19. Example of indicator S7 (Dark Surface) in a sandy soil. Scale in inches on right.

Applicable Subregions: Applicable to the Northeastern Forests Subregion (LRR R) (Figure 1) and the Long Island/Cape Cod Subregion (MLRA 149B of LRR S) (Figure 18).

User Notes: This indicator applies to soils with a very dark gray or black surface or near-surface layer that is underlain by a layer in which organic matter has been differentially distributed within the soil by water movement (Figure 20). The mobilization and translocation of organic matter result in splotchy coated and uncoated soil areas, as described in the Sandy Redox (S5) and Stripped Matrix (S6) indicators, except that for S8 the whole soil is in shades of black and gray. The chroma of 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator includes the indicator previously termed "streaking." See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for the definition of spodic horizon.

Figure 20. In this soil, the splotchy pattern below the dark surface is due to mobilization and translocation of organic matter. Scale in inches.

Indicator S9: Thin Dark Surface

Technical Description: A layer 2 in. (5 cm) or more thick starting within the upper 6 in. (15 cm) of the soil, with a value of 3 or less and chroma of 1 or less. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles in this layer must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. This layer is underlain by a layer(s) with a value of 4 or less and chroma of 1 or less to a depth of 12 in. (30 cm) or to the spodic horizon, whichever is less.

Applicable Subregions: Applicable to the Northeastern Forests Subregion (LRR R) (Figure 1) and the Long Island/Cape Cod Subregion (MLRA 149B of LRR S) (Figure 18).

User Notes: This indicator applies to soils with a very dark gray or black near-surface layer that is at least 2 in. (5 cm) thick and is underlain by a layer in which organic matter has been carried downward by flowing water (Figure 21). The mobilization and translocation of organic matter result in an even distribution of organic matter in the eluvial (E) horizon. The chroma of 1 or less is critical because it limits application of this indicator to only those soils that are depleted of iron. This indicator commonly occurs in hydric Spodosols; however, a spodic horizon is not required. See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for the definitions of Spodosol and spodic horizon.

Figure 21. Example of indicator S9 (Thin Dark Surface). Scale in inches on right.

Loamy and clayey soils

"Loamy and clayey soils" refers to soil materials with USDA textures of loamy very fine sand and finer. Use the following indicators in soil layers consisting of loamy or clayey soil materials.

All mineral layers above any of the layers meeting an F indicator, except for indicators F8, F12, and F19, must have a dominant chroma of 2 or less, or the layer(s) with a dominant chroma of more than 2 must be less than 6 in. (15 cm) thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Indicator F1: Loamy Mucky Mineral

Technical Description: A layer of mucky modified loamy or clayey soil material 4 in. (10 cm) or more thick starting within 6 in. (15 cm) of the soil surface.

Applicable Subregions: Applicable to the Northcentral Forests (LRR K) and Central Great Lakes Forests (LRR L) Subregions (Figure 1).

User Notes: *Mucky* is a USDA texture modifier for mineral soils. The organic carbon is at least 8 percent, but can range up to 18 percent. The percentage requirement is dependent upon the clay content of the soil; the higher the clay content, the higher the organic carbon requirement. See the Concepts section of this chapter for guidance on identifying mucky mineral soil materials in the field; however, loamy mucky soil material is difficult to distinguish without laboratory testing.

Indicator F2: Loamy Gleyed Matrix

Technical Description: A gleyed matrix that occupies 60 percent or more of a layer starting within 12 in. (30 cm) of the soil surface (Figure 22).

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: Gley colors are not synonymous with gray colors. Gley colors are those colors that are on the gley pages (Gretag/Macbeth 2000). They have hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with

Figure 22. This soil has a gleyed matrix in the lowest layer, starting about 7 in. (18 cm) from the soil surface. The layer above the gleyed matrix has a depleted matrix.

value 4 or more. The gleyed matrix only has to be present within 12 in. (30 cm) of the surface. Soils with gleyed matrices are saturated for significant periods; therefore, no minimum thickness of gleyed layer is required. See the Glossary (Appendix A) for the definition of a gleyed matrix.

This indicator is found in soils that are inundated or saturated nearly all of the growing season in most years (e.g., in oxbows with permanent water) and is not usually found at the boundaries between wetlands and non-wetlands.

Indicator F3: Depleted Matrix

Technical Description: A layer that has a depleted matrix with 60 percent or more chroma of 2 or less and that has a minimum thickness of either:

- 2 in. (5 cm) if the 2 in. (5 cm) is entirely within the upper 6 in. (15 cm) of the soil, or
- 6 in. (15 cm) starting within 10 in. (25 cm) of the soil surface.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This is one of the most commonly observed hydric soil indicators at wetland boundaries. Redox concentrations including iron/manganese soft masses or pore linings, or both, are required in soils with matrix values/chromas of 4/1, 4/2, and 5/2 (Figures 23 and 24). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. Redox concentrations are not required in soils with matrix values of 5 or more and chroma of 1, or values of 6 or more and chromas of 2 or 1. The low-chroma matrix must be caused by wetness and not be a relict or parent material feature. See the Glossary (Appendix A) for the definition of a depleted matrix.

Figure 23. Example of indicator F3 (Depleted Matrix), in which redox concentrations extend nearly to the surface.

Figure 24. This soil has a depleted matrix with redox concentrations in a low-chroma matrix.

Indicator F6: Redox Dark Surface

Technical Description: A layer that is at least 4 in. (10 cm) thick, is entirely within the upper 12 in. (30 cm) of the mineral soil, and has a:

- matrix value of 3 or less and chroma of 1 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings, or
- matrix value of 3 or less and chroma of 2 or less and 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This is a very common indicator used to delineate wetlands. Redox concentrations are often small and difficult to see in mineral soils that have dark (value of 3 or less) surface layers due to high organic-matter content (Figure 25). The organic matter masks some or all of the concentrations that may be present; it also masks the diffuse boundaries of

Figure 25. Redox features can be small and difficult to see within a dark soil layer.

the concentrations and makes them appear to be more sharp. Careful examination is required to see what are often brownish redox concentrations in the darkened materials. If the soil is saturated at the time of sampling, it may be necessary to let it dry at least to a moist condition for redox features to become visible. In some cases, further drying of the samples makes the concentrations (if present) easier to see. A hand lens may be helpful in seeing and describing small redox concentrations. Care should be taken to examine the interior of soil peds for redox concentrations. Dry colors, if used, also must have matrix chromas of 1 or 2, and the redox concentrations must be distinct or prominent. For soils with thick, dark surface layers, see also indicators A11 (Depleted Below Dark Surface) and A12 (Thick Dark Surface).

In soils that are wet because of subsurface saturation, the layer immediately below the dark epipedon will likely have a depleted or gleyed matrix (see the Glossary for definitions). Soils that are wet because of ponding or have a shallow, perched layer of saturation may not always have a depleted/gleyed matrix below the dark surface. This morphology has been observed in soils that have been compacted by tillage and other means. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark-colored epipedon when applying this indicator.

Indicator F7: Depleted Dark Surface

Technical Description: Redox depletions with a value of 5 or more and chroma of 2 or less in a layer that is at least 4 in. (10 cm) thick, is entirely within the upper 12 in. (30 cm) of the mineral soil (Figure 26), and has a:

- matrix value of 3 or less and chroma of 1 or less and 10 percent or more redox depletions, or
- matrix value of 3 or less and chroma of 2 or less and 20 percent or more redox depletions.

Figure 26. Redox depletions (lighter colored areas) are scattered within the darker matrix. Scale is in centimeters.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: Care should be taken not to mistake the mixing of eluvial (leached) layers that have high value and low chroma (E horizon) or illuvial layers that have accumulated carbonates (calcic horizon) into the surface layer as depletions. Mixing of layers can be caused by burrowing animals or cultivation. Pieces of deeper layers that become incorporated into the surface layer are not redox depletions. Knowledge of local conditions is required in areas where light-colored eluvial layers and/or layers high in carbonates may be present. In soils that are wet because of subsurface saturation, the layer immediately below the dark surface is likely to have a depleted or gleyed matrix. Redox depletions are usually associated with microsites that have redox concentrations occurring as pore linings or masses within the depletion(s) or surrounding the depletion(s).

Indicator F8: Redox Depressions

Technical Description: In closed depressions subject to ponding, 5 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings in a layer that is 2 in. (5 cm) or more thick and is entirely within the upper 6 in. (15 cm) of the soil (Figure 27).

Figure 27. In this example, the layer of redox concentrations begins at the soil surface and is slightly more than 2 in. (5 cm) thick.

Applicable Subregions: Applicable throughout the Northcentral and Northeast Region.

User Notes: This indicator occurs on depressional landforms, such as vernal pools and potholes, but not microdepressions on convex landscapes. Closed depressions often occur within flats or floodplain landscapes. *Note that there is no color requirement for the soil matrix.* The layer containing redox concentrations may extend below 6 in. (15 cm) as long as at least 2 in. (5 cm) occurs within 6 in. (15 cm) of the surface. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. See the Glossary for definitions of distinct and prominent.

This is a common but often overlooked indicator found at the wetland/non-wetland boundary on depressional sites.

Hydric soil indicators for problem soils

The following indicators are not currently recognized for general application by the NTCHS, or they are not recognized in the specified geographic area. However, these indicators may be used in problem wetland situations in the Northcentral and Northeast Region where there is evidence of wetland hydrology and hydrophytic vegetation, and the soil is believed to meet the definition of a hydric soil despite the lack of other indicators of a hydric soil. To use these indicators, follow the procedure described in the section on Problematic Hydric Soils in Chapter 5. If any of the following indicators is observed, it is recommended that the NTCHS be notified by following the protocol described in the “Comment on the Indicators” section of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2010).

Indicator A10: 2 cm Muck

Technical Description: A layer of muck 0.75 in. (2 cm) or more thick with a value of 3 or less and chroma of 1 or less, starting within 6 in. (15 cm) of the soil surface.

Applicable Subregions: For use with problem soils in the Northcentral Forests (LRR K), Central Great Lakes Forests (LRR L), and Long Island/Cape Cod (MLRA 149B of LRR S) Subregions.

User Notes: Normally the muck layer is at the soil surface; however, it may occur at any depth within 6 in. (15 cm) of the surface. Muck is sapric soil material with at least 12 to 18 percent organic carbon. Organic soil material is called muck if virtually all of the material has undergone sufficient decomposition to limit recognition of the plant parts. Hemic (mucky peat) and fibric (peat) soil materials do not qualify. To determine if muck is present, first remove loose leaves, needles, bark, and other easily identified plant remains. This is sometimes called leaf litter, a duff layer, or a leaf or root mat. Then examine for decomposed organic soil material. Generally, muck is black and has a greasy feel; sand grains should not be evident (see the Concepts section of this chapter for field methods to identify organic soil materials). Determination of this indicator is made below the leaf or root mat; however, root mats that meet the definition of hemic or fibric soil material are included in the decision-making process for indicators A1 (Histosol) and A2 (Histic Epipedon).

Indicator A16: Coast Prairie Redox

Technical Description: A layer starting within 6 in. (15 cm) of the soil surface that is at least 4 in. (10 cm) thick and has a matrix chroma of 3 or less with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

Applicable Subregions: For use with problem soils throughout the Northcentral and Northeast Region, *except* in the Long Island/Cape Cod Subregion (MLRA 149B of LRR S).

User Notes: These hydric soils occur mainly on depressional and intermound landforms. Redox concentrations occur mainly as iron-dominated pore linings. Common to many redox concentrations are required. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. Chroma 3 matrices are allowed because they may be the color of stripped sand grains, or because few to common sand-sized reddish particles may be present and may prevent obtaining a chroma of 2 or less.

Indicator S3: 5 cm Mucky Peat or Peat

Technical Description: A layer of mucky peat or peat 2 in. (5 cm) or more thick with a value of 3 or less and chroma of 2 or less, starting within 6 in. (15 cm) of the soil surface, and underlain by sandy soil material.

Applicable Subregions: For use with problem soils throughout the Northcentral and Northeast Region, *except* in the Long Island/Cape Cod Subregion (MLRA 149B of LRR S).

User Notes: In this region, this indicator is applicable primarily to interdunal swales along the Great Lakes and Atlantic coast. Mucky peat (hemic soil material) and peat (fibric soil material) have at least 12 to 18 percent organic carbon. Organic soil material is called peat if virtually all of the plant remains are sufficiently intact to permit identification of plant remains. Mucky peat is an intermediate stage of decomposition between peat and highly decomposed muck. See the glossary of Field Indicators of Hydric Soils in the United States (USDA Natural Resources Conservation Service 2010) for definitions. See the Concepts section of this chapter for field methods to identify organic soil materials.

Indicator S7: Dark Surface

Technical Description: A layer 4 in. (10 cm) thick starting within 6 in. (15 cm) of the soil surface with a matrix value of 3 or less and chroma of 1 or less. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. The matrix color of the layer immediately below the dark layer must have the same colors as those described above or any color that has a chroma of 2 or less.

Applicable Subregions: For use with problem soils in the Northcentral Forests (LRR K) and Central Great Lakes Forests (LRR L) Subregions.

User Notes: This indicator is applicable to interdunal swales along the Great Lakes. See the User Notes for indicator S7 earlier in this chapter.

Indicator S8: Polyvalue Below Surface

Technical Description: A layer with a value of 3 or less and chroma of 1 or less starting within 6 in. (15 cm) of the soil surface. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles in this layer must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. Immediately below this layer, 5 percent or more of the soil volume has a value of 3 or less and chroma of 1 or less and the remainder of the soil volume has a value of 4 or more and chroma of 1 or less to a depth of 12 in. (30 cm) or to the spodic horizon, whichever is less.

Applicable Subregions: For use with problem soils in the Northcentral Forests (LRR K) and Central Great Lakes Forests (LRR L) Subregions.

User Notes: See the User Notes for indicator S8 earlier in this chapter.

Indicator S9: Thin Dark Surface

Technical Description: A layer 2 in. (5 cm) or more thick starting within the upper 6 in. (15 cm) of the soil, with a value of 3 or less and chroma of 1 or less. When viewed with a 10- or 15-power hand lens, at least 70 percent of the visible soil particles in this layer must be masked with organic material. When viewed without a hand lens, the material appears to be nearly 100 percent masked. This layer is underlain by a layer(s) with a value of 4 or less and chroma of 1 or less to a depth of 12 in. (30 cm) or to the spodic horizon, whichever is less.

Applicable Subregions: For use with problem soils in the Northcentral Forests (LRR K) and Central Great Lakes Forests (LRR L) Subregions.

User Notes: See the User Notes for indicator S9 earlier in this chapter.

Indicator F12: Iron-Manganese Masses

Technical Description: On floodplains, a layer 4 in. (10 cm) or more thick with 40 percent or more chroma of 2 or less and 2 percent or more distinct or prominent redox concentrations occurring as soft iron-manganese masses with diffuse boundaries. The layer occurs entirely within 12 in. (30 cm) of the soil surface. Iron-manganese masses have a value and chroma of 3 or less. Most commonly, they are black. The thickness requirement is waived if the layer is the mineral surface layer.

Applicable Subregions: For use with problem soils throughout the Northcentral and Northeast Region, *except* in the Long Island/Cape Cod Subregion (MLRA 149B of LRR S).

User Notes: These iron-manganese masses generally are small (2 to 5 mm in size) and have value and chroma of 3 or less. They can be dominated by manganese and, therefore, have a color approaching black (Figure 28). If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. The low matrix chroma must be the result of wetness and not be a relict or parent material feature. Iron-manganese masses should not be confused with the larger and redder iron nodules associated with plinthite or with concretions that have sharp boundaries. This indicator occurs on floodplains such as those of the Mississippi, Hudson, and Penobscot Rivers.

Figure 28. Iron-manganese masses (black spots) in a 40 percent depleted matrix. Scale is in inches.

Indicator F19: Piedmont Floodplain Soils

Technical Description: On active floodplains, a mineral layer at least 6 in. (15 cm) thick starting within 10 in. (25 cm) of the soil surface with a matrix (60 percent or more of the volume) chroma of less than 4 and 20 percent or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

Applicable Subregions: For use with problem soils in the Long Island/Cape Cod Subregion (MLRA 149B of LRR S) (Figure 18).

User Notes: This indicator is restricted to floodplains that are actively receiving sediments and groundwater discharge with high iron content (Figure 29). The soil chroma must be less than 4. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible.

Figure 29. The Piedmont Floodplain Soils indicator is restricted to floodplains that are actively receiving sediments and groundwater discharge with high iron content. Photo by M. Rabenhorst. Scale in 4-in. (10-cm) increments.

Indicator F21: Red Parent Material

Technical Description: A layer derived from red parent materials (see glossary) that is at least 10 cm (4 inches) thick, starting within 25 cm (10 inches) of the soil surface with a hue of 7.5YR or redder. The matrix has a value and chroma greater than 2 and less than or equal to 4. The layer must contain 10 percent or more depletions and/or distinct or prominent redox concentrations occurring as soft masses or pore linings. Redox depletions should differ in color by having:

- value one or more higher and chroma one or more lower than the matrix, or
- value of 4 or more and chroma of 2 or less.

Applicable Subregions: For use with problem soils throughout the Northcentral and Northeast Region.

User Notes: This indicator was developed for use in areas of red parent material. In order to confirm that it is appropriate to apply this indicator to particular soils, soils formed from similar parent materials in the area should have been evaluated to determine their Color Change Propensity Index (CCPI) and be shown to have CCPI values below 30 (Rabenhorst and Parikh, 2000.) It cannot be assumed that sediment overlying red colored bedrock is derived solely from that bedrock. The total percentage of all redox concentrations and redox depletions must add up to at least 10% to meet the threshold for this indicator.

This indicator is typically found at the boundary between hydric and non-hydric soils. Users that encounter a depleted matrix in the upper part should consider F3-Depleted Matrix. F3 is often found in sites that are anaerobic for a longer period. Users that encounter a dark soil surface (value 3 or less and chroma 2 or less) should consider F6-Redox Dark Surface or F7-Depleted Dark Surface. If the site is in a closed depression subject to ponding users should consider F8-Redox Depressions. See glossary for definition of Red Parent Material.

