# NEW YORK STATE

# FRESHWATER WETLANDS

# DELINEATION MANUAL

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Steve Browne, Albany
Scott Crocoll, Latham
Diane Goetke, Albany
Nancy Heaslip, Schenectady
Ted Kerpez, New Paltz
Ken Kogut, Ray Brook
Steve Sanford, Albany
Dan Spada, Ray Brook

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## PREFACE

New York State's freshwater wetlands are protected under Article 24 of the Environmental Conservation Law, commonly known as the Freshwater Wetlands Act (the Act or Article 24). The Act directs the Department of Environmental Conservation (the Department or DEC) and the Adirondack Park Agency (the Agency or APA) to "preserve, protect and conserve freshwater wetlands and the benefits derived therefrom, to prevent the despoliation and destruction of freshwater wetlands, and to regulate use and development of such wetlands to secure the natural benefits of freshwater wetlands, consistent with the general welfare and beneficial economic, social and agricultural development of the state [§24-0103]."

Under the Act, wetlands are defined as lands and submerged lands commonly known as swamps, sloughs, bogs and flats which support wetland vegetation. Wetland vegetation is categorized into wetland trees, wetland shrubs and wet meadow vegetation that... "depend on permanent or seasonal flooding [wetland hydrology] or sufficiently water-logged soils [hydric soils] to give them a competitive advantage over other [vegetation]." Emergent, rooted floating-leaved, free-floating, submergent and bog mat plants that ordinarily grow in standing water are also categorized as wetland vegetation under Article 24. Additionally, the law describes three instances where wetland vegetation is absent from a wetland area: 1) permanently wet conditions which contain dead upland vegetation; 2) areas substantially enclosed by wetlands; and 3) the waters which overlie any wetland area [§24-0107(1)].

Wetlands protected under Article 24 are known as New York State "regulated" wetlands. The regulated area includes the wetlands themselves as well as a protective buffer or "adjacent area" extending 100 feet landward of the wetland boundary. The adjacent area can be extended further in certain situations [§24-0701(2)]. Title 3 of the Act mandates that all freshwater wetlands with an area 12.4 acres or greater be depicted on a set of maps promulgated by DEC. Wetlands less than 12.4 acres in size may also be mapped if they have unusual local importance or are located within the Adirondack Park. It is critical to note that the wetland boundaries as shown on the maps are the "...**approximate** location of the **actual** boundaries of the wetlands...[§24-0301(3)]" (emphasis added). The boundaries of a regulated wetland are more precisely established through the process of **delineation**. The DEC and the APA are required to provide such delineations pursuant to §24-0301(7). Delineation, in this manual, means the more precise depiction of the boundary of a wetland than is possible on the 1:24,000 maps promulgated by DEC and APA.

Within the "Blue Line" of the Adirondack Park, the responsibility for administering the Act (including determining the existence and extent of freshwater wetlands and regulating activities in and/or near them) resides with the APA. The Agency also administers the Adirondack Park Agency Act (Executive Law, Article 27, Section 801 et seq.) which also defines wetlands and provides for their protection. Wetlands within the Adirondack Park are regulated under the Adirondack Park Agency Act and the Freshwater Wetlands Act when the wetland area is one acre in size or larger, or of any size when the wetland is adjacent to and has free interchange at the surface with a permanent water body, such as a stream, pond or lake. Contact the Adirondack Park Agency [Box 99, Ray Brook, New York 12977, (518) 891-4050] with any questions regarding the use or application of this manual within the Adirondack Park or for any questions related to Agency wetlands jurisdiction.

## Organization of the Manual

The Manual is divided into three major parts: **Preface**, **Part I - Technical Criteria for New York State Wetland Delineation**, and **Part II - Methods for Identification and Delineation of Wetland Boundaries**. References, a glossary of technical terms, and appendices are included at the end of the manual.

## Use of the Manual

This Manual describes the methodologies employed by the DEC and the APA to delineate the boundaries of regulated freshwater wetlands in New York State. The Manual describes technical criteria, field indicators and other sources of information useful for wetland boundary delineation for areas subject to Article 24 regulation. The information is also applicable to wetlands regulated under the other New York laws such as Article 15 (*ie*. wetlands contiguous to navigable waters pursuant to §15-0505). Emphasis for delineation is on the upper boundary of wetlands (i.e. wetland-upland boundary) and not on the lower boundary between wetlands and deepwater habitats.

This Manual makes use of methods and information found in "Technical Report Y-87-1, Corps of Engineers Wetlands Delineation Manual" (1987). The Manual describes practical and efficient methods of delineating freshwater wetlands boundaries. Delineation methods outlined herein are relatively quick and can be accomplished under most weather conditions and at most times of the year (except perhaps during extreme snow or ice cover), and will provide for legally defensible and reproducible wetland boundaries.

Alternative methods are offered to provide users with a selection to suit a range of circumstances. **Wetland delineators need not become slaves to the Manual. However, to depart from methods outlined in this Manual is to enter the realm of "Best Professional Judgement" and the reasons for doing so must be well documented.**

## Using Other Publications

Individuals responsible for wetland boundary delineation should become familiar with available technical literature on wetlands, especially for their geographic region. Such literature includes: taxonomic plant manuals and field guides; scientific journals dealing with botany, ecology, and wetlands in particular; technical government reports on wetlands; proceedings of wetland workshops, conferences, and symposia; and the US Fish and Wildlife Service's (FWS) national wetland plant database which contains habitat information on about 7,000 plant species. Appendix B presents examples of the first four sources of information. In addition, the FWS's National Wetlands Inventory (NWI) maps provide information on locations of hydrophytic plant communities that may be studied in the field to improve one's knowledge of such communities in particular regions. NWI maps labeled with an asterisk are field verified and can offer the most accurate information to a field delineator.

## PART I. TECHNICAL CRITERIA FOR NEW YORK STATE WETLAND DELINEATION:

Wetland ecosystems generally possess three essential characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology, the driving force creating all wetlands. The use of these characteristics as technical criteria for wetland delineation purposes is described in the following sections.