Indicator TA6: Mesic Spodic

Technical Description: A layer 2 in. (5 cm) or more thick starting within 6 in. (15 cm) of the mineral soil surface that has a value of 3 or less and chroma of 2 or less and is underlain by either:

- a layer(s) 3 in. (8 cm) or more thick starting within 12 in. (30 cm) of the mineral soil surface that has a value and chroma of 3 or less and shows evidence of spodic development; or
- a layer(s) 2 in. (5 cm) or more thick starting within 12 in. (30 cm) of the mineral soil surface that has a value of 4 or more and chroma of 2 or less and is directly underlain by a layer(s) 3 in. (8 cm) or more thick with a value and chroma of 3 or less that shows evidence of spodic development.

Applicable Subregions: For use with problem soils in MLRAs 144A and 145 of LRR R and MLRA 149B of LRR S (Figure 30).

User Notes: This indicator is used to identify wet soils with spodic materials or that meet the definition of a Spodosol in MLRAs 144A and 145 of LRR R and MLRA 149B of LRR S only. The layer that has a value of 4 or more and chroma of 2 or less is typically described as an E or Eg horizon. These typically have color patterns described as stripped or partially stripped matrices. The layer with evidence of spodic development is typically described as a Bh, Bhs, Bhsm, Bsm, or Bs horizon. These layers typically have color patterns or cementation indicative of the accumulation of translocated iron, aluminum, and/or organic matter.

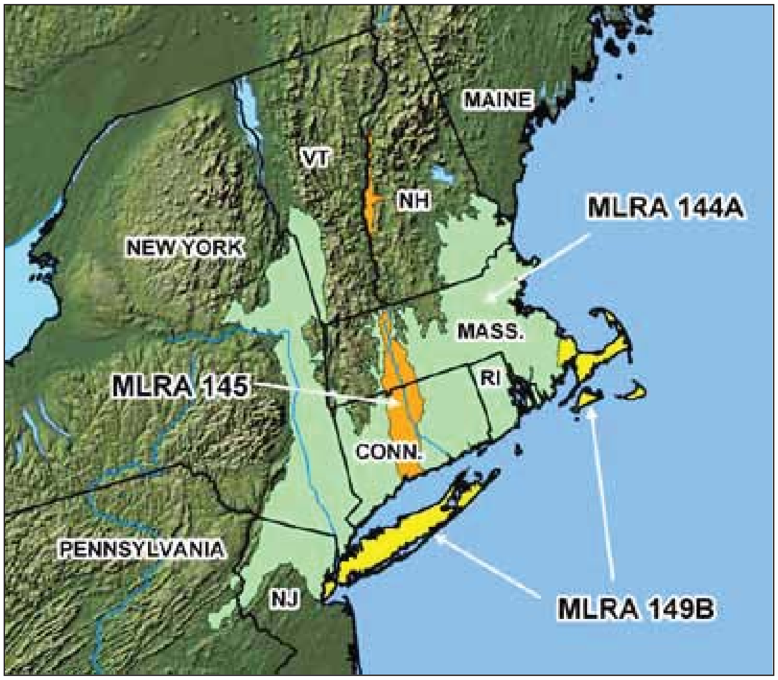


Figure 30. Location of MLRAs 144A and 145 in LRR R and MLRA 149B in LRR S.

Indicator TF12: Very Shallow Dark Surface

Technical Description: In depressions and other concave landforms, one of the following:

- If bedrock occurs between 6 in. (15 cm) and 10 in. (25 cm), a layer at least 6 in. (15 cm) thick starting within 4 in. (10 cm) of the soil surface with a value of 3 or less and chroma of 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma of 2 or less.
- If bedrock occurs within 6 in. (15 cm), more than half of the soil thickness must have a value of 3 or less and chroma of 1 or less, and the remaining soil to bedrock must have the same colors as above or any other color that has a chroma of 2 or less.

Applicable Subregions: For use with problem soils throughout the Northcentral and Northeast Region.

4 Wetland Hydrology Indicators

Introduction

Wetland hydrology indicators are used in combination with indicators of hydric soil and hydrophytic vegetation to determine whether an area is a wetland under the Corps Manual. Indicators of hydrophytic vegetation and hydric soil generally reflect a site's medium- to long-term wetness history. They provide readily observable evidence that episodes of inundation or soil saturation lasting more than a few days during the growing season have occurred repeatedly over a period of years and that the timing, duration, and frequency of wet conditions have been sufficient to produce a characteristic wetland plant community and hydric soil morphology. If hydrology has not been altered, vegetation and soils provide strong evidence that wetland hydrology is present (National Research Council 1995). Wetland hydrology indicators provide evidence that the site has a *continuing* wetland hydrologic regime and that hydric soils and hydrophytic vegetation are not relicts of a past hydrologic regime. Wetland hydrology indicators confirm that an episode of inundation or soil saturation occurred recently, but may provide little additional information about the timing, duration, or frequency of such events (National Research Council 1995).

Hydrology indicators are often the most transitory of wetland indicators. Some hydrology indicators are naturally temporary or seasonal, and many are affected by recent or long-term meteorological conditions. For example, indicators involving direct observation of surface water or saturated soils often are present only during the normal wet portion of the growing season and may be absent during the dry season or during drier-than-normal years. Hydrology indicators also may be subject to disturbance or destruction by natural processes or human activities. Most wetlands in the Northcentral and Northeast Region will exhibit one or more of the hydrology indicators presented in this chapter. However, some wetlands may lack any of these indicators due to temporarily dry conditions, disturbance, or other factors. Therefore, the lack of an indicator is not evidence for the absence of wetland hydrology. See Chapter 5 (Difficult Wetland Situations in the Northcentral and Northeast Region) for help in identifying wetlands that may lack wetland hydrology indicators at certain times.

The Northcentral and Northeast Region has a humid, temperate climate with cold, snowy winters and moderate-to-abundant spring and summer rainfall in most areas and years. The dry season is less pronounced in this region than in the adjacent regions, but increased evapotranspiration during June, July, and August causes water tables to drop and surface water to recede from wetland margins. Particularly in seasonally saturated wetlands, hydrology indicators may be difficult to find during dry periods. On the other hand, some indicators may be present on non-wetland sites immediately after a heavy rain or during periods of unusually high precipitation, river stages, reservoir releases, runoff, or snowmelt. Therefore, it is important to consider weather and climatic conditions prior to the site visit to minimize both false-positive and false-negative wetland hydrology decisions. An understanding of normal seasonal and annual variations in rainfall, temperature, and other climatic conditions is important in interpreting hydrology indicators in the region. Some useful sources of climatic data are described in Chapter 5.

Areas that have hydrophytic vegetation and hydric soils generally also have wetland hydrology unless the hydrologic regime has changed due to natural events or human activities (National Research Council 1995). Therefore, when wetland hydrology indicators are absent from an area that has indicators of hydric soil and hydrophytic vegetation, further information may be needed to determine whether or not wetland hydrology is present. If possible, one or more site visits should be scheduled to coincide with the normal wet portion of the growing season, the period of the year when the presence or absence of wetland hydrology indicators is most likely to reflect the true wetland/non-wetland status of the site. In addition, aerial photography or other remote-sensing data, stream gauge data, monitoring well data, runoff estimates, scope-and-effect equations for ditches and subsurface drainage systems, or groundwater modeling are tools that may help to determine whether wetland hydrology is present when indicators are equivocal or lacking (e.g., USDA Natural Resources Conservation Service 1997). Off-site procedures developed under the National Food Security Act Manual (USDA Natural Resources Conservation Service 1994), which use wetland mapping conventions developed by NRCS state offices, can help identify areas that have wetland hydrology on agricultural lands. The technique is based on wetness signatures visible on standard high-altitude aerial photographs or on annual crop-compliance slides taken by the USDA Farm Service Agency. Finally, on highly disturbed or problematic sites, direct hydrologic monitoring may be needed to determine whether wetland hydrology is present. The U.S. Army Corps of Engineers (2005) provides a technical standard for monitoring hydrology on such sites. This standard requires 14 or more consecutive days of flooding, ponding, and/or a water table 12 in. (30 cm) or less below the soil surface, during the growing season, at a minimum frequency of 5 years in 10 (50 percent or higher probability) (National Research Council 1995) unless an alternative standard has been established for a particular region or wetland type. See Chapter 5 for further information on these techniques.

Growing season

Beginning and ending dates of the growing season may be needed to evaluate certain wetland indicators, such as visual observations of flooding, ponding, or shallow water tables on potential wetland sites. In addition, growing season dates are needed in the event that recorded hydrologic data, such as stream gauge or water-table monitoring data, must be analyzed to determine whether wetland hydrology is present on highly disturbed or problematic sites.

Depletion of oxygen and the chemical reduction of nitrogen, iron, and other elements in saturated soils during the growing season is the result of biological activity occurring in plant roots and soil microbial populations (National Research Council 1995). Two indicators of biological activity that are readily observable in the field are (1) above-ground growth and development of vascular plants, and (2) soil temperature as an indicator of soil microbial activity (Megonigal et al. 1996, USDA Natural Resources Conservation Service 1999). If information about growing season is needed and on-site data gathering is practical, the following approaches should be used in this region to determine growing season dates in a given year. The growing season has begun and is ongoing if either of these conditions is met. Therefore, the beginning of the growing season in a given year is indicated by whichever condition occurs earlier, and the end of the growing season is indicated by whichever condition persists later.

1. The growing season has begun on a site in a given year when two or more different non-evergreen vascular plant species growing in the wetland or surrounding areas exhibit one or more of the following indicators of biological activity:

   a. Emergence of herbaceous plants from the ground

b. Appearance of new growth from vegetative crowns (e.g., in graminoids, bulbs, and corms)
c. Coleoptile/cotyledon emergence from seed
d. Bud burst on woody plants (i.e., some green foliage is visible between spreading bud scales)
e. Emergence or elongation of leaves of woody plants
f. Emergence or opening of flowers

The end of the growing season is indicated when woody deciduous species lose their leaves or the last herbaceous plants cease flowering and their leaves become dry or brown, whichever occurs latest. These changes generally take place in the fall due to cold temperatures or reduced moisture availability. Early plant senescence due to the initiation of the summer dry season in some areas does not necessarily indicate the end of the growing season and alternative procedures (e.g., soil temperature) should be used.

Determinations of the beginning or the end of the growing season should not include evergreen species, including such herbaceous species as *Polystichum acrostichoides* and *Lycopodium* spp. or deciduous species that retain their leaves into the winter (e.g., *Rhamnus cathartica*). Certain herbaceous plants, such as *Alliaria petiolata*, *Carex blanda*, *Geum canadense*, and *Hesperis matronalis*, have basal rosettes and lower stem leaves that retain chlorophyll and remain green throughout the year, including winter (Figure 31). The winter presence of green tissue in these species is not considered a vegetative signal that the growing season has begun. These types of herbaceous species do not indicate the beginning or end of the growing season. If limited to using these types of species, look for new growth from the vegetative crowns to meet the biological activity indicator.

Observations should be made in the wetland or in surrounding areas subject to the same climatic conditions (e.g., similar elevation and aspect); however, soil moisture conditions and plant communities may differ. Supporting data should be reported on the data form, in field notes, or in the delineation report, and should include the species observed (if identifiable), their abundance and location relative to the potential wetland, and type of biological activity observed. A one-time observation of biological activity during a single site visit is sufficient, but is not required unless growing season information is necessary to evaluate particular wetland hydrology indicators. However, if long-term hydrologic monitoring is planned, then plant growth, maintenance, and senescence should be monitored for continuity over the same period.

Figure 31. A caution in determining the start of the growing season using the "green up" indicator. Certain herbaceous species produce overwintering green leaves. An example is Dame's rocket (*Hesperis matronalis*) where the stem, stem leaves, and flowers die back at the end of the growing season, but a basal rosette of green leaves persists under the snowpack. The photograph above, which was taken immediately following the first exposure of the ground surface after snowmelt, illustrates this characteristic.

2. The growing season has begun in spring, and is still in progress, when soil temperature measured at 12 in. (30 cm) depth is 41 °F (5 °C) or higher. A one-time temperature measurement during a single site visit is sufficient, but is not required unless growing season information is necessary to evaluate particular wetland hydrology indicators. However, if long-term hydrologic monitoring is planned, then soil temperature should also be monitored to ensure that it remains continuously at or above 41 °F during the monitoring period. Soil temperature can be measured directly in the field by inserting a soil thermometer into the wall of a freshly dug soil pit. Measurements should be made in the wetland or in surrounding areas subject to the same climatic conditions (e.g., similar elevation and aspect); however, soil moisture conditions may differ.

If the timing of the growing season based on vegetation growth and development and/or soil temperature is unknown and on-site data collection is not practical, such as when analyzing previously recorded stream-gauge or monitoring-well data, then growing season dates may be approximated by the median dates (i.e., 5 years in 10, or 50 percent probability) of 28 °F (−2.2 °C) air temperatures in spring and fall, based on long-term records gathered at National Weather Service meteorological stations (U.S. Army Corps of Engineers 2005). These dates are reported in WETS tables available from the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) for the nearest appropriate weather station.

Wetland hydrology indicators

In this chapter, wetland hydrology indicators are presented in four groups. Indicators in Group A are based on the direct observation of surface water or groundwater during a site visit. Group B consists of evidence that the site is subject to flooding or ponding, although it may not be inundated currently. These indicators include water marks, drift deposits, sediment deposits, and similar features. Group C consists of other evidence that the soil is saturated currently or was saturated recently (e.g., oxidized rhizospheres surrounding living roots and the presence of reduced iron or sulfur in the soil profile). Group D consists of landscape, soil, and vegetation features that indicate contemporary rather than historical wet conditions. Wetland hydrology indicators are intended as one-time observations of site conditions that are sufficient evidence of wetland hydrology. Unless otherwise noted, all indicators are applicable throughout the Northcentral and Northeast Region.

Within each group, indicators are divided into two categories – *primary* and *secondary* – based on their estimated reliability in this region. One primary indicator from any group is sufficient to conclude that wetland hydrology is present; the area is a wetland if indicators of hydric soil and hydrophytic vegetation are also present. In the absence of a primary indicator, two or more secondary indicators from any group are required to conclude that wetland hydrology is present. Indicators of wetland hydrology include, but are not necessarily limited to, those listed in Table 10 and described on the following pages. Other evidence of wetland hydrology may also be used with appropriate documentation.

Table 10. Wetland hydrology indicators for the Northcentral and Northeast Region

Indicator	Category	
	Primary	Secondary
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface water	X	
A2 – High water table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water marks	X	
B2 – Sediment deposits	X	
B3 – Drift deposits	X	
B4 – Algal mat or crust	X	
B5 – Iron deposits	X	
B7 – Inundation visible on aerial imagery	X	
B8 – Sparsely vegetated concave surface	X	
B9 – Water-stained leaves	X	
B13 – Aquatic fauna	X	
B15 – Marl deposits	X	
B6 – Surface soil cracks		X
B10 – Drainage patterns		X
B16 – Moss trim lines		X
Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen sulfide odor	X	
C3 – Oxidized rhizospheres along living roots	X	
C4 – Presence of reduced iron	X	
C6 – Recent iron reduction in tilled soils	X	
C7 – Thin muck surface	X	
C2 – Dry-season water table		X
C8 – Crayfish burrows		X
C9 – Saturation visible on aerial imagery		X
Group D – Evidence from Other Site Conditions or Data		
D1 – Stunted or stressed plants		X
D2 – Geomorphic position		X
D3 – Shallow aquitard		X
D4 – Microtopographic relief		X
D5 – FAC-neutral test		X

In this supplement, wetland hydrology indicators that have depth requirements (e.g., indicator A2 – High Water Table) are evaluated from the mineral soil surface or the top of any organic soil layer, whichever is shallower. Organic layers consist of dead and decomposing plant matter. Therefore, observations should start below any living material (e.g., a living mat of mosses, lichens, etc.). The organic layer, if present, can be either saturated or unsaturated and of any thickness. Therefore, on some sites, the surface for hydric soil determinations (see Chapter 3) and wetland hydrology determinations may differ.

Group A – Observation of Surface Water or Saturated Soils

Indicator A1: Surface water

Category: Primary

General Description: This indicator consists of the direct, visual observation of surface water (flooding or ponding) during a site visit (Figure 32).

Cautions and User Notes: Care must be used in applying this indicator because surface water may be present in non-wetland areas immediately after a rainfall event or during periods of unusually high precipitation, runoff, tides, or river stages. Furthermore, some non-wetlands flood frequently for brief periods. Surface water observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, a follow-up visit during the growing season may be needed. Water perched on seasonally frozen soil is included in this indicator if the resulting inundation is normally present well into the growing season. Note that surface water may be absent from a wetland during the normal dry season or during extended periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). In addition, groundwater-dominated wetland systems may never or rarely contain surface water.

Figure 32. Wetland with surface water present.

Indicator A2: High water table

Category: Primary

General Description: This indicator consists of the direct, visual observation of the water table 12 in. (30 cm) or less below the surface in a soil pit, auger hole, or shallow monitoring well (Figure 33). This indicator includes water tables derived from perched water, throughflow, and discharging groundwater (e.g., in seeps) that may be moving laterally near the soil surface.

Cautions and User Notes: Sufficient time must be allowed for water to infiltrate into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. A water table within 12 in. (30 cm) of the surface observed during the non-growing season may be an acceptable indicator if experience and professional

Figure 33. High water table observed in a soil pit.

judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, a follow-up visit during the growing season may be needed. Water perched on seasonally frozen soil is included in this indicator if the resulting high water table is normally present well into the growing season. Care must be used in interpreting this indicator because water-table levels normally vary seasonally and are a function of both recent and long-term precipitation. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface.