The hydrophytic vegetation criterion is mandatory under New York State's Freshwater Wetlands Act [except as listed in §24-0107(8)(b),(c), and (d)]. Hydric soils and wetland hydrology provide additional information and should be used as needed to document the presence of a wetland and the location of its boundary.

For some freshwater wetlands that are consistently "wet" (submergent, emergent, floating-leaved, open water and bog wetlands), wetland hydrology and hydric soils are implicit. For freshwater wetlands that frequently lack standing water (shrub swamps, deciduous swamps, coniferous swamps, wet meadows), vegetation alone may not be adequately diagnostic for identification of a wetland boundary. In these wetland types, field verification of wetland hydrology and/or hydric soils might be required to demonstrate that the plants found at that location actually do "... depend upon seasonal or permanent flooding (hydrology) or sufficiently water-logged soils (hydric soils) to give them a competitive advantage over other [plants] [§24-0107.1(a)(1), (2) and (6)]."

Presence of the three technical criteria, listed in this Part, may not always be apparent at the time a field inspection is conducted. To help determine whether any of the three wetland criteria are satisfied, various physical properties or other signs may be observable in the field. Also, good baseline information may be available from site-specific studies and inspections, published reports, or other written material on wetlands. In the following sections, background information, scientific criteria and field indicators for each of the three criteria are presented to help the user identify wetland boundaries.

### Hydrophytic Vegetation

For purposes of this Manual, hydrophytic vegetation means macrophytic plant life that meets the definition of wetland vegetation in the Freshwater Wetlands Act as described above. In addition, delineators should refer to the "National List of Plant Species that Occur in Wetlands."

This list is published by the U.S. Fish and Wildlife Service (FWS) in cooperation with U.S. Army Corps of Engineers (ACOE), Environmental Protection Agency (EPA), and the Natural Resources Conservation Service (NRCS), formerly called the U.S. Soil Conservation Service. The list includes nearly 7,000 vascular plant species found in U.S. wetlands (Reed 1988). Out of this number, only about 27 percent of the plants are "obligate wetland" species that nearly always occur in wetlands under natural conditions. This means that the majority of plant species growing in wetlands also grow in non-wetlands to some degree.

The list of wetland plant species separates vascular plants into four basic groups (commonly called "wetland indicator status") based on a plant species' frequency of occurrence in wetlands:

### *Plant Indicator Status Categories*

**(1)** ***OBLIGATE WETLAND PLANTS*** **(*OBL*)** that occur almost always (estimated probability >99%) in wetlands under natural conditions;

**(2)** ***FACULTATIVE WETLAND PLANTS*** **(*FACW*)** that usually occur in wetlands (estimated probability 67-99%), but occasionally are found in non-wetlands;

**(3)** ***FACULTATIVE PLANTS*** **(*FAC*)** that are equally likely to occur in wetlands or non-wetlands (estimated probability 34-66%); and

**(4)** ***FACULTATIVE UPLAND PLANTS*** **(*FACU*)** that usually occur in non-wetlands but occasionally are found in wetlands (estimated probability 1-33%).

If a species occurs almost always (estimated probability >99%) in non-wetlands under natural conditions, it is considered an ***OBLIGATE UPLAND PLANT*** (***UPL***). These UPL plants do not usually appear on the wetland plant list; they are listed only when found in wetlands with a higher probability in a particular region of the country. If a species is not on the list, it is most probably an upland plant.

When in doubt about an unlisted species, that species should be treated as neutral and the boundary delineation based upon other dominant or sub-dominant vegetation present, along with soils and/or hydrology as necessary.

The "National List of Plant Species that Occur in Wetlands" uses a plus (+) or minus (-) sign to specify a higher or lower portion of a particular wetland indicator frequency for the three facultative-type indicators; for purposes of identifying hydrophytic vegetation according to this manual, however, FACW+, FACW-, and FAC+ are included in the FACW and FAC categories, respectively, in the hydrophytic vegetation criterion.

The "National List of Plant Species That Occur in Wetlands" has been subdivided into regional and state lists. New York State's wetland plants list should be used when evaluating whether the hydrophytic vegetation criterion is satisfied for the purposes of delineating wetland boundaries in New York State. New York's plant list was published in 1986 and revised in 1989. Since the lists are periodically updated, delineators should contact the FWS or NRCS to ensure the most current version is used for wetland boundary delineations.

Individuals who conduct wetland delineations must identify the dominant and sub-dominant vegetation in each stratum (trees, shrubs, herbs and vines) of a plant community. Plant identification requires use of field guides or more technical taxonomic manuals (see Appendix B for sample list). When necessary, a delineator should seek help with identification of difficult species. Once a plant is identified to genus and species, the delineator should then consult the appropriate Federal list of plants that occur in wetlands in New York State to determine the "wetland indicator status" of the plant. The information will then be used to help determine if hydrophytic vegetation is present.

## Hydrophytic Vegetation Criterion

### *Dominant Vegetation*

Dominance, as used in this manual, is based strictly upon the abundance of a species that can be visually estimated or measured in the field. When identifying dominant vegetation within a given plant community, one should consider dominance within each stratum. All dominants are treated equally in characterizing the plant community as a whole to determine whether hydrophytic vegetation is present. For each stratum in the plant community, dominant species are considered to be those with 20 percent or more areal coverage in the plant community.

Percent areal canopy coverage for trees and shrubs and percent areal ground coverage for herbs are commonly used measures of dominance. Dominant species can also be identified using other accepted approaches. For example, calculation of frequency, density, importance value, etc. are also valid measures of dominance not covered in this manual. Basal area calculation, a commonly used dominance measure for trees, is covered in this Manual on page 20. Under most circumstances, visual estimation of percent coverage is quick, convenient and adequate for evaluating plant communities. These methods are described in Part II.

When present, vegetative strata for which dominants should be determined include:

**(1) TREES** usually $\geq$5.0 inches diameter at breast height [dbh] and 20 feet or taller;

**(2) SHRUBS AND SAPLINGS** usually 3 to 20 feet tall, including multi-stemmed plants, bushy shrubs and small trees and saplings;

**(3) HERBS** herbaceous plants including graminoids, forbs, ferns, fern allies, herbaceous vines, and tree and shrub seedlings; and

**(4) WOODY VINES**

Bryophytes (mosses, horned liverworts, and true liverworts) may also represent an important component of some wetlands. There are no national, state or regional plant lists that include the wetland indicator status of these non-vascular plants. However, some bryophytes including Sphagnum species are often abundant in some wetlands including shrub bogs, moss-lichen wetlands, and wooded swamps, and are considered by most wetland scientists to be obligate wetland plants.

## Vegetation Field Indicators of Wetland (adapted from Tiner 1993)

Having established the dominant species for each stratum, hydrophytic vegetation is considered present if **any** of the following are present:

(1) ***FACW* or wetter species comprise more than 50 percent of the dominant species of the plant community and no *FACU* or *UPL* species are dominant**, or;

(2) **OBL perennial species collectively represent at least 10 percent areal cover in the plant community and are evenly distributed throughout the community and not restricted to depressional microsites**, or;

(3) **One or more dominant plant species in the community has one or more of the following morphological adaptations: hypertrophied lenticels, buttressed stems or trunks, multiple trunks, adventitious roots, shallow root systems, or other locally applicable adaptation,**[1] or;

(4) **The presence of unbroken expanses of peat mosses (*Sphagnum* spp.) and other regionally applicable species of bryophytes over persistently saturated soil.**

Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger than others. When a decision is based on an indicator appearing in the lower portion of the list, carefully evaluate the parameter to ensure that the proper decision was reached.

The presence of **any** of the above-listed hydrophytic vegetation characteristics typically indicates a wetland. Thus, an area that exhibits any of these indicators can be considered a wetland without detailed examination of hydrology and/or soils, provided significant unusual hydrologic modifications are not evident.

In some areas, particularly in transition zones dominated by FAC species, the wetland boundary may be particularly difficult to delineate using vegetation alone.

> **If none of the above vegetation indicators of wetland is found, but more than 50 percent of the dominant species of all strata are *FAC* or some combination of *FAC* and wetter species (including *OBL*, *FACW+*, *FACW-*, *FAC+*); then investigation and verification of hydrology and/or hydric soils is required to locate a wetland boundary.**

## Wetland Hydrology

Of the three technical criteria of wetland identification, wetland hydrology can be the most difficult to verify with certainty in the field.

Permanent or periodic inundation or soil saturation to the surface, at least seasonally, are the driving forces behind wetland formation. The presence of water to the root zones for two weeks or more during the growing season (*ie*. soil temperatures above biologic zero [41$^{o}$]) typically creates anaerobic conditions in the soil. These conditions affect the types of plants that can grow and the types of soils that develop. In other words, wetland hydrology is exhibited in the species of plants growing at the site and recorded in the morphological soil features.

Many factors influence the wetness of an area including: precipitation, stratigraphy, topography, soil permeability, and plant cover. Most wetlands usually have at least a seasonal abundance of water. This water may come from direct precipitation, overbank flooding, surface water runoff due to precipitation or snow melt, groundwater discharge, or tidal flooding. The frequency and duration of inundation and soil saturation vary widely from permanent to seasonal or irregular flooding or saturation. Many wetlands are found along rivers, lakes, and estuaries where flooding is likely to occur, while other wetlands form in isolated depressions surrounded by upland where surface water collects. Still others develop on slopes of varying steepness, in surface water drainageways or where groundwater discharges to the land surface in spring or seepage areas.

[1] Many plants growing in wetlands develop morphological adaptations in response to inundation or soil saturation. Examples include pneumatophores, buttressed tree trunks, multiple trunks, adventitious roots, shallow root systems, floating stems, floating leaves, polymorphic leaves, hypertrophied lenticels, inflated leaves, stems or roots, and aerenchyma (air-filled) tissue in roots and stems (see Table 1 for examples).

The frequency and duration of inundation or soil saturation are important characteristics in separating wetlands from non-wetlands. Duration usually is the more important factor. Low-lying areas in a floodplain or marsh have longer and more frequent periods of inundation and saturation than most areas at higher elevations. Floodplain configuration may significantly affect the duration of inundation by facilitating rapid runoff or by causing poor drainage. Soil permeability related to the texture of the soil also influences the duration of inundation or soil saturation. For example, clayey soils absorb water more slowly than sandy or loamy soils, and therefore have slower permeability and remain saturated much longer. Type and amount of plant cover affect both degree of inundation and duration of saturated soil conditions.

## Wetland Hydrology Criterion

When defining hydrology, one considers soil saturation to the surface or complete inundation. Therefore, for the purposes of this Manual, hydrologic criteria are based on hydric soils characteristics of soil saturation and inundation. (See "Hydric Soil Criteria" listed on page 10.)

To determine whether the wetland hydrology criterion is met, wetland delineators can consult available recorded data and aerial photographs and investigate field indicators that provide direct or indirect evidence of inundation or soil saturation. (See Table 2 for information about recorded hydrologic data and aerial photography).

## Hydrologic Field Indicators of Wetland

At some times of the year and in some types of wetlands, wetland hydrology is obvious since standing water or inundated or saturated soils are readily observable. Yet in many instances, especially along the uppermost boundary of wetlands, hydrology is not nearly so apparent. Another complicating factor is that indicators of flooding can extend well beyond a wetland boundary, into low-lying upland areas flooded by some unusual event. Consequently, hydrologic indicators alone are generally not sufficient for delineating wetland boundaries. Despite this limitation, hydrologic indicators are useful in determining the presence of wetlands in some situations such as sites dominated by FAC vegetation. Signs of hydrology can help to confirm that such an area meets the definition of a wetland.