Indicator A3: Saturation

Category: Primary

General Description: Visual observation of saturated soil conditions 12 in. (30 cm) or less from the soil surface as indicated by water glistening on the surfaces and broken interior faces of soil samples removed from the pit or auger hole (Figure 34). This indicator must be associated with an existing water table located immediately below the saturated zone; however, this requirement is waived under episaturated conditions if there is a restrictive soil layer or bedrock within 12 in. (30 cm) of the surface.

Figure 34. Water glistens on the surface of a saturated soil sample.

Cautions and User Notes: Glistening is evidence that the soil sample was taken either below the water table or within the saturated capillary fringe above the water table. Recent rainfall events and the proximity of the water table at the time of sampling must be considered in applying and interpreting this indicator. Water observed in soil cracks or on the faces of soil aggregates (peds) does not meet this indicator unless ped interiors are also saturated. Depth to the water table must be recorded on the data form or in field notes. A water table is not required below the saturated zone under episaturated conditions if the restrictive layer or bedrock is present within 12 in. (30 cm) of the surface. Note the restrictive layer in the soils section of the data form. The restrictive layer may be at the surface.

Group B – Evidence of Recent Inundation

Indicator B1: Water marks

Category: Primary

General Description: Water marks are discolorations or stains on the bark of woody vegetation, rocks, bridge supports, buildings, fences, or other fixed objects as a result of inundation (Figure 35).

Figure 35. Water marks (light-colored areas) on trees in a seasonally flooded wetland.

Cautions and User Notes: When several water marks are present, the highest reflects the maximum extent of inundation. Water marks indicate a water-level elevation and can be extrapolated from nearby objects across lower elevation areas. Water marks on different trees or other objects should form a level plane that can be viewed from one object to another. Use caution with water marks that may have been caused by extreme, infrequent, or very brief flooding events, or by flooding that occurred outside the growing season. In areas with altered hydrology, use care with relict water marks that may reflect the historic rather than the current hydrologic regime. In regulated systems, such as reservoirs, water-level records can be used to distinguish unusually high pools from normal operating levels. This indicator does not include lines caused by ice scour or abrasion, which are indicated by bark or tissue damage.

Indicator B2: Sediment deposits

Category: Primary

General Description: Sediment deposits are thin layers or coatings of fine-grained mineral material (e.g., silt or clay) or organic matter (e.g., pollen), sometimes mixed with other detritus, remaining on tree bark (Figure 36), plant stems or leaves, rocks, and other objects after surface water recedes.

Figure 36. Silt deposit left after a recent high-water event forms a tan coating on these tree trunks (upper edge indicated by the arrow).

Cautions and User Notes: Sediment deposits most often occur in riverine backwater and ponded situations and indicate where water has stood for sufficient time to allow suspended sediment to settle. The upper edge of the sediment deposit reflects a water-surface elevation that can be extrapolated across lower elevation areas. Sediment deposits may remain for considerable periods before being removed by precipitation or subsequent inundation. Use caution with sediment left after infrequent high flows or very brief flooding events, such as those caused by ice jams. This indicator does not include thick accumulations of sand or gravel in fluvial channels that may reflect historic flow conditions or recent extreme events. Use caution in areas where silt and other material trapped in the snowpack may be deposited directly on the ground surface during spring thaw.

Indicator B3: Drift deposits

Category: Primary

General Description: Drift deposits consist of rafted debris that has been deposited on the ground surface or entangled in vegetation or other fixed objects. Debris consists of remnants of vegetation (e.g., branches, stems, and leaves), man-made litter, or other waterborne materials. Drift material may be deposited at or near the high water line in ponded or flooded areas, piled against the upstream sides of trees, rocks, and other fixed objects (Figure 37), or widely distributed within the dewatered area.

Figure 37. Drift deposit on the upstream side of a sapling in a floodplain wetland.

Cautions and User Notes: Deposits of drift material are often found adjacent to streams or other sources of flowing water in wetlands. They also occur in tidal marshes, along lake shores, and in other ponded areas. The elevation of a drift line can be extrapolated across lower elevation areas. Use caution with drift lines that may have been caused by extreme, infrequent, or very brief flooding events, debris piles not related to flooding or ponding, and in areas with functioning drainage systems capable of removing excess water quickly.

Indicator B4: Algal mat or crust

Category: Primary

General Description: This indicator consists of a mat or dried crust of algae, perhaps mixed with other detritus, left on or near the soil surface after dewatering.

Cautions and User Notes: Algal deposits include but are not limited to those produced by green algae (Chlorophyta) and blue-green algae (cyanobacteria). They may be attached to low vegetation or other fixed objects, or may cover the soil surface (Figure 38). Dried crusts of blue-green algae may crack and curl at plate margins (Figure 39). Algal deposits are usually seen in seasonally ponded areas, lake fringes (e.g., *Cladophora* in the Great Lakes), tidal areas, and low-gradient stream margins. They reflect prolonged wet conditions sufficient for algal growth and development.

Figure 38. Dried algal deposit clinging to low vegetation.

Indicator B5: Iron deposits

Category: Primary

General Description: This indicator consists of a thin orange or yellow crust or gel of oxidized iron on the ground surface or on objects near the surface.

Cautions and User Notes: Iron deposits form in areas where reduced iron discharges with groundwater and oxidizes upon exposure to air. The oxidized iron forms a film or sheen on standing water and an orange or yellow deposit (Figures 40 and 41) on the ground surface or objects above the surface after dewatering.

Figure 39. Dried crust of blue-green algae on the soil surface.

Figure 40. Iron deposit (orange streaks) in a small channel.

Figure 41. At this site, ferrous iron moves with the groundwater from a cattail marsh to a shallow ditch, where it oxidizes when exposed to the air and forms an orange-colored iron deposit.

Indicator B7: Inundation visible on aerial imagery

Category: Primary

General Description: One or more recent aerial photographs or satellite images show the site to be inundated.

Cautions and User Notes: Care must be used in applying this indicator because surface water may be present on a non-wetland site immediately after a heavy rain or during periods of unusually high precipitation, runoff, tides, or river stages. See Chapter 5 for procedures to evaluate the normality of precipitation. Surface water observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, additional photos or a site visit during the growing season may be needed. Surface water may be absent from a wetland during the normal dry season or during extended periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). It is recommended that multiple years of photography be evaluated. If 5 or more years of aerial photography are available, the procedure described by the USDA Natural Resources Conservation Service (1997, section 650.1903) is recommended (see Chapter 5, section on Wetlands that Periodically Lack Indicators of Wetland Hydrology, for additional information). Record the date and source of the photography in the remarks section of the data form or in the delineation report.

Indicator B8: Sparsely vegetated concave surface

Category: Primary

General Description: On concave land surfaces (e.g., depressions and swales), the ground surface is either unvegetated or sparsely vegetated (less than 5 percent ground cover) due to long-duration ponding during the growing season (Figure 42).

Figure 42. A sparsely vegetated, seasonally ponded depression. Note the watermarks on trees.

Cautions and User Notes: Ponding during the growing season can limit the establishment and growth of ground-layer vegetation. Sparsely vegetated concave surfaces should contrast with vegetated slopes and convex surfaces in the same area. A woody overstory of trees or shrubs may or may not be present. Examples in the region include concave positions on floodplains, potholes, and seasonally ponded depressions in forested areas.

Indicator B9: Water-stained leaves

Category: Primary

General Description: Water-stained leaves are fallen or recumbent dead leaves that have turned grayish or blackish in color due to inundation for long periods.

Cautions and User Notes: Water-stained leaves are most often found in depressional wetlands (e.g., vernal pools) and along streams in shrub-dominated or forested habitats; however, they also occur in herbaceous communities. Staining often occurs in leaves that are in contact with the soil surface while inundated for long periods (Figure 43). Overlapping leaves may become matted together due to wetness and decomposition. Water-stained leaves maintain their blackish or grayish colors when dry. They should contrast strongly with fallen leaves in nearby non-wetland landscape positions.

Figure 43. Water-stained leaves in a seasonally ponded depression, with an unstained leaf (right center) for comparison.

Indicator B13: Aquatic fauna

Category: Primary

General Description: Presence of live individuals, diapausing insect eggs or crustacean cysts, or dead remains of aquatic fauna, such as, but not limited to, clams, aquatic snails, aquatic insects, ostracods, shrimp, other crustaceans, tadpoles, or fish, either on the soil surface or clinging to plants or other emergent objects.

Cautions and User Notes: Examples of dead remains include clam shells, chitinous exoskeletons, insect head capsules, aquatic snail shells (Figure 44), and skins or skeletons of aquatic amphibians or fish (Figure 45). Aquatic fauna or their remains should be reasonably abundant; one or two individuals are not sufficient. Use caution in areas where faunal remains may have been transported by high winds, unusually high water, or other animals into non-wetland areas. Shells and exoskeletons are resistant to tillage but may be moved by equipment beyond the boundaries of the wetland. They may also persist in the soil for years after dewatering.

Figure 44. Shells of aquatic snails in a seasonally ponded fringe wetland.

Figure 45. Dead green frogs (*Rana clamitans melanota*) in a drying seasonal pool.

Indicator B15: Marl deposits

Category: Primary

General Description: This indicator consists of the presence of marl on the soil surface.

Cautions and User Notes: Marl deposits consist mainly of calcium carbonate precipitated from standing or flowing water through the action of algae or diatoms. Marl appears as a tan or whitish deposit on the soil surface after dewatering (Figure 46) and may form thick deposits in some areas. Subsurface marl layers in some soils do not qualify for this indicator. Marl deposits are found mainly in calcareous fens, seeps, or white cedar swamps in areas underlain by limestone bedrock.

Indicator B6: Surface soil cracks

Category: Secondary

General Description: Surface soil cracks consist of shallow cracks that form when fine-grained mineral or organic sediments dry and shrink, often creating a network of cracks or small polygons (Figure 47).

Cautions and User Notes: Surface soil cracks are often seen in fine sediments and in areas where water has ponded long enough to destroy surface soil structure in depressions, lake fringes, and floodplains. Use caution, however, as they may also occur in temporary ponds and puddles

Figure 46. Marl deposit (tan-colored areas) and iron sheen in a calcareous fen.

Figure 47. Surface soil cracks in a seasonally ponded depression.

in non-wetlands and in areas that have been effectively drained. This indicator does not include deep cracks due to shrink-swell action in clay soils, such as those in the Lake Champlain Valley and in Vertisols.

Indicator B10: Drainage patterns

Category: Secondary

General Description: This indicator consists of flow patterns visible on the soil surface or eroded into the soil, low vegetation bent over in the direction of flow, absence of leaf litter or small woody debris due to flowing water, and similar evidence that water flowed across the ground surface.

Cautions and User Notes: Drainage patterns are usually seen in areas where water flows broadly over the surface and is not necessarily confined to a channel, such as in areas adjacent to streams, in seeps, and swales that convey surface water (Figures 48, 49, and 50). Use caution in areas subject to high winds or affected by recent unusual flooding events, and in vegetated swales in upland areas.

Figure 48. Drainage patterns seen during typical early spring flows in a forested wetland. The patterns are also evident when the wetland is dry.

Figure 49. Drainage patterns in a slope wetland.

Figure 50. Vegetation bent over in the direction of water flow across a stream terrace.

Indicator B16: Moss trim lines

Category: Secondary

General Description: Presence of moss trim lines on trees or other upright objects in seasonally inundated areas.

Cautions and User Notes: Moss trim lines (Figure 51) are formed when water-intolerant mosses growing on tree trunks and other upright objects are killed by prolonged inundation, forming an abrupt lower edge to the moss community at the high-water level (Carr et al. 2006). They are occasionally seen in floodplains and ponded areas throughout the region. Trim lines on different trees in the inundated area should indicate the same water-level elevation. The elevation of a trim line can be extrapolated across lower elevation areas in the vicinity. This indicator does not include lines caused by ice scour or abrasion, which are indicated by bark or tissue damage, and does not include trim lines in lichens which, due to slow regrowth, may reflect unusually high or infrequent flooding events. Certain species of aquatic mosses and liverworts are tolerant of long-duration inundation and occur on trees and other objects below the high-water level. Therefore, the lack of a trim line does not indicate that the site does not pond or flood.

Figure 51. Moss trim lines in a seasonally flooded wetland. Trim lines indicate a recent high-water level.

Group C – Evidence of Current or Recent Soil Saturation

Indicator C1: Hydrogen sulfide odor

Category: Primary

General Description: A hydrogen sulfide (rotten egg) odor within 12 in. (30 cm) of the soil surface.

Cautions and User Notes: Hydrogen sulfide is a gas produced by soil microbes in response to prolonged saturation in soils where oxygen, nitrogen, manganese, and iron have been largely reduced and there is a source of sulfur. For hydrogen sulfide to be detectable, the soil must be saturated at the time of sampling and must have been saturated long enough to become highly reduced. These soils are often permanently saturated and anaerobic at or near the surface. To apply this indicator, dig the soil pit no deeper than 12 in. to avoid release of hydrogen sulfide from deeper in the profile. Hydrogen sulfide odor serves as both an indicator of hydric soil and wetland hydrology. This single observation proves that the soil meets the definition of a hydric soil (i.e., anaerobic in the upper part), plus has an ongoing wetland hydrologic regime. Often these soils have a high water table (wetland hydrology indicator A2), but the hydrogen sulfide odor provides further proof that the soil has been saturated for a long period of time.

Indicator C3: Oxidized rhizospheres along living roots

Category: Primary

General Description: Presence of a layer of any thickness containing 2 percent or more iron-oxide coatings or plaques on the surfaces of living roots and/or iron-oxide coatings or linings on soil pores immediately surrounding living roots within 12 in. (30 cm) of the surface.

Cautions and User Notes: Oxidized rhizospheres are the result of oxygen leakage from living roots into the surrounding anoxic soil, causing oxidation of ferrous iron present in the soil solution. They are evidence of saturated and reduced soil conditions during the plant's lifetime. Iron concentrations or plaques may form on the immediate root surface or may coat the soil pore adjacent to the root (Figures 52 and 53). In either case, the oxidized iron must be associated with living roots to indicate

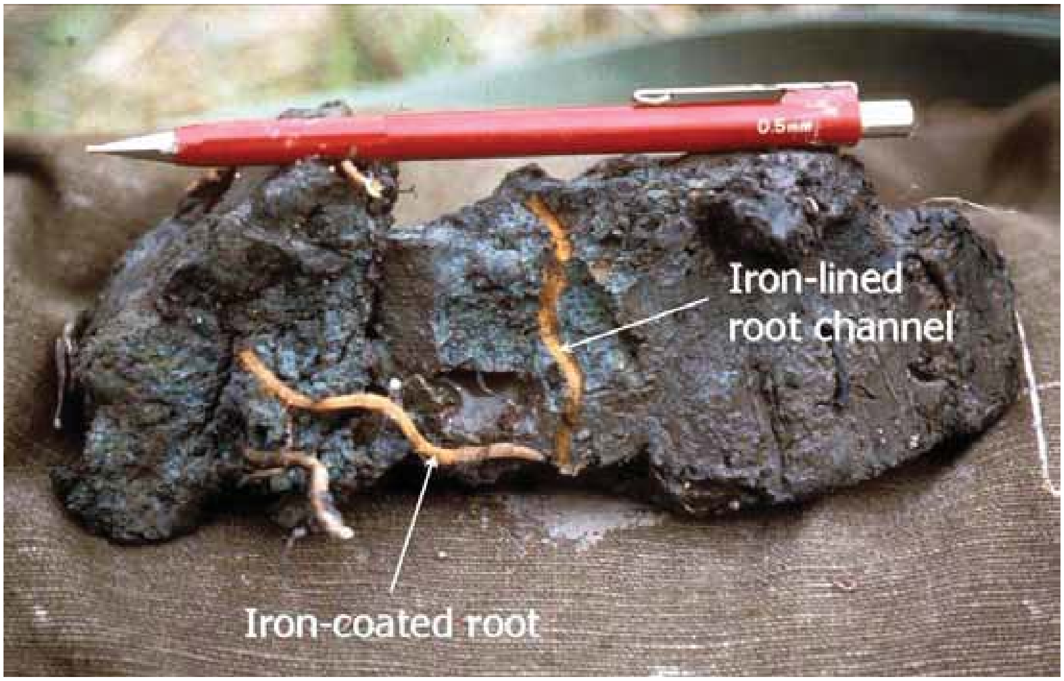


Figure 52. Iron-oxide plaque (orange coating) on a living root. Iron also coats the channel or pore from which the root was removed.


Figure 53. This soil has many oxidized rhizospheres associated with living roots.

contemporary wet conditions and to distinguish these features from other pore linings. Care must be taken to distinguish iron-oxide coatings from organic matter associated with plant roots. Viewing with a hand lens may help to distinguish mineral from organic material and to identify oxidized rhizospheres along fine roots and root hairs. Iron coatings sometimes show concentric layers in cross section and may transfer iron stains to the fingers when rubbed. Note the location and abundance of oxidized rhizospheres in the soil profile description or remarks section of the data form. There is no minimum thickness requirement for the layer containing oxidized rhizospheres. Oxidized rhizospheres must occupy at least 2 percent of the volume of the layer.

Indicator C4: Presence of reduced iron

Category: Primary

General Description: Presence of a layer containing reduced (ferrous) iron in the upper 12 in. (30 cm) of the soil profile, as indicated by a ferrous iron test or by the presence of a soil that changes color upon exposure to the air.

Cautions and User Notes: The reduction of iron occurs in soils that have been saturated long enough to become anaerobic and chemically reduced. Ferrous iron is converted to oxidized forms when saturation ends and the soil reverts to an aerobic state. Thus, the presence of ferrous iron indicates that the soil is saturated and/or anaerobic at the time of sampling. The presence of ferrous iron can be verified with alpha, alpha-dipyridyl reagent (Figure 54) or by observing a soil that changes color upon exposure to air (i.e., reduced matrix). A positive reaction to alpha, alpha-dipyridyl should occur over more than 50 percent of the soil layer in question. The reagent does not react when wetlands are dry; therefore, a negative test result is not evidence that the soil is not reduced at other times of year. Soil samples should be tested or examined immediately after opening the soil pit because ferrous iron may oxidize and colors change soon after the sample is exposed to the air. Avoid areas of the soil that may have been in contact with iron digging tools. Soils that contain little weatherable iron may not react even when saturated and reduced. There are no minimum thickness requirements or initial color requirements for the soil layer in question.

Figure 54. When alpha, alpha-dipyridyl is applied to a soil containing reduced iron, a positive reaction is indicated by a pink or red coloration to the treated area.

Indicator C6: Recent iron reduction in tilled soils

Category: Primary

General Description: Presence of a layer containing 2 percent or more redox concentrations as pore linings or soft masses in the tilled surface layer of soils cultivated within the last two years. The layer containing redox concentrations must be within the tilled zone or within 12 in. (30 cm) of the soil surface, whichever is shallower.

Cautions and User Notes: Cultivation breaks up or destroys redox features in the plow zone. The presence of redox features that are continuous and unbroken indicates that the soil was saturated and reduced since the last episode of cultivation (Figure 55). Redox features often form around organic material, such as crop residue, incorporated into the tilled soil. Use caution with older features that may be broken up but not destroyed by tillage. Newly formed redox concentrations should have diffuse boundaries. The indicator is most reliable in areas that are cultivated regularly, so that soil aggregates and older redox features are more likely to be broken up. If not obvious, information about the timing of last cultivation may be available from the land owner, other knowledgeable

Figure 55. Redox concentrations in the tilled surface layer of a recently cultivated soil.

individuals, aerial photography, or the Farm Service Agency. A plow zone of 6 to 8 in. (15 to 20 cm) in depth is typical but may extend deeper. There is no minimum thickness requirement for the layer containing redox concentrations.

Indicator C7: Thin muck surface

Category: Primary

General Description: This indicator consists of a layer of muck 1 in. (2.5 cm) or less thick at the soil surface.

Cautions and User Notes: Muck is highly decomposed (i.e., sapric) organic material that is associated with wetness (see the Concepts section of Chapter 3 for guidance on identifying muck). In this region, muck accumulates where soils are saturated to the surface for long periods each year. A thin muck layer on the soil surface indicates an active wetland hydrologic regime because thin muck surfaces disappear quickly or become incorporated into mineral horizons when wetland hydrology is withdrawn. On the other hand, thick muck layers can persist for years after wetland hydrology is effectively removed, as in many drained muck soils that are used to grow vegetable crops throughout the region.

Although thick muck layers also occur in wetlands, a muck layer greater than 1 in. thick does not qualify for this indicator. Use caution in areas with folistic surface layers (see the Concepts section of Chapter 3).

Indicator C2: Dry-season water table

Category: Secondary

General Description: Visual observation of the water table between 12 and 24 in. (30 and 60 cm) below the surface during the normal dry season or during a drier-than-normal year.

Cautions and User Notes: Due to normal seasonal fluctuations, water tables in wetlands often drop below 12 in. during the summer dry season. A water table between 12 and 24 in. during the dry season, or during an unusually dry year, likely indicates a normal wet-season water table within 12 in. of the surface. Sufficient time must be allowed for water to infiltrate into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface. Water tables in wetlands often drop well below 24 in. during dry periods. Therefore, a dry-season water table below 24 in. does not necessarily indicate a lack of wetland hydrology. See Chapter 5 (section on Wetlands that Periodically Lack Indicators of Wetland Hydrology) to determine average dry-season dates and drought periods. In the Remarks section of the data form or in a separate report, provide documentation for the conclusion that the site visit occurred during the normal dry season, recent rainfall has been below normal, or the area has been affected by drought. This indicator does not apply in agricultural areas that have controlled drainage structures for subsurface irrigation.

Indicator C8: Crayfish burrows

Category: Secondary

General Description: Presence of crayfish burrows, as indicated by openings in soft ground up to 2 in. (5 cm) in diameter, often surrounded by chimney-like mounds of excavated mud.

Cautions and User Notes: Crayfish breathe with gills and require at least periodic contact with water. Some species dig burrows for refuge and breeding (Figure 56). Crayfish burrows are usually found near streams, ditches, and ponds in areas that are seasonally inundated or have seasonal high water tables at or near the surface. They are also found in wet meadows and pastures where there is no open water. Crayfish may extend their burrows 10 ft (3 m) or more in depth to keep pace with a falling water table; thus, the eventual depth of the burrow does not reflect the level of the seasonal high water table.

Figure 56. Crayfish burrow in a saturated wetland.

Indicator C9: Saturation visible on aerial imagery

Category: Secondary

General Description: One or more recent aerial photographs or satellite images indicate soil saturation. Saturated soil signatures must correspond to field-verified hydric soils, depressions or drainage patterns, differential crop management, or other evidence of a seasonal high water table.

Cautions and User Notes: This indicator is useful when plant cover is sparse or absent and the ground surface is visible from above. Saturated areas generally appear as darker patches within the field (Figure 57).

Figure 57. Aerial photograph of an agricultural field with saturated soils indicated by darker colors.

Saturated areas are often more evident on color infrared imagery. Inundated (indicator B7) and saturated areas may be present in the same field; if they cannot be distinguished, then use indicator C9 for the entire wet area. Care must be used in applying this indicator because saturation may be present on a non-wetland site immediately after a heavy rain or during periods of abnormally high precipitation, runoff, or river stages. Saturation observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, additional photos or a site visit during the growing season may be needed. Saturation may be absent from a wetland during the normal dry season or during extended periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability). It is recommended that multiple years of photography be evaluated. If 5 or more years of aerial photography are available, the procedure described by the Natural Resources Conservation Service (1997, section 650.1903, and associated state wetland mapping conventions) is recommended in actively farmed areas. Use caution, as similar signatures may be caused by factors other than saturation. This indicator requires on-site verification that saturation signatures seen on photos correspond to hydric soils or other evidence of a seasonal high water table. This may be a useful tool for identifying the presence and location of subsurface drainage lines in current or former agricultural fields, and multiple years of photos may be helpful in evaluating the frequency and extent of soil saturation. This method may be inconclusive in areas with dark soil surfaces. Record the date and source of the photography in the Remarks section of the data form or in a separate report.

Group D – Evidence from Other Site Conditions or Data

Indicator D1: Stunted or stressed plants

Category: Secondary

General Description: This indicator is present if individuals of the same species growing in the potential wetland are clearly of smaller stature, less vigorous, or stressed compared with individuals growing in nearby non-wetland situations (Figures 58 and 59).

Cautions and User Notes: Some plant species can become established and grow in both wetlands and non-wetlands but may exhibit obvious stunting, yellowing, or stress in wet situations. This indicator is applicable to natural plant communities as well as agricultural crops and other introduced or planted vegetation. For this indicator to be present, a majority of individuals in the stand must be stunted or stressed. The comparison with

Figure 58. Stunted corn due to wet spots in an agricultural field in New Hampshire.

Figure 59. Black spruce in the wetland (foreground) are stressed and stunted compared with spruce in the adjacent areas (background).

individuals in non-wetland situations may be accomplished over a broad area and is not limited to the project site. Use caution in areas where stunting of plants on non-wetland sites may be caused by low soil fertility, excessively drained soils, cold temperatures, uneven application of agricultural chemicals, salinity, or other factors. In this region, this indicator is often seen in black spruce, red spruce, and balsam fir, as well as agricultural crops and other introduced or planted species.

Indicator D2: Geomorphic position

Category: Secondary

General Description: This indicator is present if the immediate area in question is located in a depression, drainageway, concave position within a floodplain, at the toe of a slope, on the low-elevation fringe of a pond or other water body, or in an area where groundwater discharges.

Cautions and User Notes: Excess water from precipitation and snowmelt naturally accumulates in certain geomorphic positions in the landscape, particularly in low-lying areas such as depressions, drainageways, toe slopes (Figure 6), and fringes of water bodies below any obvious terraces (Figure 60). These areas often, but not always, exhibit wetland hydrology. This indicator is not applicable in areas with functioning drainage systems and does not include concave positions on rapidly permeable soils (e.g., floodplains with sand and gravel substrates) that do not have wetland hydrology unless the water table is near the surface.

Figure 60. Fringes of water bodies, such as this estuarine fringe, are likely to exhibit wetland hydrology.

Indicator D3: Shallow aquitard

Category: Secondary

General Description: This indicator consists of the presence of an aquitard within 24 in. (60 cm) of the soil surface that is potentially capable of perching water within 12 in. (30 cm) of the surface.

Cautions and User Notes: An aquitard is a relatively impermeable soil layer or bedrock that slows the downward infiltration of water, and can produce a perched water table. In some cases, the aquitard may be at the surface (e.g., in clay soils) and cause water to pond on the surface. Potential aquitards in this region include dense glacial till, lacustrine deposits, fragipans, iron-cemented layers (e.g., ortstein), and clay layers. An aquitard can often be identified by the limited root penetration through the layer and/or the presence of redoximorphic features in the layer(s) above the aquitard. Local experience and professional judgment should indicate that the perched water table is likely to occur during the growing season for sufficient duration in most years. Soil layers that are seasonally frozen do not qualify as aquitards unless they are observed to perch water for long periods during the growing season. Use caution in areas with functioning drainage systems that are capable of removing perched water quickly.

Indicator D4: Microtopographic Relief

Category: Secondary

General Description: This indicator consists of the presence of microtopographic features that occur in areas of seasonal inundation or shallow water tables, such as hummocks, tussocks, and flark-and-strang topography, with microhighs less than 36 in. (90 cm) above the base soil level (Figure 61).

Figure 61. This hemlock-dominated wetland has trees growing on hummocks and herbaceous plants growing in tussocks.

Cautions and User Notes: These features are the result of vegetative and geomorphic processes in wetlands and produce the characteristic microtopographic diversity of some wetland systems. Microtopographic lows are either inundated or have shallow water tables for long periods each year. Microtopographic highs may or may not have wetland hydrology, but usually are small, narrow, or fragmented, often occupying less than half of the surface area. If indicators of hydrophytic vegetation or hydric soil are absent from microhighs, see the procedure for wetland/non-wetland mosaics in Chapter 5. This indicator does not include uneven topography due to vegetation-covered rocks, logs, or other debris, or trampling by livestock.

Indicator D5: FAC-neutral test

Category: Secondary

General Description: The plant community passes the FAC-neutral test.

Cautions and User Notes: The FAC-neutral test is performed by compiling a list of dominant plant species across all strata in the community, and dropping from the list any species with a Facultative indicator status (i.e., FAC). The FAC-neutral test is met if more than 50 percent of the remaining dominant species are rated FACW and/or OBL. This indicator can be used in communities that contain no FAC dominants. If there are an equal number of dominants that are OBL and FACW versus FACU and UPL, or if all dominants are FAC, non-dominant species should be considered.

5 Difficult Wetland Situations in the Northcentral and Northeast Region

Introduction

Some wetlands can be difficult to identify because wetland indicators may be missing due to natural processes or recent disturbances. This chapter provides guidance for making wetland determinations in difficult-to-identify wetland situations in the Northcentral and Northeast Region. It includes regional examples of problem area wetlands and atypical situations as defined in the Corps Manual, as well as other situations that can make wetland delineation more challenging. Problem area wetlands are naturally occurring wetland types that lack indicators of hydrophytic vegetation, hydric soil, or wetland hydrology periodically due to normal seasonal or annual variability, or permanently due to the nature of the soils or plant species on the site. Atypical situations are wetlands in which vegetation, soil, and/or hydrology indicators are absent due to recent human activities or natural events. In addition, this chapter addresses certain procedural problems (e.g., wetland/non-wetland mosaics) that can make wetland determinations in the region difficult or confusing. The chapter is organized into the following sections:

- Lands Used for Agriculture and Silviculture
- Problematic Hydrophytic Vegetation
- Problematic Hydric Soils
- Wetlands that Periodically Lack Indicators of Wetland Hydrology
- Wetland/Non-Wetland Mosaics

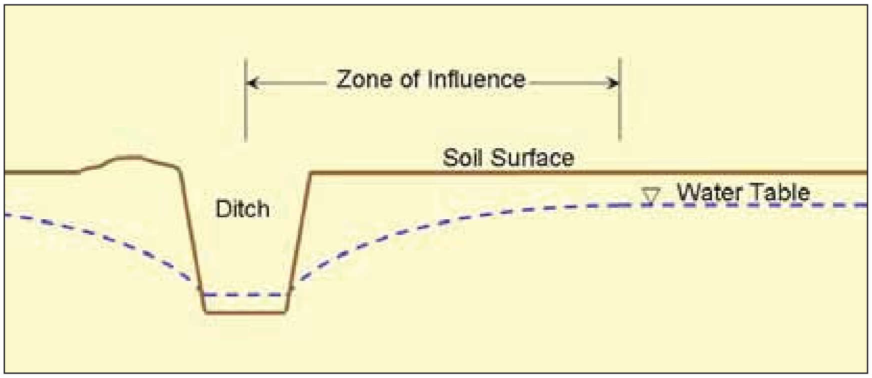
The list of difficult wetland situations presented in this chapter is not intended to be exhaustive and other problematic situations may exist in the region. See the Corps Manual for general guidance. Furthermore, more than one wetland factor (i.e., vegetation, soil, and/or hydrology) may be disturbed or problematic on a given site. In general, *wetland determinations on difficult or problematic sites must be based on the best information available to the field inspector, interpreted in light of his or her professional experience and knowledge of the ecology of wetlands in the region*.

Lands used for agriculture and silviculture

Agriculture and silviculture are important land uses in the Northcentral and Northeast Region, and both of these activities present challenges to wetland identification and delineation. Wetlands used for agriculture or silviculture often lack a natural plant community and may be planted to crops, pasture species, or desirable tree species and may be altered by mowing, grazing, herbicide use, or other management practices. Soils may be disturbed by cultivation, land clearing, grading, or bedding, at least in the surface layers, and hydrology may or may not be manipulated. Some areas that are used for agriculture or silviculture still retain wetland hydrology. In other areas, historic wetlands have been effectively drained and no longer meet wetland hydrology standards. Relict wetland indicators may still be present in these areas, making it difficult to distinguish current wetlands from those that have been effectively drained. In addition, agricultural activities can include improved groundwater management, involving the manipulation of water tables to conserve both water and nutrients (e.g., Frankenberger et al. 2006).

Agricultural and silvicultural drainage systems use ditches, subsurface drainage lines or "tiles," and water-control structures to manipulate the water table and improve conditions for crops or other desired species. A freely flowing ditch or drainage line depresses the water table within a certain lateral distance or zone of influence (Figure 62). The effectiveness of drainage in an area depends in part on soil characteristics, the timing and amount of rainfall, and the depth and spacing of ditches or drains. Wetland determinations on current and former agricultural or silvicultural lands must consider whether a drainage system is present, how it is designed to function, and whether it is effective in removing wetland hydrology from the area.

A number of information sources and tools are listed below to help determine whether wetlands are present on lands where vegetation, soils, hydrology, or a combination of these factors have been manipulated. Some of these options are discussed in more detail later in this chapter under the appropriate section headings.



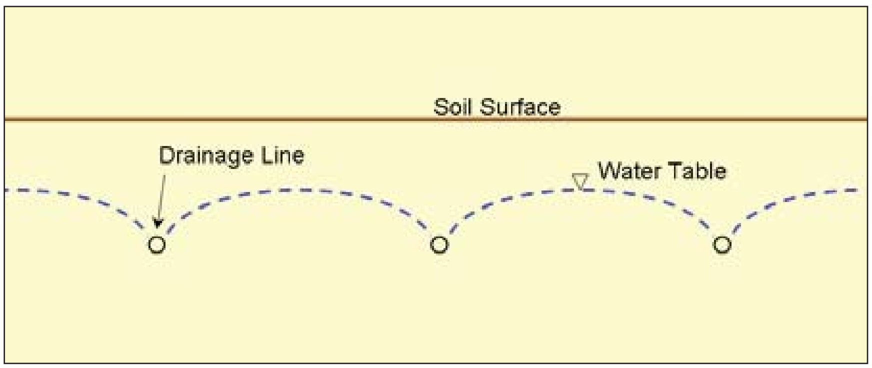


Figure 62. Effects of ditches (upper) and parallel subsurface drainage lines (lower) on the water table.

1. **Vegetation** – The goal is to determine the plant community that would occupy the site under normal circumstances, if the vegetation were not cleared or manipulated.

   a. Examine the site for volunteer vegetation that emerges between cultivations, plantings, mowings, or other treatments.
   b. Examine the vegetation on an undisturbed reference area with soils and hydrology similar to those on the site.
   c. Check NRCS soil survey reports for information on the typical vegetation on soil map units (hydrology of the site must be unaltered).
   d. If the conversion to agriculture or silviculture was recent and the hydrology of the site was not manipulated, examine pre-disturbance aerial photography, NWI maps, and other sources for information on the previous vegetation.
   e. Cease the clearing, cultivation, or manipulation of the site for one or more growing seasons with normal rainfall and examine the plant community that develops.

2. **Soils** – Tilling of agricultural land mixes the surface layer(s) of the soil and may cause compaction below the tilled zone (i.e., a "plow pan") due to the weight and repeated passage of farm machinery. Similar disturbance to surface soils may also occur in areas managed for silviculture. Nevertheless, a standard soil profile description and examination for hydric soil indicators are often sufficient to determine whether hydric soils are present. Other options and information sources include the following:

    a. Examine NRCS soil survey maps and the local hydric soils list for the likely presence of hydric soils on the site.
    b. Examine the soils on an undisturbed reference area with landscape position, parent materials, and hydrology similar to those on the site.
    c. Use alpha, alpha-dipyridyl reagent to check for the presence of reduced iron during the normal wet portion of the growing season, or note whether the soil changes color upon exposure to the air.
    d. Monitor the site in relation to the appropriate wetland hydrology or hydric soils technical standard.