If significant drainage or groundwater alteration has occurred, then it is necessary to determine whether the area in question is effectively drained and is now non-wetland or is only partly drained and remains wetland despite some hydrologic modification. Effectively drained areas should not be considered wetland if the area was drained legally, such as under a NYS wetlands permit, or if the area drained naturally, such as a result of a beaver dam wash out, with subsequent drying of a site. Areas appearing on a NYS regulatory wetlands map that have been drained under the agricultural exemption or in violation of Article 24 should still be treated as regulated wetlands if there is sufficient evidence that these areas once supported hydrophytic vegetation. Guidance for determining whether such an area should be considered wetland is found in the section on disturbed areas (page 23).

In the absence of visible evidence of significant hydrologic modification, wetland hydrology is presumed to occur in an area having hydrophytic vegetation and hydric soils.

Some hydrologic indicators can be assessed quickly in the field. Although they are not necessarily indicative of hydrologic events during the growing season or in wetlands alone, they do provide evidence that inundation or soil saturation has occurred at some time. You should use professional judgement in deciding whether the hydrologic indicators demonstrate that the wetland hydrology criterion has been satisfied. When considering these indicators, it is important to be aware of recent extreme flooding events and heavy rainfall periods that could cause low-lying non-wetlands to exhibit some of these signs. It is best to avoid, if possible, field inspections during and immediately after these events. If it can not be avoided, then these events must be considered when delineating a wetland boundary. Also, remember that hydrology varies seasonally and annually as well as daily, and that at some times of the year (e.g. late summer in New York) water tables are at their lowest points. During these low water periods, signs of soil saturation and flooding may be difficult to find in many wetlands. The following indicators can be assessed quickly in the field.

### *Primary Hydrologic Indicators*
[taken from "Data Form: Routine Wetland Determination" (1987 COE Wetlands Delineation Manual)]

Indicators are listed in order of decreasing reliability. Although all are valid indicators, some are stronger than others. When a boundary decision is based on an indicator appearing in the lower portion of the list, evaluate the specific indicator carefully, in conjuction with other information found on the site, to ensure that the decision is justified.

Any **one** of the following primary hydrologic characteristics (along with hydrophytic vegetation) indicates the presence of a wetland:

**(1) Visual observation of inundation -** The most obvious and revealing hydrologic indicator may be observing the areal extent of inundation. However, both seasonal conditions and recent weather conditions should be considered when investigating an area because these conditions can affect whether surface water is present on a non-wetland site.

**(2) Visual observation of soil saturation -** In some cases, saturated soils are obvious, since the ground surface is soggy or mucky under foot. In many cases, however, examination of this indicator requires digging a hole to a depth of 18 inches and observing the standing water level after sufficient time for drainage into the hole. The required time will vary depending on soil texture. In some cases, the highest level where water flows into the hole can be observed by examining the wall of the hole. This level represents the depth to the water table. The depth to saturated soils will always be nearer the surface than the depth to the water table due to capillary fringe movement of water through the soil. In some heavy clay soils, water may not rapidly accumulate in the hole even when the soil is saturated. If water is observed at the bottom of the hole but has not filled to a 12-inch depth, examine the sides of the hole and determine the shallowest depth at which water is entering the hole. Saturated soils may also be detected by a "squeeze test", which involves taking a soil sample from within 18 inches of the surface (actual depth depends on soil permeability) and squeezing the sample. If you can squeeze water from the sample, the soil is saturated at the depth of the sample at that particular time. When applying the soil saturation indicator, both the season of the year and the preceding weather conditions must be considered.

**(3) Water marks -** Water marks are found most commonly on woody vegetation but may also be observed on other vegetation. They often occur as stains on bark or other fixed objects (e.g., bridge pillars, buildings, and fences). When several water marks are present, the highest usually reflects the maximum extent of recent inundation.

**(4) Drift lines -** This indicator is typically found adjacent to streams or other sources of water flow in wetlands. Evidence consists of deposition of debris in a line on the soil surface or debris entangled in above-ground vegetation or other fixed objects. Debris usually consists of remnants of vegetation (branches, stems, and leaves), sediment, litter, and other water-borne materials deposited more or less parallel to the direction of water flow. Drift lines provide an indication of the minimum portion of the area inundated during a flooding event; the maximum level of inundation is generally at a higher elevation than that indicated by a drift line.

**(5) Water-borne sediment deposits -** Plants and other vertical objects often have thin layers, coatings, or depositions of mineral or organic matter on them after inundation. This evidence may remain for a considerable period before it is removed by precipitation or subsequent inundation. Sediment deposition on vegetation and other objects provides an indication of the minimum inundation level. When sediments are primarily organic (e.g., fine organic material and algae), the detritus may become encrusted on or slightly above the soil surface after the water dries.

**(6) Wetland drainage patterns -** Many wetlands (e.g., floodplain wetlands) have characteristic meandering or braided drainage patterns that are readily recognized in the field or on aerial photographs and occasionally on topographic maps.

Be aware that drainage patterns also occur in upland areas after periods of considerable precipitation; therefore, topographic position must also be considered when applying this indicator.

### *Secondary Hydrologic Indicators*

Any **two or more** of the following secondary hydrologic characteristics (along with hydrophytic vegetation) indicates the presence of a wetland.

**(1) Oxidized zones around living roots and rhizomes (rhizospheres) -** Some plants are able to survive saturated soil conditions (*ie.*, a reducing environment) because they can transport oxygen to their root zones. Look for iron oxide concretions (orangish or reddish brown in color) forming along the channels of living roots and rhizomes as evidence of soil saturation (anaerobic conditions) for a significant period during the growing season.

**(2) Water-stained leaves -** Forested wetlands that are inundated early in the year will frequently have water-stained leaves in depressional areas on the forest floor. These leaves are darkened, generally grayish or blackish in color, as a result of being underwater for significant periods.