3. **Hydrology** – The goal is to determine whether wetland hydrology is present on a managed site under normal circumstances, as defined in the Corps Manual and subsequent guidance. These sites may or may not have been hydrologically manipulated.

    a. Examine the site for existing indicators of wetland hydrology. If the natural hydrology of the site has been permanently altered, discount any indicators known to have been produced before the alteration (e.g., relict water marks or drift lines).
    b. In agricultural areas (e.g., row crops, hayfields, tree farms, nurseries, orchards, and others) examine five or more years of aerial photographs for wetness signatures listed in Part 513.30 of the National Food Security Act Manual (USDA Natural Resources Conservation Service 1994) or in wetland mapping conventions available from NRCS offices or online in the electronic Field Office Technical Guide (eFOTG) (http://www.nrcs.usda.gov/technical/efotg/). Use the procedure given by the USDA Natural Resources Conservation Service (1997) to determine whether wetland hydrology is present.
    c. Estimate the effects of ditches and subsurface drainage systems using scope-and-effect equations (USDA Natural Resources Conservation Service 1997). A web application to analyze data using various models is available at http://www.wli.nrcs.usda.gov/technical/web_tool/tools_java.html.

Scope-and-effect equations are approximations only and may not reflect actual field conditions. Their results should be verified by comparison with other techniques for evaluating drainage and should not overrule onsite evidence of wetland hydrology.

d. Use state drainage guides to estimate the effectiveness of an existing drainage system (USDA Natural Resources Conservation Service 1997). Drainage guides may be available from NRCS offices. Cautions noted in item *c* above also apply to the use of drainage guides. In addition, Corps of Engineers district offices should be consulted for locally developed techniques to evaluate wetland drainage.
e. Use hydrologic models (e.g., runoff, surface water, and groundwater models) to determine whether wetland hydrology is present (e.g., USDA Natural Resources Conservation Service 1997).
f. Monitor the hydrology of the site in relation to the appropriate wetland hydrology technical standard (U. S. Army Corps of Engineers 2005).

Problematic hydrophytic vegetation

Description of the problem

Many factors affect the structure and composition of plant communities in the region, including climatic variability, spread of exotic species, agricultural and silvicultural use, and other human land-use practices. As a result, some wetlands may exhibit indicators of hydric soil and wetland hydrology but lack any of the hydrophytic vegetation indicators presented in Chapter 2, at least at certain times. To identify and delineate these wetlands may require special sampling procedures or additional analysis of factors affecting the site. To the extent possible, the hydrophytic vegetation decision should be based on the plant community that is normally present during the wet portion of the growing season in a normal rainfall year. The following procedure addresses several examples of problematic vegetation situations in the Northcentral and Northeast Region.

Procedure

Problematic hydrophytic vegetation can be identified using a combination of observations made in the field and/or supplemental information from the scientific literature and other sources. These procedures should be applied only where indicators of hydric soil and wetland hydrology are present, unless one or both of these factors is also disturbed or problematic, but no indicators of hydrophytic vegetation are evident. The following procedures are recommended:

1. Verify that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present. If indicators of either hydric soil or wetland hydrology are absent, the area is likely non-wetland unless soil and/or hydrology are also disturbed or problematic. If indicators of hydric soil and wetland hydrology are present (or are absent due to disturbance or other problem situations), proceed to step 2.

2. Verify that the area is in a landscape position that is likely to collect or concentrate water. If the landscape setting is appropriate, proceed to step 3. Appropriate settings include the following.

    a. Concave surface (e.g., depression or swale)
    b. Active floodplain or low terrace
    c. Level or nearly level area (e.g., 0- to 3-percent slope)
    d. Toe slope (Figure 6) or an area of convergent slopes (Figure 5)
    e. Fringe of another wetland or water body
    f. Area with a restrictive soil layer or aquitard within 24 in. (60 cm) of the surface
    g. Area where groundwater discharges (e.g., a seep)
    h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

3. Use one or more of the approaches described in step 4 (Specific Problematic Vegetation Situations below) or step 5 (General Approaches to Problematic Hydrophytic Vegetation on page 131) to determine whether the vegetation is hydrophytic. In the remarks section of the data form or in the delineation report, explain the rationale for concluding that the plant community is hydrophytic even though indicators of hydrophytic vegetation described in Chapter 2 were not observed.

4. Specific Problematic Vegetation Situations

    a. *Temporal shifts in vegetation.* As described in Chapter 2, the species composition of some wetland plant communities in the region can change in response to seasonal weather patterns and long-term climatic fluctuations. Wetland types that are influenced by these shifts include Great Lakes coastal wetlands, vernal pools, interdunal swales, wet meadows, wet prairies, seeps, and springs. Lack of hydrophytic vegetation during the dry season, when FACU and UPL warm-season grasses and annuals dominate many areas, should not immediately eliminate a site from consideration as a wetland, because the site may have been dominated by wetland species earlier in the growing season. A site qualifies for further consideration if the plant community at the time of sampling does not exhibit hydrophytic vegetation indicators, but indicators of hydric soil and wetland hydrology are present or known to be disturbed or problematic. The following sampling and analytical approaches are recommended in these situations:

(1) Seasonal Shifts in Plant Communities

(a) If possible, return to the site during the normal wet portion of the growing season (generally in early spring) and re-examine the site for indicators of hydrophytic vegetation.
(b) Examine the site for identifiable plant remains, either alive or dead, or other evidence that the plant community that was present during the normal wet portion of the growing season was hydrophytic.
(c) Use off-site data sources to determine whether the plant community that is normally present during the wet portion of the growing season is hydrophytic. Appropriate data sources include early growing season aerial photography, NWI maps, soil survey reports, remotely sensed data, public interviews, state wetland conservation plans, and previous reports about the site. If necessary, re-examine the site early in the growing season to verify the hydrophytic vegetation determination.
(d) If the vegetation on the site is substantially the same as that on a wetland reference site having similar soils, landscape position, and known wetland hydrology, then consider the vegetation to be hydrophytic (see step *5c* in this procedure for more information).
(e) If the hydrophytic status of the vegetation during the normal wet portion of the growing season in a normal rainfall year cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

(2) Prolonged Dry to Drought Conditions (lasting more than one growing season)

(a) Investigate climate records (e.g., WETS tables, drought indices) to determine if the area is under the influence of a drought or prolonged dry conditions (for more information, see the section on Wetlands that Periodically Lack Indicators of Wetland Hydrology later in this chapter). If so, evaluate any off-site data that provide information on the plant community that exists on the site during normal years, including aerial photography, Farm Service Agency annual crop slides, NWI maps, other remote sensing data, soil survey reports, public interviews, NRCS hydrology tools (USDA Natural Resources Conservation Service 1997), and previous site reports. Determine whether the vegetation that is present during normal years is hydrophytic.

(b) If the vegetation on the affected site is substantially the same as that on a wetland reference site in the same general area having similar soils and known wetland hydrology, then consider the vegetation to be hydrophytic (see step *5c* in this procedure).

(c) If the hydrophytic status of the vegetation during the normal wet portion of the growing season in a normal rainfall year cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

(3) Long-Term Fluctuations in Lake Levels. Water levels in lakes and ponds rise and fall depending upon annual precipitation patterns. These changes may induce short- or long-term shifts in fringing vegetation depending upon the duration of the wet or dry conditions. The Great Lakes have experienced significant periodic fluctuations in water levels since the early part of the twentieth century. During years with high lake levels, large areas of coastal vegetation may be inundated and converted to open water. During periods with low lake levels, some fringe wetlands may dry out and their vegetation may shift to non-hydrophytic plant communities. Similar vegetation changes may be observed on a smaller scale around the margins of other lakes and ponds across the North-central and Northeast Region (Tiner 2005). To determine the plant community that is present during normal lake levels, the following approaches are recommended.

(a) Determine whether water levels have been higher or lower than the long-term average by examining current and historical water-level data, such as those available for the Great Lakes from the Corps of Engineers Detroit District (http://www.lre.usace.army.mil/greatlakes/hh/greatlakeswaterlevels/). If water levels have been appreciably higher or lower than average for two or more consecutive years, examine off-site data sources to determine whether the plant community that is present on the site during years with normal lake levels is hydrophytic. Appropriate data sources include early growing-season aerial photography taken during normal years, NWI maps, soil survey reports, other remotely sensed data, interviews with the land owner and other knowledgeable people, state wetland conservation plans, and previous reports about the site.

(b) Examine the existing vegetation on the site, emphasizing long-lived woody and other perennial plant species. Discount annual and other short-lived species that may have become established during the period of unusually high or low lake levels.

(c) If the vegetation on the site is substantially the same as that on a wetland reference site on the same lake having similar soils, landscape position, and known wetland hydrology, then consider the vegetation to be hydrophytic (see step *5c* in this procedure for more information).

(d) If the hydrophytic status of the vegetation during years with normal lake levels cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

b. *Vernal pools*. Vernal pools are small, seasonal water bodies that pond water from the time of snowmelt into early to mid-summer. They are common throughout the glaciated Northcentral and Northeast Region, although most remaining pools are located in forested settings. The pools may be situated within wetlands or non-wetlands. They are characterized by vernal-pool-specific fauna, particularly amphibians and invertebrates that require the pools to complete their life cycles (Colburn 2004). The vegetation in and around these pools is influenced by the seasonal hydrology. During the early part of the growing season, they may lack herbaceous vegetation due to inundation and it may be necessary to base the hydrophytic vegetation decision solely on woody plants. Where woody vegetation is lacking, herbaceous vegetation should be examined later in the growing season. In pools that retain water for very long periods, vegetation may not become well established even during drier periods. During the driest times of the year, or in drought years, some pools become dominated by upland plants, particularly annuals. The following approaches are recommended for evaluating vernal pools where indicators of hydric soil and wetland hydrology are present, but hydrophytic vegetation is not evident at the time of the site visit.

(1) If the pool is filled with water at the time of the visit, emergent vegetation is absent, and a follow-up site visit is practical, then return to the site soon after seasonal draw-down and check for indicators of hydrophytic vegetation.

(2) If the site is visited during the dry season, vegetation in the potential pool area is dominated by upland species (particularly annuals), and a follow-up site visit is practical, then revisit the site during the normal wet portion of the growing season and check again for indicators of hydrophytic vegetation.

(3) If the hydrophytic status of the vegetation during the normal wet portion of the growing season in a normal rainfall year cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

c. *Areas affected by grazing.* Both short- and long-term grazing can cause shifts in dominant species in the vegetation. For instance, trampling by large herbivores can cause soil compaction, altering soil permeability and infiltration rates, and affecting the plant community. Grazers can also influence the abundance of plant species by selectively grazing certain palatable species or avoiding less palatable species. This shift in species composition due to grazing can influence the hydrophytic vegetation determination. Be aware that shifts in both directions, favoring either wetland species or upland species, can occur in these situations. Limited grazing does not necessarily affect the outcome of a hydrophytic vegetation decision. However, the following approaches are recommended in cases where the effects of grazing are so great that the hydrophytic vegetation determination would be unreliable or misleading.

(1) Examine the vegetation on a nearby, ungrazed reference site having similar soils and hydrologic conditions. Ungrazed areas may be present on adjacent properties or in fenced exclosures or streamside management zones. Assume that the same plant community would exist on the grazed site, in the absence of grazing.

(2) If feasible, remove livestock or fence representative livestock exclusion areas to allow the vegetation time to recover from grazing, and reevaluate the vegetation during the next growing season.

(3) If grazing was initiated recently, use offsite data sources such as aerial photography, NWI maps, and interviews with the land owner and other persons familiar with the site or area to determine what plant community was present on the site before grazing began. If the previously ungrazed community was hydrophytic, then consider the current vegetation to be hydrophytic.

(4) If an appropriate ungrazed area cannot be located or if the ungrazed vegetation condition cannot be determined, make the wetland determination based on indicators of hydric soils and wetland hydrology.

d. *Managed plant communities.* Natural plant communities throughout the region have been replaced with agricultural crops or are otherwise managed to meet human goals. Examples include clearing of woody species on grazed pasture land; periodic disking, plowing, or mowing; planting of native and non-native species (including cultivars or planted species that have escaped and become established on other sites); use of herbicides; silvicultural activities; and suppression of wildfires. These actions can result in elimination of certain species and their replacement with other species, changes in abundance of certain plants, and shifts in dominant species, possibly influencing a hydrophytic vegetation determination. The following approaches are recommended if the natural vegetation has been altered through management to such an extent that a hydrophytic vegetation determination is not possible or would be unreliable:

(1) Examine the vegetation on a nearby, unmanaged reference site having similar soils and hydrologic conditions. Assume that the same plant community would exist on the managed site in the

absence of human alteration.

(2) For recently cleared or tilled areas (not planted or seeded), leave representative areas unmanaged for at least one growing season with normal rainfall and reevaluate the vegetation.

(3) If management was initiated recently, use offsite data sources such as aerial photography, NWI maps, and interviews with the land owner and other persons familiar with the area to determine what plant community was present on the site before the management occurred.

(4) If the unmanaged vegetation condition cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

e. *Areas affected by fires, floods, and other natural disturbances.* Fires, floods, and other natural disturbances can dramatically alter the vegetation on a site. Vegetation can be completely or partially removed, or its composition altered, depending upon the intensity of the disturbance. Limited disturbance does not necessarily affect the investigator's ability to determine whether the plant community is or is not hydrophytic. However, if the vegetation on a site has been removed or made unidentifiable by a recent fire, flood, or other disturbance, then one or more of the following approaches may be used to determine whether the vegetation present before the disturbance was hydrophytic. Additional guidance can be found in Part IV, Section F (Atypical Situations) of the Corps Manual.

(1) Examine the vegetation on a nearby, undisturbed reference site having similar soils and hydrologic conditions. Assume that the same plant community would exist on the disturbed site in the absence of disturbance.

(2) Use offsite data sources such as aerial photography, NWI maps, and interviews with knowledgeable people to determine what plant community was present on the site before the disturbance.

(3) If the undisturbed vegetation condition cannot be determined, make the wetland determination based on indicators of hydric soil and wetland hydrology.

f. *Areas dominated exclusively by non-vascular plants*. In areas that lack vascular plants but are dominated by peat mosses (e.g., *Sphagnum* spp.), the vegetation should be considered to be hydrophytic if indicators of hydric soil and wetland hydrology are present, the landscape position is appropriate for wetlands, and hydrology has not been altered.

5. General Approaches to Problematic Hydrophytic Vegetation. The following general procedures are provided to identify hydrophytic vegetation in difficult situations not necessarily associated with specific vegetation types or management practices, including wetlands dominated by FACU, NI, NO, or unlisted species that are functioning as hydrophytes. The following recommended approaches should be applied only where indicators of hydric soil and wetland hydrology are present (or are absent due to disturbance or other problem situations) and the landscape position is appropriate to collect or concentrate water, but indicators of hydrophytic vegetation are not evident.

a. *FACU species that commonly dominate wetlands.* The following FACU species occur in and dominate many wetlands in the Northcentral and Northeast Region and may cause a wetland plant community to fail to meet any of the hydrophytic vegetation indicators described in Chapter 2: eastern hemlock (*Tsuga canadensis*), eastern white pine (*Pinus strobus*), red spruce (*Picea rubens*), pitch pine (*Pinus rigida*), Virginia creeper (*Parthenocissus quinquefolia*), springbeauty (*Claytonia virginica*), and the following non-native species: common buckthorn (*Rhamnus cathartica*), multiflora rose (*Rosa multiflora*), tartarian honeysuckle (*Lonicera tatarica*), and Morrow's honeysuckle (*L. morrowii*) (indicator statuses may vary by plant list region). If the potential wetland area lacks hydrophytic vegetation indicators due to the presence of one or more of the FACU species listed above, use the following procedure to make the hydrophytic vegetation determination:

(1) At each sampling point in the potential wetland, drop any FACU species listed above from the vegetation data, and compile the species list and coverage data for the remaining species in the community.

(2) Reevaluate the remaining vegetation using hydrophytic vegetation indicators 2 (Dominance Test) and/or 3 (Prevalence Index). If either indicator is met, then the vegetation is hydrophytic.

b. *Direct hydrologic observations.* Verify that the plant community occurs in an area subject to prolonged inundation or soil saturation during the growing season. This can be done by visiting the site at 2- to 3-day intervals during the portion of the growing season when surface water is most likely to be present or water tables are normally high. Hydrophytic vegetation is considered to be present, and the site is a wetland, if surface water is present and/or the water table is 12 in. (30 cm) or less from the surface for 14 or more consecutive days during the growing season during a period when antecedent precipitation has been normal or drier than normal. If necessary, microtopographic highs and lows should be evaluated separately. The normality of the current year's rainfall must be considered in interpreting field results, as well as the likelihood that wet conditions will occur on the site at least every other year (for more information, see the section on "Wetlands that Periodically Lack Indicators of Wetland Hydrology" in this chapter).

c. *Reference sites with known hydrology.* If indicators of hydric soil and wetland hydrology are present, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas whose hydrology is known. Hydrologic characteristics of wetland reference areas should be documented through long-term monitoring or by application of the procedure described in item *5b* above. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the district or field office.

d. *Technical literature.* Published and unpublished scientific literature may be used to support a decision to treat specific FACU species or species with no assigned indicator status (e.g., NI, NO, or unlisted) as hydrophytes or certain plant communities as hydrophytic. Preferably, this literature should discuss the species' natural distribution along the moisture gradient, its capabilities and adaptations for life in wetlands, wetland types in which it is typically found, or other wetland species with which it is commonly associated.

Problematic hydric soils

Description of the problem

Soils with faint or no indicators

Some soils that meet the hydric soil definition may not exhibit any of the indicators presented in Chapter 3. These problematic hydric soils exist for a number of reasons and their proper identification requires additional information, such as landscape position, presence or absence of restrictive soil layers, or information about hydrology. This section describes several soil situations in the Northcentral and Northeast Region that are considered to be hydric if additional requirements are met. In some cases, these hydric soils may appear to be non-hydric due to the color of the parent material from which the soils developed. In others, the lack of hydric soil indicators is due to conditions (e.g., red parent materials) that inhibit the development of redoximorphic features despite prolonged soil saturation and anoxia. In addition, recently developed wetlands may lack hydric soil indicators because insufficient time has passed for their development. Examples of problematic hydric soils in the region include, but are not limited to, the following.

1. **Sandy Soils.** The development of hydric soil indicators can be inhibited in some sandy soils due to low iron or manganese content and/or low organic-matter content. To help identify the hydric soil boundary, examine soils in obvious wetland and non-wetland locations to determine what features to look for in soil profiles near the boundary. Use caution in areas where soil disturbances, such as plowing, may have brought red or black soil material from below to create what appear to be redoximorphic features near the surface.
2. **Red Parent Materials.** Soils derived from red parent materials are a challenge for hydric soil identification because the red, iron-rich materials contain minerals that are resistant to weathering and chemical reduction under anaerobic conditions. This inhibits the formation of redoximorphic features and typical hydric soil morphology. These soils are found in scattered locations throughout the region in areas of Mesozoic geologic materials or alluvium derived from these formations, including the Great Lakes region and river valleys in Connecticut and Massachusetts. A transect sampling approach can be helpful in making a hydric soil determination in soils derived from red parent materials. This involves describing the soil profile in an obvious non-wetland location and an

obvious wetland location to identify particular soil features that are related to the wetness gradient. Relevant features may include a change in soil matrix chroma (e.g., from 4 to 3) or the presence of redox depletions or reddish-black manganese concentrations. Hydric soil indicators F8 (Redox Depressions), F12 (Iron-Manganese Masses), and F21 (Red Parent Material) may be useful in identifying hydric soils in areas with red parent materials.

3. **Dark Parent Materials.** These soils formed in dark-colored (gray and black) parent materials derived from carboniferous and phyllitic bedrock. They occur in the Narragansett Basin of Rhode Island, parts of south-eastern and western Massachusetts, throughout Vermont, and in extreme western New Hampshire. The inherited soil colors commonly are low chroma and low value, making it difficult to assess soil wetness using conventional morphological indicators. Low-chroma colors, depleted matrices, and redox depletions typically are masked by the dark mineralogy. Some features may be observable under magnification (Stolt et al. 2001).
4. **Fluvial Deposits within Floodplains.** These soils commonly occur on vegetated bars within the active channel and above the bankfull level of rivers and streams. In some cases, these soils lack hydric soil indicators due to seasonal or annual deposition of new soil material, low iron or manganese content, and/or low organic-matter content. Redox concentrations can sometimes be found between soil stratifications in areas where organic matter gets buried, such as along the fringes of floodplains.
5. **Recently Developed Wetlands.** Recently developed wetlands include mitigation sites, wetland management areas (e.g., for waterfowl), other wetlands intentionally or unintentionally produced by human activities, and naturally occurring wetlands that have not been in place long enough to develop hydric soil indicators.
6. **Seasonally Ponded Soils.** Seasonally ponded, depressional wetlands occur throughout the region. Many are perched systems with water ponding above a restrictive soil layer, such as a hardpan or clay layer that is at or near the surface. Ponded depressions also occur in floodplains where receding floodwaters, precipitation, and local runoff are held above a slowly permeable soil layer. Some of these wetlands lack hydric soil indicators due to the limited saturation depth.
7. **Wet Soils with High-Chroma Subsoils.** Several problematic soil situations occur in the region that result in the formation and persistence of high-chroma, wet soils. For example, in the oak openings region of Ohio, Indiana, and Michigan, along the interface between LRRs L and M,

some wetlands lack hydric soil indicators due to high-chroma subsoils (often a chroma of 4 or more) beneath a surface layer that may or may not exhibit hydric soil indicators. These soils formed in sandy beach deposits that originated along ancient lake shores during the Pleistocene period. Surface soil textures are often fine sands, fine sandy loams, and loamy fine sands. Underlying dense glacial till slows the infiltration of snowmelt and spring rainfall, causing water to perch for long periods within the sandy deposits above. Wind erosion in the oak openings can also transport soil material and bury natural soil horizons.

In addition, along the shorelines of the Great Lakes within LRRs L and K, some wetlands lack hydric soil indicators due to the presence of high-chroma sands (often a chroma of 3 or more). These high-chroma, sandy soils occur at the landward edge of coastal marshes, in interdunal wetlands, and in dune-and-swale complexes. They do not meet a hydric soil indicator due to matrix chromas greater than 2. These soils often exhibit redox concentrations as pore linings and/or soft masses within 12 in. (30 cm) of the surface. In adjacent upland areas, redox concentrations are absent or are only observed at depth. It may be helpful to involve a soil scientist or wetland scientist familiar with these problem soils.

8. **Discharge Areas for Iron-Enriched Groundwater.** Discharge of iron-enriched groundwater occurs in many locations throughout the region. The seasonal input of iron from the groundwater produces soil chromas generally greater than 3 and as high as 6 below the surface layer(s). These soils are usually found in seepage areas in glacial till, such as in areas with converging slopes or near-surface stratigraphic discontinuities. They can also occur on foot or toe slopes associated with sandy parent materials. Investigators should look for redox concentrations and depletions in the layer with high chroma and a depleted matrix below the layer of iron concentration. Wetland hydrology indicator B5 (Iron Deposits) can help to identify the presence of this problem soil (Figure 63).

Soils with relict hydric soil indicators

Some soils in the region exhibit redoximorphic features and hydric soil indicators that formed in the recent or distant past when conditions may have been wetter than they are today. These features have persisted even though wetland hydrology may no longer be present. Examples include soils associated with abandoned river courses and areas adjacent to deeply incised stream channels. In addition, wetlands drained for agricultural

Figure 63. Red areas in this photograph are iron deposits on the soil surface that are a result of high iron concentrations in the groundwater.

purposes starting in the 1800s may contain persistent hydric soil features. Wetland soils drained during historic times are still considered to be hydric but may lack the hydrology to support wetlands. Relict hydric soil features may be difficult to distinguish from contemporary features. However, if indicators of hydrophytic vegetation and wetland hydrology are present, then hydric soil indicators can be assumed to be contemporary.

Non-hydric soils that may be misinterpreted as hydric

In well-drained and aerated soils, iron translocation is also a normal process. Infiltrating water from precipitation or snowmelt moves downward through the soil profile and, together with organic acids derived from the litter layer, leaches or washes iron from the mineral layers near the surface. The iron moves downward in solution and accumulates in lower layers. As the near-surface layers are continually leached, their colors become similar to those of redox depletions. The accumulation of iron in the lower horizons may result in colors similar to redox concentrations. This coloration is most pronounced in Spodosols.

Spodosols are a common soil order in the Northcentral and Northeast Region. They form in relatively acidic soil materials and can be either hydric or non-hydric. In Spodosols, organic carbon, iron, and aluminum are leached from a layer near the soil surface. This layer, known as the E horizon, has a bleached light-gray appearance and consists of relatively clean particles of sand and silt. The materials leached from the E horizon are deposited lower in the soil in the spodic horizon (e.g., Bhs or Bs horizon). If sufficient iron has been leached and redeposited, the spodic horizon will have a strong reddish color. In some Spodosols, E-horizon and spodic-horizon colors can be confused with the redox depletions and concentrations produced under anaerobic soil conditions. Normally, E horizons and spodic horizons are present in the soil in relatively continuous horizontal bands. Chemical weathering in an aerated soil is accomplished by the downward movement of water; therefore, the layers or horizons are relatively parallel to the soil surface and consistent across the soil. Transitions are relatively abrupt between the organic-enriched surface, the leached E horizon, and the iron-enriched B horizon. Below the B horizon, the transition becomes more gradual as the red hue of the iron-enriched B horizon gradually changes to the yellower hue of the underlying C horizon. However, if E horizons are thin or there are extensive plant roots, they may be discontinuous. Tree throw can also mix and break the horizons of aerated upland soils, so care should be taken to examine all site characteristics before concluding that a soil is hydric.

Generally, non-hydric Spodosols occur in the more mountainous portions of the region where temperatures are cooler. They tend to have thin, white-colored E horizons and spodic horizons that are less than 1 in. (2.5 cm) thick and not cemented. Hydric Spodosols are generally sandy in texture, have thicker gray-colored E horizons, and cemented spodic horizons (ortstein) that are greater than 1 in. (2.5 cm) thick.

Procedure

Soils that are thought to meet the definition of a hydric soil but do not exhibit any of the indicators described in Chapter 3 can be identified by the following recommended procedure. This procedure should be used only where indicators of hydrophytic vegetation and wetland hydrology are present (or are absent due to disturbance or other problem situations), but indicators of hydric soil are not evident.

1. Verify that one or more indicators of hydrophytic vegetation are present or that vegetation is problematic or has been altered (e.g., by tillage or other land alteration). If so, proceed to step 2.

2. Verify that at least one primary or two secondary indicators of wetland hydrology are present or that indicators are absent due to disturbance or other factors. If so, proceed to step 3. If indicators of hydrophytic vegetation and/or wetland hydrology are absent, then the area is probably non-wetland and no further analysis is required.
3. Thoroughly describe and document the soil profile and landscape setting. Verify that the area is in a landscape position that is likely to collect or concentrate water. If the landscape setting is appropriate, proceed to step 4. Appropriate settings include the following.

   a. Concave surface (e.g., depression or swale)
   b. Active floodplain or low terrace
   c. Level or nearly level area (e.g., 0- to 3-percent slope)
   d. Toe slope (Figure 6) or an area of convergent slopes (Figure 5)
   e. Fringe of another wetland or water body
   f. Area with a restrictive soil layer or aquitard within 24 in. (60 cm) of the surface
   g. Area where groundwater discharges (e.g., a seep)
   h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

4. Use one or more of the following approaches to determine whether the soil is hydric. In the remarks section of the data form or in the delineation report, explain why it is believed that the soil lacks any of the NTCHS hydric soil indicators described in Chapter 3 and why it is believed that the soil meets the definition of a hydric soil.

   a. Determine whether one or more of the following indicators of problematic hydric soils is present. See the descriptions of each indicator given in Chapter 3. If one or more indicators are present, then the soil is hydric.

      (1) 2 cm Muck (A10) (applicable to LRR K, L, and MLRA 149B of LRR S)
      (2) Coast Prairie Redox (A16) (applicable to LRR K, L, and R)
      (3) 5 cm Mucky Peat or Peat (S3) (applicable to LRR K, L, and R)
      (4) Dark Surface (S7) (applicable to LRR K, L, and M)
      (5) Polyvalue Below Surface (S8) (applicable to LRR K and L)
      (6) Thin Dark Surface (S9) (applicable to LRR K and L)
      (7) Iron-Manganese Masses (F12) (applicable to LRR K, L, and R)

(8) Piedmont Floodplain Soils (F19) (applicable to MLRA 149B of LRR S)
(9) Mesic Spodic (TA6) (applicable to MLRAs 144A and 145 of LRR R and MLRA 149B of LRR S)
(10) Red Parent Material (F21) (applicable throughout the Northcentral and Northeast Region in areas containing soils derived from red parent materials)
(11) Very Shallow Dark Surface (TF12) (applicable throughout the Northcentral and Northeast Region)

b. Determine whether one or more of the following problematic soil situations is present. If present, consider the soil to be hydric.

(1) Sandy Soils
(2) Red Parent Materials
(3) Dark Parent Materials
(4) Fluvial Deposits within Floodplains
(5) Recently Developed Wetlands
(6) Seasonally Ponded Soils
(7) Wet Soils with High-Chroma Subsoils
(8) Discharge Areas for Iron-Enriched Groundwater
(9) Other (in field notes, describe the problematic soil situation and explain why it is believed that the soil meets the hydric soil definition)

c. Soils that have been saturated for long periods and have become chemically reduced may change color when exposed to air due to the rapid oxidation of ferrous iron (Fe^{2+}) to Fe^{3+} (i.e., a reduced matrix) (Figures 64 and 65). If the soil contains sufficient iron, this can result in an observable color change, especially in hue or chroma. The soil is hydric if a mineral layer 4 in. (10 cm) or more thick starting within 12 in. (30 cm) of the soil surface that has a matrix value of 4 or more and chroma of 2 or less becomes redder by one or more pages in hue and/or increases one or more in chroma when exposed to air within 30 minutes (Vepraskas 1992).

Care must be taken to obtain an accurate color of the soil sample immediately upon excavation. The colors should be observed closely and examined again after several minutes. Do not allow the sample to become dry. Dry soils will usually have a different color than wet or moist soils. As always, do not attempt to determine colors while wearing sunglasses or tinted lenses. Colors must be determined in the field under natural light and not under artificial light.

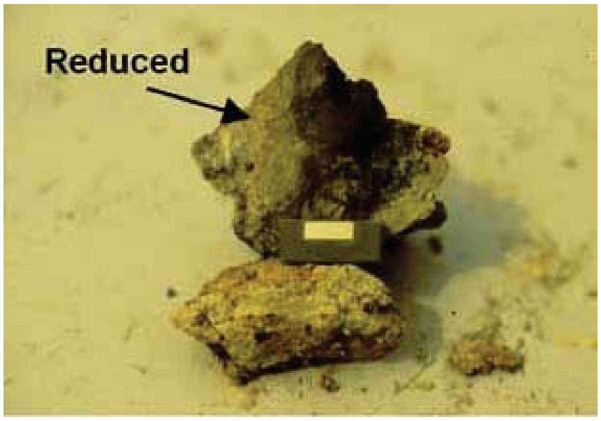


Figure 64. This soil exhibits colors associated with reducing conditions. Scale is 1 cm.

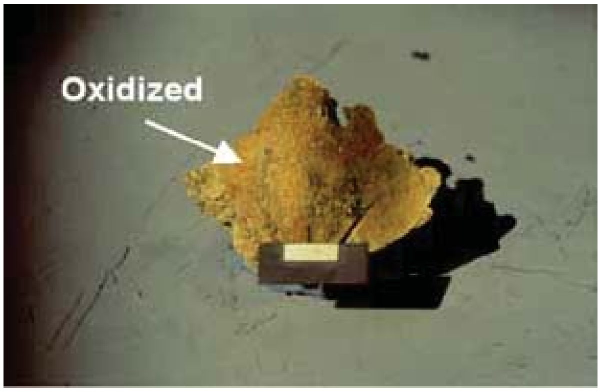


Figure 65. The same soil as in Figure 63 after exposure to the air and oxidation has occurred.

d. If the soil is saturated at the time of sampling, alpha, alpha-dipyridyl reagent can be used in the following procedure to determine if reduced (ferrous) iron is present. If ferrous iron is present as described below, then the soil is hydric.

Alpha, alpha-dipyridyl is a reagent that reacts with reduced iron. In some cases, it can be used to provide evidence that a soil is hydric when it lacks other hydric soil indicators. The soil is likely to be hydric if application of alpha, alpha-dipyridyl to mineral soil material in at least 60 percent of a layer at least 4 in. (10 cm) thick within a depth of 12 in. (30 cm) of the soil surface results in a positive reaction within 30 seconds evidenced by a pink or red coloration to the reagent during the growing season.

Using a dropper, apply a small amount of reagent to a freshly broken ped face to avoid any chance of a false positive test due to iron contamination from digging tools. Look closely at the treated soil for evidence of color change. If in doubt, apply the reagent to a sample of known upland soil and compare the reaction to the sample of interest. A positive reaction will not occur in soils that lack iron and may not occur in soils with high pH. The lack of a positive reaction to the reagent does not preclude the presence of a hydric soil. Specific information about the use of alpha, alpha-dipyridyl can be found in NRCS Hydric Soils Technical Note 8 (http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html).

e. Using gauge data, water-table monitoring data, or repeated direct hydrologic observations, determine whether the soil is ponded or flooded, or the water table is 12 in. (30 cm) or less from the surface, for 14 or more consecutive days during the growing season in most years (at least 5 years in 10, or 50 percent or higher probability) (U.S. Army Corps of Engineers 2005). If so, then the soil is hydric. Furthermore, any soil that meets the NTCHS hydric soil technical standard (NRCS Hydric Soils Technical Note 11, http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html) is hydric.

Wetlands that periodically lack indicators of wetland hydrology

Description of the problem

Wetlands are areas that are flooded or ponded, or have soils that are saturated with water, for long periods during the growing season in most years. If the site is visited during a time of normal precipitation amounts and it is inundated or the water table is near the surface, then the wetland hydrology determination is straight forward. During the dry season, however, surface water recedes from wetland margins, water tables drop, and many wetlands dry out completely. Superimposed on this seasonal cycle is a long-term pattern of multi-year droughts alternating with years of higher-than-average rainfall. Wetlands in general are inundated or saturated at least 5 years in 10 (50 percent or higher probability) over a long-term record. However, some wetlands in the Northcentral and Northeast Region do not become inundated or saturated in some years and, during drought cycles or prolonged dry conditions, may not inundate or saturate for several years in a row.

Wetland hydrology determinations are based on indicators, many of which were designed to be used during dry periods when the direct observation of surface water or a shallow water table is not possible. However, some wetlands may lack any of the listed hydrology indicators, particularly during the dry season or in a dry year. Examples in the region include vernal pools and potholes, floodplain wetlands, flatwoods, interdunal swales, wet prairies, sedge meadows, and other wet meadows. The evaluation of wetland hydrology requires special care on any site where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators appear to be absent. Among other factors, this evaluation should consider the timing of the site visit in relation to normal seasonal and annual hydrologic variability, and whether the amount of rainfall prior to the site visit has been normal. This section describes a number of approaches that can be used to determine whether wetland hydrology is present on sites where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators may be lacking due to normal variations in rainfall or runoff, human activities that destroy hydrology indicators, and other factors.