**(3) Surface-scoured areas -** Surface scouring occurs along floodplains where overbank flooding erodes sediments (e.g., at the bases of trees). Trees, shrubs and persistent herbaceous plants reclining in the direction of water flow are indicators of surface scour. The absence of leaf litter from the soil surface is, at times, an indication of surface scouring. Forested wetlands that contain standing waters for relatively long duration will occasionally have areas of bare or essentially bare soil, sometimes associated with local depressions.

**(4) Dead vegetation** - The presence of dead non-wetland vegetation, which has succumbed due to soil saturation or inundation is often an indication of natural or human-induced alteration of the hydrologic regime.

**In the absence of any one primary hydrologic indicator or any two of the secondary indicators, and if more than 50 percent of the dominant plant species of all strata are *FAC* or any combination of *FAC* or wetter species (including *OBL*, *FACW+*, *FACW-*, *and FAC+* species), and there is no indication of recent significant hydrologic modification, then investigation and verification of hydric soils is required to locate a wetland boundary. If the area has been significantly disturbed hydrologically, refer to the section on disturbed areas (page 22).**

## Hydric Soils

Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. In general, as defined by "Soil Taxonomy" (USDA Soil Survey Staff 1975), hydric soils are flooded, ponded, or saturated usually for more than two weeks during the period when soil temperatures are above biologic zero (41˚F). These soils usually support hydrophytic vegetation. The National Technical Committee on Hydric Soils (NTCHS) has developed criteria for hydric soils and a list of the Nation's hydric soils (USDA Soil Conservation Service [NTCHS], 1991); New York's soils list was published January 1988 and revised in March 1989.

## Hydric Soil Criterion

(from the USDA Soil Conservation Service, National Technical Committee for Hydric Soils [NTCHS], 1991):

The following criteria developed by NTCHS were designed to generate a list of hydric soils based on soil attributes found in the NRCS "Soil Interpretations Record". **They are not meant for on-site identification or verification of hydric soils.** Field indicators of hydric soils (see page 14) are designed for on-site identification of soils that meet the hydric soil definition and criteria. Therefore the hydric soils criteria are presented here for academic and illustrative purposes only.

### *NTCHS Criteria for Hydric Soils*

**(1)** All Histosols except Folists; or

**(2)** Soils in Aquic Suborder, Aquic Subgroups, Albolls Suborder, Salorthids Great Group, or Pell Great Groups of Vertisols, Pachic Subgroups, or Cumulic Subgroups that are:

a. somewhat poorly drained and have a frequently occurring water table at less than 0.5 feet from the surface for a significant period (usually more than 2 weeks) during the growing season, or

b. poorly drained or very poorly drained and have either:

**(i)** a frequently occurring water table at less than 0.5 feet from the surface for a significant period (usually more than 2 weeks) during the growing season if textures are coarse sand, sand or fine sand in all layers within 20 inches, or for other soils;

**(ii)** a frequently occurring water table at less than 1.0 feet from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is equal to or greater than 6.0 inches/hour in all layers within 20 inches; or

**(iii)** a frequently occurring water table at less than 1.5 feet from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is less than 6.0 inches/hour in any layer within 20 inches, or

**(3)** Soils that are freqently ponded for long duration or very long duration during the growing season, or

**(4)** Soils that are frequently flooded for long duration or very long duration during the growing season."

(Note: Long duration is defined as inundation for a single event that ranges from fourteen days to one month; very long duration is defined as inundation for a single event that is greater than one month; frequently flooded is defined as flooding likely to occur often under usual weather conditions - more than 50 percent chance of flooding in any year or more than 50 times in 100 years. Other technical terms in the NTCHS criteria for hydric soils are generally defined in the glossary.)

### *Soil Types*

All soils are separated into two major types on the basis of composition: organic soils and mineral soils. In general, soils with at least 18 inches of organic material in the upper part of the soil profile and soils with organic material resting on bedrock are considered organic soils (Histosols). Soils largely composed of sand, silt, and/or clay are mineral soils. (For technical definitions, see "Soil Taxonomy," U.S.D.A. Soil Survey Staff 1975.)

## Hydric Organic Soils

Accumulation of organic matter results from prolonged anaerobic soil conditions associated with long periods of submergence and/or soil saturation during the growing season. These saturated conditions impede aerobic decomposition (oxidation) of the bulk organic materials such as leaves, stems, and roots, and encourage their accumulation as peat or muck. Consequently, most organic soils are characterized as very poorly drained soils (Tiner & Veneman 1989).

Hydric organic soils are subdivided into **three** groups based on the presence of identifiable plant material:

(1) **muck** (Saprists) in which two-thirds or more of the material is decomposed and less than one-third of the plant fibers are identifiable;

(2) **peat** (Fibrists) in which less than one-third of the material is decomposed and more than two-thirds of the plant fibers are still identifiable; and

(3) **mucky peat or peaty muck** (Hemists) in which the ratio of decomposed to identifiable plant matter is more nearly even (U.S.D.A. Soil Survey Staff 1975).

Hydric organic soils can be easily recognized as black-colored muck and/or as black to dark brown-colored peat. In mucks, almost all of the plant remains have been decomposed beyond recognition. When rubbed, mucks feel greasy and leave hands dirty. In contrast, the plant remains in peats show very little decomposition and the original constituent plants can be recognized fairly easily. When peat material is rubbed between the fingers, most plant fibers will remain identifiable, leaving hands relatively clean.

Between the extremes of mucks and peats, organic soils with partially decomposed plant fibers are recognized. In peaty mucks up to two-thirds of the plant fibers can be destroyed by rubbing between the fingers, while in mucky peats up to two-thirds of the plant remains are still recognizable after rubbing.

Many organic soils also emit an odor of rotten eggs. Such odors are only detected in water-logged soils that are essentially permanently saturated and have sulfidic material within a few inches of the soil surface. Under saturated conditions, the sulfates in water are biologically reduced to hydrogen sulfide as organic materials accumulate, and the "rotten-egg" odor is produced.

## Hydric Mineral Soils

Soils without a significant organic material component are classified as mineral soils. Some mineral soils may have thick organic surface layers due to heavy seasonal rainfall or a high water table, yet they are still composed largely of mineral matter (Ponnamperuma 1972). Mineral soils that are covered with standing (ponded) water or are saturated for extended periods during the growing season are classified as hydric mineral soils. Soil saturation may result from low-lying topographic position, ground-water seepage, or the presence of soils or layers with low permeability (e.g., clay, confining bed-rock or hardpan).

Due to their wetness during the growing season, hydric mineral soils usually develop certain morphological properties that can be readily observed in the field. Prolonged anaerobic soil conditions cause a chemical reduction of some soil components, mainly iron oxides and manganese oxides. This reduction affects solubility, movement, and aggregation of these oxides which is reflected in the soil color and other physical characteristics that usually indicate the presence of hydric soils. The two most widely recognized features that reflect wetness in mineral soils are **gleying** and **mottling**.

**Gleyed soils** are predominantly neutral gray in color and occasionally greenish or bluish gray. In gleyed soils, the distinctive colors result from a process known as gleization, the segregation or removal of reduced iron and manganese from the soil. Gleying immediately below the A-horizon is an indication of a markedly reduced soil (for a description of soil horizons see "Generalized soil profile" Appendix E). Mineral soils gleyed to the surface layer are hydric soils. Mineral soils that are always saturated are usually uniformly gleyed throughout the saturated area. Gleying can occur in both mottled and unmottled soils. Gleyed soils also often show evidence of rust-colored, oxidized zones (rhizospheres) around living roots.

Some non-hydric soils have gray layers (called an E-horizon) immediately below the surface layer that are gray for reasons other than saturation (e.g., leaching due to organic acids). These soils often have brighter (e.g., brownish or reddish) layers below the gray layer and can be recognized as non-hydric on that basis.

**Mottles** are spots or blotches of different colors or shades of colors interspersed with the dominant (matrix) color. Mineral soils that are alternately saturated and oxidized (aerated) during the year are usually mottled in the part of the soil that is seasonally wet. The abundance, size, and color of the mottles usually reflect the duration of the saturation period and indicate whether or not the soil is hydric. Soils that have brightly colored mottles and a low chroma matrix are indicative of a fluctuating water table. Mineral soils that are predominantly grayish with brown or yellow mottles are usually saturated for long periods during the growing season and are classified as hydric. Soils that are predominantly brown or yellow with gray mottles are saturated for shorter periods and may or may not be hydric.

Soil colors are emphasized in the process of wetland delineation because they often reveal much about a soil's wetness regime. Scientists and others examining soils can determine approximate colors by comparing a soil sample with the **Munsell Soil Color Charts** (Kollmorgen Corporation, 1975). The standardized Munsell soil colors are identified by three components: hue, value and chroma:

(1) *Hue* is related to one of the main spectral colors: red, yellow, green, blue, or purple, or various mixtures of these principal colors;

(2) *Value* refers to the degree of lightness;

(3) *Chroma* notation indicates the color strength or purity.

Low chroma colors (two or less) such as black, various shades of gray, and the darker shades of brown and red are often diagnostic of hydric soils. Soil colors should be determined in soils that are or have been moistened. The chroma notations in the Munsell Charts are for soils in a moistened condition.

Hydric mineral soils usually have one of the following color features in the horizon immediately below the A-horizon:

(1) **matrix chroma of 2 or less in mottled soils**, or

(2) **matrix chroma of 1 or less in unmottled soils**.

Mineral soils that are never saturated are usually bright-colored and not mottled. However, in some hydric soils, mottles may not be visible due to masking by organic matter (Parker, et al. 1984).

Hydric mineral soils can be quite difficult to recognize. In general, a thick dark surface layer, grayish (gleyed) subsurface and subsoil colors, the presence of orange or reddish brown (iron) and/or dark reddish brown or black (manganese) mottles or concretions near the surface, and the wet condition of the soil indicates the presence of a hydric mineral soil.

Care should be taken when identifying the thick, dark surface layer. It can occur under wet or dry conditions. Usually, under wet conditions, the layer is greasy and saturated. Under dry conditions, it is often very fibrous.

The grayish subsurface and subsoil colors and thick, dark surface layers are the best indicators of current wetness, since the orange-colored mottles are very insoluble and once formed, may remain indefinitely as relict mottles of former wetness (Diers and Anderson 1984).

Be aware that the colors of certain topsoils might not indicate the true hydrologic condition. Activities such as cultivation and soil enrichment affect the original soil color. Hence, the soil colors below the A-horizon (usually below 10 inches) often need examination. Also, beware of problematic hydric soils that have colors other than those described above; see Problem Wetland Delineations section, page 28.

## Soil Field Indicators of Wetland

(adapted from Tiner, 1993)

Several field indicators are available for determining whether a given soil meets the definition of hydric soils. Other factors to consider in recognizing hydric soils include obligate wetland plants, topography, observed or recorded inundation or soil saturation, and evidence of human alterations, e.g., drainage and filling. Any one of the following typically indicates that hydric soils are present:

(1) **Organic soils (all Histosols except Folists) present;** or

(2) **Histic epipedon[2] (e.g., organic surface layer 8-16 inches thick) present.** Histic epipedon is a layer at or near the surface of a hydric mineral soil that is saturated with water for 30 consecutive days or more in most years; or

(3) **Sulfidic material ($H_2S$, odor of "rotten eggs") present within 12 inches of the soil surface; or**

(4) **Gleyed, low chroma (*ie.* chroma 2 or less with mottles *or* chroma 1 or less with or without mottles) horizon or dominant ped faces present immediately below (within 1 inch) the surface layer *and* within 18 inches of the soil surface; or**