Procedure

1. Verify that indicators of hydrophytic vegetation and hydric soil are present, or are absent due to disturbance or other problem situations. If so, proceed to step 2.
2. Verify that the site is in a landscape position that is likely to collect or concentrate water. If the landscape setting is appropriate, proceed to step 3. Appropriate settings are listed below.

   a. Concave surface (e.g., depression or swale)
   b. Active floodplain or low terrace
   c. Level or nearly level area (e.g., 0- to 3-percent slope)
   d. Toe slope (Figure 6) or an area of convergent slopes (Figure 5)
   e. Fringe of another wetland or water body
   f. Area with a restrictive soil layer or aquitard within 24 in. (60 cm) of the surface
   g. Area where groundwater discharges (e.g., a seep)
   h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

3. Use one or more of the following approaches to determine whether wetland hydrology is present and the site is a wetland. In the remarks section

of the data form or in the delineation report, explain the rationale for concluding that wetland hydrology is present even though indicators of wetland hydrology described in Chapter 4 were not observed.

a. *Site visits during the dry season*. Determine whether the site visit occurred during the normal annual "dry season." The dry season, as used in this supplement, is the period of the year when soil moisture is normally being depleted and water tables are falling to low levels in response to decreased precipitation and/or increased evapotranspiration, usually during late spring and summer. It also includes the beginning of the recovery period in late summer or fall. The Web-Based Water-Budget Interactive Modeling Program (WebWIMP) is one source for approximate dates of wet and dry seasons for any terrestrial location based on average monthly precipitation and estimated evapotranspiration (http://climate.geog.udel.edu/~wimp/). In general, the dry season in a typical year is indicated when potential evapotranspiration exceeds precipitation (indicated by negative values of DIFF in the WebWIMP output), resulting in drawdown of soil moisture storage (negative values of DST) and/or a moisture deficit (positive values of DEF, also called the unmet atmospheric demand for moisture). Actual dates for the dry season vary by locale and year.

   In many wetlands, direct observation of flooding, ponding, or a shallow water table would be unexpected during the dry season. Wetland hydrology indicators, if present, would most likely be limited to indirect evidence, such as water marks, drift deposits, or surface cracks. In some situations, hydrology indicators may be absent during the dry season. If the site visit occurred during the dry season on a site that contains hydric soils and hydrophytic vegetation and no significant hydrologic manipulation (e.g., no dams, levees, water diversions, land grading, etc., and the site is not within the zone of influence of any ditches or subsurface drains), then consider the site to be a wetland. If necessary, revisit the site during the normal wet season and check again for the presence or absence of wetland hydrology indicators, or use one or more of the following evaluation methods.

b. *Periods with below-normal rainfall*. Determine whether the amount of rainfall that occurred in the 2 to 3 months preceding the site visit was normal, above normal, or below normal based on the normal range reported in WETS tables. WETS tables are provided by the

NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) and are calculated from long-term (30-year) weather records gathered at National Weather Service meteorological stations. To determine whether precipitation was normal prior to the site visit, actual rainfall in the current month and previous 2 to 3 months should be compared with the normal ranges for each month given in the WETS table (USDA Natural Resources Conservation Service 1997, Sprecher and Warne 2000). The lower and upper limits of the normal range are indicated by the columns labeled "30% chance will have less than" and "30% chance will have more than" in the WETS table. The USDA Natural Resources Conservation Service (1997, Section 650.1903) also gives a procedure that can be used to weight the information from each month and determine whether the entire period was normal, wet, or dry.

When precipitation has been below normal, wetlands may not flood, pond, or develop shallow water tables even during the typical wet portion of the growing season and may not exhibit other indicators of wetland hydrology. Therefore, if precipitation was below normal prior to the site visit, and the site contains hydric soils and hydrophytic vegetation and no significant hydrologic manipulation (e.g., no dams, levees, water diversions, land grading, etc., and the site is not within the zone of influence of any ditches or subsurface drains), then consider the site to be a wetland. If necessary, revisit the site during a period of normal rainfall and check again for hydrology indicators, or use one or more of the other evaluation methods described in this section.

c. *Drought years*. Determine whether the area has been subject to drought. Drought periods can be identified by comparing annual rainfall totals with the normal range of annual rainfall given in WETS tables or by examining trends in drought indices, such as the Palmer Drought Severity Index (PDSI) (Sprecher and Warne 2000). PDSI takes into account not only precipitation but also temperature, which affects evapotranspiration, and soil moisture conditions. The index is usually calculated on a monthly basis for major climatic divisions within each state. Therefore, the information is not site-specific. PDSI ranges potentially between –6 and +6 with negative values indicating dry periods and positive values indicating wet periods. An index of -1.0 indicates mild drought, –2.0 indicates moderate drought, -3.0 indicates severe drought, and –4.0 indicates extreme drought.

Time-series plots of PDSI values by month or year are available from the National Climatic Data Center at (http://www.ncdc.noaa.gov/oa/climate/onlineprod/drought/xmgr.html#ds). If wetland hydrology indicators appear to be absent on a site that has hydrophytic vegetation and hydric soils, no significant hydrologic manipulation (e.g., no dams, levees, water diversions, land grading, etc., and the site is not within the zone of influence of any ditches or subsurface drains), and the region has been affected by drought, then consider the site to be a wetland. If necessary, revisit the site during a normal rainfall year and check again for wetland hydrology indicators, or use one or more of the other methods described in this section.

d. *Reference sites*. If indicators of hydric soil and hydrophytic vegetation are present on a site that lacks wetland hydrology indicators, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas with known hydrology. Hydrology of wetland reference areas should be documented through long-term monitoring (see item *g* below) or by application of the procedure described in item *5b* on page 132 (Direct Hydrologic Observations) of the procedure for Problematic Hydrophytic Vegetation in this chapter. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the District or field office.

e. *Hydrology tools*. The "Hydrology Tools" (USDA Natural Resources Conservation Service 1997) is a collection of methods that can be used to determine whether wetland hydrology is present on a potential wetland site that lacks indicators due to disturbance or other reasons, particularly on lands used for agriculture. Generally they require additional information, such as aerial photographs or stream-gauge data, or involve hydrologic modeling and approximation techniques. These methods are not intended to overrule an indicator-based wetland determination on a site that is not disturbed or problematic. A hydrologist may be needed to help select and carry out the proper analysis. The seven hydrology tools are used to:

(1) Analyze stream and lake gauge data

(2) Estimate runoff volumes and determine duration and frequency of ponding in depressional areas, based on precipitation and temperature data, soil characteristics, land cover, and other inputs
(3) Evaluate the frequency of wetness signatures on repeated aerial photography (see item *f* below for additional information)
(4) Model water-table fluctuations in fields with parallel drainage systems using the DRAINMOD model
(5) Estimate the "scope and effect" of ditches or subsurface drain lines
(6) Use NRCS state drainage guides to estimate the effectiveness of agricultural drainage systems
(7) Analyze data from groundwater monitoring wells (see item *g* below for additional information)

f. *Evaluating multiple years of aerial photography*. Each year, the Farm Service Agency (FSA) takes low-level aerial photographs in agricultural areas to monitor the acreages planted in various crops for USDA programs. NRCS has developed an off-site procedure that uses these photos, or repeated aerial photography from other sources, to make wetland hydrology determinations (USDA Natural Resources Conservation Service 1997, Section 650.1903). The method is intended for use on agricultural lands where human activity has altered or destroyed other wetland indicators. However, the same approach may be useful in other environments.

The procedure uses five or more years of growing-season photography and evaluates each photo for wetness signatures that are listed in "wetland mapping conventions" developed by NRCS state offices. Wetland mapping conventions can be found in the electronic Field Office Technical Guide (eFOTG) for each state (http://www.nrcs.usda.gov/technical/efotg/). From the national web site, choose the appropriate state, then select any county (the state's wetland mapping conventions are the same in every county). Wetland mapping conventions are listed among the references in Section I of the eFOTG. However, not all states have wetland mapping conventions.

Wetness signatures for a particular state may include surface water, saturated soils, flooded or drowned-out crops, stressed crops due to wetness, differences in vegetation patterns due to different planting dates, inclusion of wet areas into set-aside programs, unharvested crops, isolated areas that are not farmed with the rest of the field, patches of greener vegetation during dry periods, and other evidence of wet conditions (see Part 513.30 of USDA Natural Resources Conservation Service 1994). For each photo, the procedure described in item *b* above is used to determine whether the amount of rainfall in the 2 to 3 months prior to the date of the photo was normal, below normal, or above normal. Only photos taken in normal rainfall years, or an equal number of wetter-than-normal and drier-than-normal years, are used in the analysis. If wetness signatures are observed on photos in more than half of the years included in the analysis, then wetland hydrology is present. Data forms that may be used to document the wetland hydrology determination are given in section 650.1903 of USDA Natural Resources Conservation Service (1997).

g. *Long-term hydrologic monitoring.* On sites where the hydrology has been manipulated by man (e.g., with ditches, subsurface drains, dams, levees, water diversions, land grading) or where natural events (e.g., downcutting of streams) have altered conditions such that hydrology indicators may be missing or misleading, direct monitoring of surface and groundwater may be needed to determine the presence or absence of wetland hydrology. The U. S. Army Corps of Engineers (2005) provides minimum standards for the design, construction, and installation of water-table monitoring wells, and for the collection and interpretation of groundwater monitoring data, in cases where direct hydrologic measurements are needed to determine whether wetlands are present on highly disturbed or problematic sites. This standard calls for 14 or more consecutive days of flooding, ponding, or a water table 12 in. (30 cm) or less below the soil surface during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability), unless a different standard has been established for a particular geographic area or wetland type. A disturbed or problematic site that meets this standard has wetland hydrology. This standard is not intended (1) to overrule an indicator-based wetland determination on a site that is not disturbed or problematic, or (2) to test or validate existing or proposed wetland indicators.

Wetland/non-wetland mosaics

Description of the problem

In this supplement, “mosaic” refers to a landscape where wetland and non-wetland components are too closely associated to be easily delineated or mapped separately. These areas often have complex microtopography, with repeated small changes in elevation occurring over short distances. Tops of ridges and hummocks are often non-wetland but are interspersed throughout a wetland matrix having clearly hydrophytic vegetation, hydric soils, and wetland hydrology. Potential examples of wetland/non-wetland mosaics in the Northcentral and Northeast Region include ridge-and-swale topography on floodplains; dune-and-swale systems near the Great Lakes and Atlantic coast; current and former flatwoods, such as those on the Lake Superior clay plain in northeastern Minnesota and northern Wisconsin; areas that exhibit bedding from agricultural or silvicultural operations; areas containing numerous vernal pools; and areas where wind-thrown trees have created pit-and-mound or cradle/knoll topography.

Wetland components of a mosaic are often not difficult to identify. The problem for the wetland delineator is that microtopographic features are too small and intermingled, and there are too many such features per acre, to delineate and map them accurately. Instead, the following sampling approach can be used to estimate the percentage of wetland in the mosaic. From this, the number of acres of wetland on the site can be calculated, if needed.

Procedure

First, identify and flag all contiguous areas of either wetland or non-wetland on the site that are large enough to be delineated and mapped separately. The remaining area should be mapped as "wetland/non-wetland mosaic" and the approximate percentage of wetland within the area determined by the following procedure.

1. Establish one or more continuous line transects across the mosaic area, as needed. Measure the total length of each transect. A convenient method is to stretch a measuring tape along the transect and leave it in place while sampling. If the site is shaped appropriately and multiple transects are used, they should be arranged in parallel with each transect starting from a random point along one edge of the site. However, other arrangements of transects may be needed for oddly shaped sites.
2. Use separate data forms for the swales or troughs and for the ridges or hummocks. Sampling of vegetation, soil, and hydrology should follow the general procedures described in the Corps Manual and this supplement. Plot sizes and shapes for vegetation sampling must be adjusted to fit the microtopographic features on the site. Plots intended to sample the

troughs should not overlap adjacent hummocks, and vice versa. Only one or two data forms are required for each microtopographic position, and do not need to be repeated for similar features or plant communities.

3. Identify every wetland boundary in every trough or swale encountered along each transect. Each boundary location may be marked with a pin flag or simply recorded as a distance along the stretched tape.
4. Determine the total distance along each transect that is occupied by wetlands and non-wetlands until the entire length of the line has been accounted for. Sum these distances across transects, if needed. Determine the percentage of wetland in the wetland/non-wetland mosaic by the following formula.

$$\%\ wetland = \frac{Total\ wetland\ distance\ along\ all\ transects}{Total\ length\ of\ all\ transects} \times 100$$

An alternative approach involves point-intercept sampling at fixed intervals along transects across the area designated as wetland/non-wetland mosaic. This method avoids the need to identify wetland boundaries in each swale, and can be carried out by pacing rather than stretching a measuring tape across the site. The investigator uses a compass or other means to follow the selected transect line. At a fixed number of paces (e.g., every two steps) the wetland status of that point is determined by observing indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. Again, a completed data form is not required at every point but at least one representative swale and hummock should be documented with completed forms. After all transects have been sampled, the result is a number of wetland sampling points and a number of non-wetland points. Estimate the percentage of wetland in the wetland/non-wetland mosaic by the following formula:

$$\%\ wetland = \frac{Number\ of\ wetland\ points\ along\ all\ transects}{Total\ number\ of\ points\ sampled\ along\ all\ transects} \times 100$$

If high-quality aerial photography is available for the site, a third approach to estimating the percentage of wetland in a wetland/non-wetland mosaic is to use a dot grid, planimeter, or geographic information system (GIS) to determine the percentage of ridges (non-wetlands) and swales (wetlands) through photo interpretation of topography and vegetation patterns. This technique requires onsite verification that most ridges qualify as non-wetlands and most swales qualify as wetlands.

References

Bailey, R. G. 1995. *Description of the ecoregions of the United States, second edition*. Miscellaneous Publication 1391 (revised). Washington, DC: U.S. Department of Agriculture, Forest Service. (http://www.fs.fed.us/land/ecosysmgmt/ecoreg1_home.html)

Barbour, M. G., and W. D. Billings, eds. 1988. *North American terrestrial vegetation*. New York, NY: Cambridge University Press.

Barbour, M. G., J. H. Burk, W. D. Pitts, F. S. Gilliam, and M. W. Schwartz. 1999. *Terrestrial plant ecology, 3rd edition*. Toronto, Canada: Addison Wesley.

Barkley, T. M., ed. 1986. *Flora of the Great Plains*. Lawrence, KS: University Press of Kansas.

Braun, E. L. 1950. *Deciduous forests of eastern North America.* Philadelphia, PA: Blakiston.

Brohman, R. J., and L. D. Bryant, eds. 2005. *Existing vegetation classification and mapping technical guide, version 1.0.* General Technical Report WO-67. Washington, DC: U.S. Department of Agriculture, Forest Service.

Carr, D. W., D. A. Leeper, and T. F. Rochow. 2006. Comparison of six biologic indicators of hydrology and the landward extent of hydric soils in west-central Florida, USA, cypress domes. *Wetlands* 26:1012–1019.

Colburn, E. A. 2004. *Vernal pools: Natural history and conservation.* Blacksburg, VA: McDonald and Woodward.

Cox, G. 1990. *Laboratory manual of general ecology, sixth edition*. Dubuque, IA: William C. Brown.

Curtis, J. 1971. *The vegetation of Wisconsin*. Madison, WI: University of Wisconsin Press.

Davis, M. B. 1981. Quaternary history and the stability of forest communities. In *Forest succession: Concepts and application,* ed. D. C. West, H. H. Shugart, and D. B. Botkin, 132–153. New York, NY: Springer-Verlag.

Eggers, S., and D. Reed. 1997. *Wetland plants and plant communities of Minnesota and Wisconsin.* St. Paul, MN: St. Paul District, U.S. Army Corps of Engineers.

Embleton, C., and C. A. M. King. 1968. *Glacial and periglacial geomorphology*. New York, NY: St. Martin's Press.

Environmental Laboratory. 1987. *Corps of Engineers wetlands delineation manual*. Technical Report Y-87-1. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station. (http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf)

Foster, D. R., and G. A. King. 1984. Landscape features, vegetation and developmental history of a patterned fen in south-eastern Labrador, Canada. *Journal of Ecology* 72: 115-143.

Frankenberger, J., E. Kladivko, G. Sands, D. Jaynes, N. Fausey, M. Helmers, R. Cooke, J. Strock, K. Nelson, and L. Brown. 2006. *Questions and answers about drainage water management for the Midwest*. Report WQ-44. West Lafayette, IN: Purdue University Cooperative Extension Service. (http://www.ces.purdue.edu/extmedia/WQ/WQ-44.pdf)

Freeze, R. A. and J. A. Cherry. 1979. *Groundwater*. Englewood Cliffs, NJ: Prentice-Hall.

Gretag/Macbeth. 2000. *Munsell® color*. New Windsor, NY.

Johnson, C. 1985. *Bogs of the Northeast*. Hanover, NH: University Press of New England.

Kent, M., and P. Coker. 1992. Vegetation description and analysis: A practical approach. New York, NY: Wiley.

Maine Geological Survey. 2005. *Surficial geologic history of Maine*. Augusta, ME. http://maine.gov/doc/nrimc/mgs/explore/surficial/facts/surficial.htm; accessed 9 May 2008.

Martini, I. P., M. E. Brookfield, and S. Sadura. 2001. *Principles of glacial geomorphology and geology*. Upper Saddle River, NJ: Prentice-Hall.

Megonigal, J. P., S. P. Faulkner, and W. H. Patrick. 1996. The microbial activity season in southeastern hydric soils. *Soil Science Society of America Journal* 60:1263–1266.

Metzler, K., and R. W. Tiner. 1992. *Wetlands of Connecticut*. Report of Investigations No. 13. Hartford, CT: State Geological and Natural History Survey of Connecticut, Department of Environmental Protection.

Minnesota Department of Natural Resources. 2003. *Field guide to the native plant communities of Minnesota: The Laurentian mixed forest province*. St. Paul, MN: Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program.

Mueller-Dombois, D., and H. Ellenberg. 1974. *Aims and methods of vegetation ecology*. New York, NY: Wiley.

National Research Council. 1995. *Wetlands: Characteristics and boundaries*. Washington, DC: National Academy Press.

Rabenhorst, M.C. and S. Parikh. 2000. Propensity of soils to develop redoximorphic color changes. *Soil Science Society of America Journal* 64:1904-1910.

Reed, P. B., Jr. 1988. *National list of plant species that occur in wetlands: 1988 national summary*. Biological Report 88(24). Washington, DC: U.S. Fish and Wildlife Service. (http://www.usace.army.mil/CECW/Documents/cecwo/reg/plants/list88.pdf)

Reschke, C. 1990. *Ecological communities of New York State*. Latham, NY: New York State Natural Heritage Program, Department of Environmental Conservation.