(5) **Nonsandy soils with a low chroma matrix (chroma of 2 or less) within 18 inches of the soil surface *and* one of the following present within 12 inches of the surface:**

a. **iron and/or manganese concretions or nodules.** During the oxidation-reduction process, iron and manganese in suspension are sometimes segregated as oxides to concretions or soft masses. Concretions are local concentrations of chemical compounds (e.g., iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and color (Buckman and Brady 1969). Manganese concretions are usually black or dark brown, while iron concretions are usually yellow, orange or reddish brown. In hydric soils, these concretions are also usually accompanied by soil colors described above;

b. **distinct or prominent oxidized rhizospheres along several living roots**;

c. **low chroma mottles; or**

(6) **Sandy soils with one of the following present:**

a. **thin surface layer (1 inch or greater) of peat or muck where a leaf litter surface mat is present;**

b. **surface layer of peat or muck of any thickness where a leaf litter surface mat is absent**
Organic matter tends to accumulate above or in the surface horizon of sandy soils that are inundated or saturated to the surface for a significant portion of the growing season. The mineral surface layer generally appears darker than the mineral material immediately below it due to organic matter interspersed among or adhering to sand particles. Because organic matter also accumulates on upland soils, in some instances it may be difficult to distinguish a surface organic layer associated with a wetland site from litter

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[2]Histic epipedon contains (a) a minimum of 20 percent organic matter when no clay is present or (b) a minimum of 30 percent organic matter when clay content is 60 percent or greater. Soils with histic epipedons are inundated or saturated for sufficient periods to greatly retard aerobic decomposition of organic matter, and are considered hydric soils. In general, an histic epipedon is a thin surface layer of peat or muck if the soil has not been plowed (U.S.D.A. Soil Survey Staff 1975);

and duff associated with an upland site unless the species composition of the organic materials is determined;

c. **a surface layer (A-horizon) having a low chroma matrix (chroma of 1 or less and value of 3 or less) greater than 4 inches thick;**

d. **vertical organic streaking or blotchiness within 12 inches of the surface.**
Organic matter is moved downward through sand as the water table fluctuates. This often occurs more rapidly and to a greater degree in certain sections of a sandy soil containing a high content of organic matter. Thus, the sandy soil appears vertically streaked with darker areas. When soil from a darker area is rubbed between the fingers, the dark organic matter stains the fingers;

e. **easily recognized (distinct or prominent) high chroma mottles occupy at least 2 percent of the low chroma subsoil matrix within 12 inches of the surface;**

f. **organic concretions within 12 inches of the surface;**

g. **easily recognized (distinct or prominent) oxidized rhizospheres along living roots within 12 inches of the surface;**

h. **a cemented layer (orstein) within 18 inches of the soil surface.**
As organic matter is moved downward through some sandy soils, it may accumulate at the point representing the most commonly occurring depth to the water table. This organic matter may become slightly cemented with aluminum. Spodic horizons often occur at depths of 12 to 30 inches below the mineral surface. Wet spodosols (formerly called "groundwater podzolic soils") usually have thick, dark surface horizons that are high in organic matter with thick, dull gray E-horizons above a very dark-colored (black) spodic horizon. Not all soils with spodic horizons meet the hydric soil criterion (see "Spodosols" page 30); or

(7) **Other regionally applicable, field-verifiable soil properties associated with prolonged seasonal high water tables.**

Note: In recently deposited sandy material, such as accreting sand bars, it may be impossible to find any of the above indicators. Such cases are considered natural, problem area wetlands and the determination of hydric soil should be based on knowledge of local hydrology. See "Floodplain and Sandy Soils" page 29.

## Summary of Technical Criteria for New York State Wetland Delineation

The hydrophytic vegetation criterion must be verified when conducting a wetland boundary delineation. In addition, investigation and verification of hydrology and/or hydric soils is needed to locate a wetland boundary where none of the five "Vegetation Indicators of Wetland" are found but more than 50 percent of the dominant species of all strata are FAC or some combination of FAC and wetter species (including OBL, FACW+, FACW-, FAC+). "Hydrologic Indicators of Wetland" include primary and secondary indicators. Hydric soils are determined through observation of soil composition, colors, morphology, etc.

# PART II. METHODS FOR IDENTIFICATION AND DELINEATION OF WETLAND BOUNDARIES

## Pre-inspection Procedures

The following steps are recommended before conducting a site inspection for the purposes of a wetland boundary delineation. In applying these procedures, relevant available information on wetlands in the area of concern is collected and reviewed prior to a site investigation. Table 2 lists primary data sources.

**Step 1.** Locate the area of interest on a New York State Freshwater Wetlands Map and U.S. Geological Survey (USGS) topographic map (if available) and approximate where the area falls in relation to mapped wetland areas. If the area to be delineated contains or is adjacent to the boundary of a mapped wetland (*ie.* within approximately 500 feet), proceed to Step 2. If there is no mapped wetland in the immediate vicinity, note whether marsh or swamp symbols or lakes, ponds, rivers, and other waterbodies are present within the area on either the wetland map or the USGS map. If they are, then there is a good chance that a wetland is present. Further information may be required to ascertain whether a wetland that meets statutory requirements under Article 24 occurs on the site.

**Proceed to Step 2.**

**Step 2.** Review NRCS soil survey maps where available. The NRCS in cooperation with the National Technical Committee for Hydric Soils (NTCHS) has prepared a list of the Nation's hydric soils. Individual state lists have also been prepared. The national and state lists identify those soil series that meet the hydric soil records in NRCS's soils database. These lists are periodically updated.

The NRCS also maintains lists of hydric soil map units for many counties in the United States. These lists may be obtained from local NRCS district offices and are the preferred lists to use when locating areas of hydric soils. An hydric soil map unit list identifies all map units that are either named by a hydric soil or have a potential of having hydric soil inclusions. The list provides the map unit symbol, the name of the hydric soil part or parts of the map unit, information on the hydric soil composition of the map unit, and probable landscape position of hydric soils in the map unit delineation. The county lists also include map units named by miscellaneous land types or higher levels in "Soil Taxonomy" that meet hydric soil criteria.