Russell, E. W. B. 1983. Indian-set fires in the forests of the northeastern United States. *Ecology* 64:78–88.

Sperduto, D. D. 2005. *Natural community systems of New Hampshire*. Concord, NH: New Hampshire Natural Heritage Bureau and The Nature Conservancy.

Sprecher, S. W., and A. G. Warne. 2000. *Accessing and using meteorological data to evaluate wetland hydrology*. ERDC/EL TR-WRAP-00-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center. (http://el.erdc.usace.army.mil/elpubs/pdf/wrap00-1/wrap00-1.pdf)

Stein, B. A., L. S. Kutner, and J. S. Adams. 2000. *Precious heritage: The status of biodiversity in the United States.* New York, NY: Oxford University Press.

Stolt, M. H., B. C. Lesinski, and W. Wright. 2001. Micromorphology of seasonally saturated soils in carboniferous glacial till. *Soil Science* 166:406–414.

Stone, J., and G. M. Ashley. 1992. Ice-wedge casts, pingo scars, and the drainage of glacial Lake Hitchcock. In *84th annual meeting of the New England intercollegiate geological conference: Guidebook for field trips in the Connecticut Valley region of Massachusetts and adjacent states*, 305–331. Amherst, MA: University of Massachusetts, Department of Geology and Geography.

Stuckey, R. L., and T. M. Barkley. 1993. Weeds in North America. Vol. 1, Chapter 8 in *Flora of North America north of Mexico,* ed. Flora of North America Editorial Committee. New York, NY: Oxford University Press.

Tiner, R. W. 1989. *Wetlands of Rhode Island*. Newton Corner, MA: U.S. Fish and Wildlife Service, Northeast Region.

Tiner, R. W. 1999. *Wetland indicators: A guide to wetland identification, delineation, classification, and mapping*. Boca Raton, FL: Lewis Publishers.

Tiner, R. W. 2005. *In search of swampland: A wetland sourcebook and field guide, second edition*. New Brunswick, NJ: Rutgers University Press.

Tiner, R. W. 2008. *Field guide to tidal wetland plants of the northeastern United States and neighboring Canada*. Amherst, MA: University of Massachusetts Press.

U. S. Army Corps of Engineers. 2005. *Technical standard for water-table monitoring of potential wetland sites*. ERDC TN-WRAP-05-02. Vicksburg, MS: U.S. Army Engineer Research and Development Center. (http://el.erdc.usace.army.mil/wrap/pdf/tnwrap05-2.pdf)

USDA Natural Resources Conservation Service. 1994. *National food security act manual, third edition* (as amended). Washington, DC. (http://www.nrcs.usda.gov/programs/compliance/index.html)

USDA Natural Resources Conservation Service. 1997. *Hydrology tools for wetland determination*. Chapter 19, Engineering Field Handbook. Fort Worth, TX: U.S. Department of Agriculture. (http://policy.nrcs.usda.gov/OpenNonWebContent.aspx?content=17556.wba)

USDA Natural Resources Conservation Service. 1999. *Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys*. Agriculture Handbook 436. Washington, DC: U.S. Department of Agriculture. (http://soils.usda.gov/technical/classification/taxonomy/)

USDA Natural Resources Conservation Service. 2002. *Field book for describing and sampling soils, version 2.0*. ed. P. J. Schoeneberger, D. A. Wysocki, E. C. Benham, and W. D. Broderson. Lincoln, NE: National Soil Survey Center. (http://soils.usda.gov/technical/fieldbook/)

USDA Natural Resources Conservation Service. 2005. *National soil survey handbook, part 629, glossary*. Washington, DC: U.S. Department of Agriculture. (ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Survey_Handbook/629_glossary.pdf)

USDA Natural Resources Conservation Service. 2006. *Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin*. Agriculture Handbook 296. Washington, DC: U.S. Department of Agriculture. (http://soils.usda.gov/survey/geography/mlra/index.html)

USDA Natural Resources Conservation Service. 2010. *Field indicators of hydric soils in the United States, Version 7.0*. ed. L. M. Vasilas, G. W. Hurt, and C. V. Noble. Washington, DC: USDA NRCS in cooperation with the National Technical Committee for Hydric Soils. (http://soils.usda.gov/use/hydric/)

USDA Soil Conservation Service. 1994. Changes in hydric soils of the United States. *Federal Register* 59(133):35680–35681, July 13, 1994.

U.S. Department of the Interior (USDI) Bureau of Land Management. 1996. *Sampling vegetation attributes.* BLM/RS/ST-96/002+1730. Denver, CO.

Vepraskas, M. J. 1992. *Redoximorphic features for identifying aquic conditions*. Technical Bulletin 301. Raleigh, NC: North Carolina Agricultural Research Service, North Carolina State Univ.

Vepraskas, M. J., and S. W. Sprecher 1997. *Aquic conditions and hydric soils: The problem soils*. Special Publication Number 50. Madison, WI: Soil Science Society of America.

Wakeley, J. S., and R. W. Lichvar. 1997. Disagreement between plot-based prevalence indices and dominance ratios in evaluations of wetland vegetation. *Wetlands* 17:301–309.

Wentworth, T. R., G. P. Johnson, and R. L. Kologiski. 1988. Designation of wetlands by weighted averages of vegetation data: A preliminary evaluation. *Water Resources Bulletin* 24:389–396.

Wright, H., B. Coffin, and N. Aaseng, eds. 1992. *The patterned peatlands of Minnesota*. Minneapolis, MN: University of Minnesota Press.

Appendix A: Glossary

This glossary is intended to supplement those given in the Corps Manual and other available sources. See the following publications for terms not listed here:

- Corps Manual (Environmental Laboratory 1987) (http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf).
- Field Indicators of Hydric Soils in the United States (USDA Natural Resources Conservation Service 2010) (http://soils.usda.gov/use/hydric/).
- National Soil Survey Handbook, Part 629 (USDA Natural Resources Conservation Service 2005) (ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Survey_Handbook/629_glossary.pdf).

Absolute cover. In vegetation sampling, the percentage of the ground surface that is covered by the aerial portions (leaves and stems) of a plant species when viewed from above. Due to overlapping plant canopies, the sum of absolute cover values for all species in a community or stratum may exceed 100 percent. In contrast, "relative cover" is the absolute cover of a species divided by the total coverage of all species in that stratum, expressed as a percent. Relative cover cannot be used to calculate the prevalence index.

Aquitard. A layer of soil or rock that retards the downward flow of water and is capable of perching water above it. For the purposes of this supplement, the term aquitard also includes the term aquiclude, which is a soil or rock layer that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients.

Contrast. The color difference between a redox concentration and the dominant matrix color. Differences are classified as faint, distinct, or prominent and are defined in the glossary of USDA Natural Resources Conservation Service (2010) and illustrated in Table A1.

Table A1. Tabular key for contrast determinations using Munsell notation.

Hues are the same (Δ h = 0)		
Δ Value	**Δ Chroma**	**Contrast**
0	≤1	Faint
0	2	Distinct
0	3	Distinct
0	≥4	Prominent
1	≤1	Faint
1	2	Distinct
1	3	Distinct
1	≥4	Prominent
≤2	≤1	Faint
≤2	2	Distinct
≤2	3	Distinct
≤2	≥4	Prominent
3	≤1	Distinct
3	2	Distinct
3	3	Distinct
3	≥4	Prominent
≥4	---	Prominent

Hues differ by 2 pages (Δ h = 2)		
Δ Value	**Δ Chroma**	**Contrast**
0	0	Faint
0	1	Distinct
0	≥2	Prominent
1	≤1	Distinct
1	≥2	Prominent
≥2	---	Prominent

Hues differ by 1 page (Δ h = 1)		
Δ Value	**Δ Chroma**	**Contrast**
0	≤1	Faint
0	2	Distinct
0	≥3	Prominent
1	≤1	Faint
1	2	Distinct
1	≥3	Prominent
2	≤1	Distinct
2	2	Distinct
2	≥3	Prominent
≥3	---	Prominent

Hues differ by 3 or more pages (Δ h ≥ 3)		
Δ Value	**Δ Chroma**	**Contrast**
Color contrast is prominent, except for low chroma and value.		Prominent

Note: If both colors have values of ≤3 and chromas of ≤2, the color contrast is Faint (regardless of the difference in hue).

Adapted from USDA Natural Resources Conservation Service (2002)

Depleted matrix. The volume of a soil horizon or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create colors of low chroma and high value. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. In some places the depleted matrix may change color upon exposure to air (reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

- Matrix value of 5 or more and chroma of 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 6 or more and chroma of 2 or 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 or 5 and chroma of 2, with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 and chroma of 1, with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings (USDA Natural Resources Conservation Service 2010).

Common (2 to less than 20 percent) to many (20 percent or more) redox concentrations (USDA Natural Resources Conservation Service 2002) are required in soils with matrix colors of 4/1, 4/2, and 5/2 (Figure A1). Redox concentrations include iron and manganese masses and pore linings (Vepraskas 1992). See “contrast” in this glossary for the definitions of “distinct” and “prominent.”

Diameter at breast height (DBH). A standard method of expressing the diameter of the trunk or bole measured at 1.37 meters (4.5 ft) above the ground. On sloping ground, measurements should be taken from the uphill side of the trunk.

Diapause. A period during which growth or development is suspended and physiological activity is diminished, as in certain aquatic invertebrates in response to drying of temporary wetlands.

Distinct. See Contrast.

Figure A1. Illustration of values and chromas that require 2 percent or more distinct or prominent redox concentrations and those that do not, for hue 10YR, to meet the definition of a depleted matrix. *Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.* Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc. (Gretag/Macbeth 2000).

Episaturation. Condition in which the soil is saturated with water at or near the surface, but also has one or more unsaturated layers below the saturated zone. The zone of saturation is perched on top of a relatively impermeable layer.

Flark-and-strang topography. Microtopographic relief consisting of flarks (linear pools or swales) and strangs or strings (low ridges) oriented perpendicular to the direction of water flow in patterned fens, bogs, and other peatlands (Foster and King 1984).

Fragmental soil material. Soil material that consists of 90 percent or more rock fragments; less than 10 percent of the soil consists of particles 2 mm or smaller (USDA Natural Resources Conservation Service 2010).

Gleyed matrix. A gleyed matrix has one of the following combinations of hue, value, and chroma and the soil is not glauconitic (Figure A2):

- 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or
- 5G with value of 4 or more and chroma of 1 or 2; or
- N with value of 4 or more (USDA Natural Resources Conservation Service 2010).

Growing season. In the Northcentral and Northeast Region, growing season dates are determined through onsite observations of the following indicators of biological activity in a given year: (1) above-ground growth and development of vascular plants and/or (2) soil temperature (see Chapter 4 for details). If onsite data gathering is not practical, growing season dates may be approximated by using WETS tables available from the NRCS National Water and Climate Center to determine the median dates of 28 °F (−2.2 °C) air temperatures in spring and fall based on long-term records gathered at the nearest appropriate National Weather Service meteorological station.

High pH. pH of 7.9 or higher. Includes Moderately Alkaline, Strongly Alkaline, and Very Strongly Alkaline (USDA Natural Resources Conservation Service 2002).

Hummock. A low mound, ridge, or microtopographic high. In wet areas, plants growing on hummocks may avoid some of the deleterious effects of inundation or shallow water tables.

Layer(s). A soil horizon, subhorizon, or combination of contiguous horizons or subhorizons sharing at least one property referred to in the indicators.

Figure A2. For hydric soil determinations, a gleyed matrix has the hues and chroma identified in this illustration with a value of 4 or more. *Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.* Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc. (Gretag/Macbeth 2000).

Nodules and concretions. Irregularly shaped, firm to extremely firm accumulations of iron and manganese oxides. When broken open, nodules have uniform internal structure whereas concretions have concentric layers (Vepraskas 1992).

Ped. A unit of soil structure, such as a block, column, granule, plate, or prism, formed by natural processes.

Prominent. See Contrast.

Red parent material. Parent material with a natural inherent reddish color attributable to the presence of iron oxides occurring as coatings on and occluded within the mineral grains. Soils that formed in red parent material have conditions that greatly retard the development and extent of the redoximorphic features that normally occur under prolonged aquic conditions. Most commonly, the material consists of dark red, consolidated Mesozoic or Paleozoic sedimentary rocks, such as shale, siltstone, and sandstone, or alluvial materials derived from such rocks. Assistance from a local soil scientist may be needed to determine where red parent material occurs.

Reduced matrix. Soil matrix that has a low chroma in situ due to presence of reduced iron, but whose color changes in hue or chroma when exposed to air as Fe^{2+} is oxidized to Fe^{3+} (Vepraskas 1992).

Saturation. For wetland delineation purposes, a soil layer is saturated if virtually all pores between soil particles are filled with water (National Research Council 1995, Vepraskas and Sprecher 1997). This definition includes part of the capillary fringe above the water table (i.e., the tension-saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979).

Tussock. A plant growth form, generally in grasses or sedges, in which plants grow in tufts or clumps bound together by roots and elevated above the substrate.

Within. When referring to specific hydric soil indicator depth requirements, “within” means not beyond in depth. “Within a depth of 15 cm,” for example indicates that the depth is less than or equal to 15 cm.

Appendix B: Point-Intercept Sampling Procedure for Determining Hydrophytic Vegetation

The following procedure for point-intercept sampling is an alternative to plot-based sampling methods to estimate the abundance of plant species in a community. The approach may be used with the approval of the appropriate Corps of Engineers District to evaluate vegetation as part of a wetland delineation. Advantages of point-intercept sampling include better quantification of plant species abundance and reduced bias compared with visual estimates of cover. The method is useful in communities with high species diversity, and in areas where vegetation is patchy or heterogeneous, making it difficult to identify representative locations for plot sampling. Disadvantages include the increased time required for sampling and the need for vegetation units large enough to permit the establishment of one or more transect lines within them. The approach also assumes that soil and hydrologic conditions are uniform across the area where transects are located. In particular, transects should not cross the wetland boundary. Point-intercept sampling is generally used with a transect-based prevalence index (see below) to determine whether vegetation is hydrophytic.

In point-intercept sampling, plant occurrence is determined at points located at fixed intervals along one or more transects established in random locations within the plant community or vegetation unit. If a transect is being used to sample the vegetation near a wetland boundary, the transect should be placed parallel to the boundary and should not cross either the wetland boundary or into other communities. Usually a measuring tape is laid on the ground and used for the transect line. Transect length depends upon the size and complexity of the plant community and may range from 100 to 300 ft (30 to 90 m) or more. Plant occurrence data are collected at fixed intervals along the line, for example every 2 ft (0.6 m). At each interval, a “hit” on a species is recorded if a vertical line at that point would intercept the stem or foliage of that species. Only one “hit” is recorded for a species at a point even if the same species would be intercepted more than once at that point. Vertical intercepts can be determined using a long pin or rod protruding into and through the various vegetation layers, a sighting device (e.g., for the canopy), or an imaginary vertical line. The total number of "hits" for each species along the transect is then determined. The result is a list of species and their frequencies of occurrence along the line (Mueller-Dombois and Ellenberg 1974; Tiner 1999). Species are then categorized by wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL), the total number of hits determined within each category, and the data used to calculate a transect-based prevalence index. The formula is similar to that given in Chapter 2 for the plot-based prevalence index (see Indicator 3), except that frequencies are used in place of cover estimates. The community is hydrophytic if the prevalence index is 3.0 or less. To be valid, more than 80 percent of "hits" on the transect must be of species that have been identified correctly and placed in an indicator category.

The transect-based prevalence index is calculated using the following formula:

$$PI = \frac{F_{OBL} + 2F_{FACW} + 3F_{FAC} + 4F_{FACU} + 5F_{UPL}}{F_{OBL} + F_{FACW} + F_{FAC} + F_{FACU} + F_{UPL}}$$

where:

PI = Prevalence index;
F_{OBL} = Frequency of obligate (OBL) plant species;
F_{FACW} = Frequency of facultative wetland (FACW) plant species;
F_{FAC} = Frequency of facultative (FAC) plant species;
F_{FACU} = Frequency of facultative upland (FACU) plant species;
F_{UPL} = Frequency of upland (UPL) plant species.

Appendix C: Data Form

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: ______________________ City/County: ______________________ Sampling Date: __________

Applicant/Owner: ______________________________________ State: ________ Sampling Point: __________

Investigator(s): ______________________ Section, Township, Range: ______________________

Landform (hillslope, terrace, etc.): ______________ Local relief (concave, convex, none): ______________ Slope (%): ______

Subregion (LRR or MLRA): __________ Lat: ______________ Long: ______________ Datum: __________

Soil Map Unit Name: ______________________________________ NWI classification: ______________

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ______ No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes ______ No______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ______ No Hydric Soil Present? Yes ______ No Wetland Hydrology Present? Yes ______ No	**Is the Sampled Area within a Wetland? Yes ______ No** If yes, optional Wetland Site ID: ______________________
Remarks: (Explain alternative procedures here or in a separate report.)	

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
___ Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No ______ Depth (inches):

Water Table Present? Yes ______ No ______ Depth (inches):

Saturation Present? Yes ______ No ______ Depth (inches):
(includes capillary fringe)

Wetland Hydrology Present? Yes ______ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: ______

Tree Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	______ = Total Cover		
Sapling/Shrub Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	______ = Total Cover		
Herb Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	______ = Total Cover		
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
	______ = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ______ (A)

Total Number of Dominant Species Across All Strata: ______ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ______ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	______	x 1 =	______
FACW species	______	x 2 =	______
FAC species	______	x 3 =	______
FACU species	______	x 4 =	______
UPL species	______	x 5 =	______
Column Totals:	______ (A)		______ (B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ______ **No**

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: ______

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L, M**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ______ No ______

Remarks:

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14. ABSTRACT
This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual, which provides technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The development of Regional Supplements is part of a nation-wide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. This supplement is applicable to the Northcentral and Northeast Region, which consists of all or portions of 15 states: Connecticut, Illinois, Indiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin.

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