Before conducting a wetland delineation, locate the area of concern on a soil survey map and identify the soil map units for the area. The list of hydric soils should be consulted to determine whether the soil map units are hydric. The hydric soils locations and other information should be compiled and made available for the field investigation.

**Proceed to Step 3.**

**Step 3.** Review recent aerial photos of the project area, if available. Aerial photographs may provide direct evidence of inundation or soil saturation in an area. Inundation (flooding or ponding) is best observed during the early spring when snow and ice are gone and leaves of deciduous trees and shrubs are not yet present. This allows detection of wet soil conditions that would be obscured by the tree or shrub canopy at full leaf-out. Early spring is also the best season for aerial photography of marshes.

When possible, photography from multiple dates should be examined. A "one-date" photograph will reflect conditions only at that time and may give no indication of other situations which may be typical of the site.

During photo interpretation, look for one or more signs of wetlands. For example: (1) hydrophytic vegetation; (2) surface water; (3) saturated soils; (4) flooded or drowned out crops; (5) stressed crops due to wetness; (6) greener crops in dry years; (7) differences in vegetation patterns due to different planting dates.

Accurate photo interpretation of some wetland types requires considerable expertise. In general, evergreen forested wetlands and temporarily flooded wetlands may be confusing. It is difficult to see beneath the canopy of some evergreen dominated forests. Temporarily flooded wetlands are also difficult to determine unless multiple date photography exists. Referring to other sources, such as NWI maps, soil surveys or professional photogrammetrists may also be helpful with air photo interpretation.

**Proceed to Step 4.**

**Step 4.** Review available site-specific information. Recorded hydrologic data usually provides both short and long-term information on the frequency and duration of flooding. Recorded data include stream gauge data, lake gauge data, flood predictions, and historical flood records. Use of these data are commonly limited to areas adjacent to streams and other similar areas. Recorded data may be available from the following sources:

(1) **USACOE district offices** (data for major waterbodies and for site-specific areas from planning and design documents)

(2) **USGS** (stream and tidal gauge data)
(3) **State, county and local agencies** (flood data)
(4) **NRCS state offices** (small watershed projects data)
(5) **Private developers or landowners** (site-specific hydrologic data, which may include water table or groundwater well data).

In some cases, information on vegetation, soils, and hydrology for the project area has been collected and maps drawn during previous visits to the area by department personnel, environmental consultants or others.

**After reviewing this information, proceed to Step 5.**

**Step 5.** Based on a review of existing information, determine whether NYS-regulated wetlands may exist on or near the subject area.

If there is no evidence of a regulated wetland, then no inspection of the site is necessary.

If a wetland may exist, or if after examining the available reference material you are still unsure whether a regulated wetland occurs in the area, then a field inspection of the site should be conducted.

**Proceed to Step 6.**

**Step 6.** When an onsite inspection is necessary, compile and review all pertinent background information before going to the subject site. This information will be helpful in determining the nature and extent of the wetland and what type of field methods may be employed.

Also, examine available information and decide whether there is evidence of sufficient natural or human-induced alteration to significantly modify all or a portion of the area's vegetation, soils, and/or hydrology. If such disturbance is noted, identify the limits of affected areas for on-site evaluation. The presence of disturbed areas within the area of interest will affect the type and extent of data collection needed to delineate a wetland boundary and investigate the wetland disturbance if necessary. See page 23 for disturbed area delineation procedures.

## Field Delineation Methods

In most cases, wetland delineations can be conducted without rigorous sampling of vegetation and soils. The routine delineation outlined in this manual is based on the plant community assessment procedure found in the Federal Manual. The routine approach requires identification of representative plant communities in the subject area. If needed, soils and hydrology are examined. After identifying wetland and non-wetland communities, the wetland boundary is delineated. All pertinent observations on the three wetland criteria should be recorded on an appropriate data sheet such as the one found in Appendix A on pages 43-44. Recommended equipment and materials for conducting field delineations are listed in Table 3.

## Routine Delineation Procedure

Following are steps you must take to delineate an area identified as a wetland.

**Step 1.** As you conduct your on-site investigation, identify and record plant community types present in the wetland and adjacent area. Record plants, animals, signs of hydrology and hydric soils and sketch the approximate location of each plant community, including those in the adjacent area on a data form. Take note of geological, elevational and other physical changes across the site.

**Proceed to Step 2.**

**Step 2.** Determine whether disturbed conditions are present at the subject site by considering the possibility or evidence of the following:

(1) Does it appear that site conditions have been altered by human activities, possibly without benefit of required permits?

(2) Are site conditions altered as a result of catastrophic climatological or other natural environmental occurrences such as fires, floods, beaver dam washout, prolonged droughts, etc.?

(3) Are site conditions altered as a result of legally conducted, unregulated farming activities (*ie.* plowing, draining, clearing of non-tree vegetation)?

(4) Does the existing vegetation appear to be in a state of flux (*ie.* dominant plants are not reproducing, plants lack vigor, etc.), responding to an ongoing on- or off-site perturbation?

**If the answer to any of these questions is YES, proceed to the section on Disturbed Area Wetlands (page 23).**

**If any significantly disturbed areas are observed in the project area, identify their limits. These areas should be evaluated separately for wetland delineation purposes (usually after evaluating undisturbed areas).**

**If the answer to all of these questions is NO, normal conditions are assumed to be present.**

**Proceed to Step 3.**

**Step 3.** Determine if normal environmental conditions exist that could make wetland boundary delineation difficult. Consider the following:

(1) Is the area presently lacking hydrophytic vegetation or hydrologic indicators due to seasonal, annual or longer-term fluctuations in precipitation, surface water, or groundwater levels?

(2) Are hydrophytic vegetation indicators lacking or difficult to find or identify due to seasonal fluctuations in temperature (e.g., winter die-back, seasonality of plant growth, snow or ice cover)?

**If the answer to either of these questions is YES, or uncertain, proceed to the section on Problematic Wetland Areas (page 28).**

**If the answers is NO, then the existing conditions are conducive to normal wetlands delineation procedures.**

**Proceed to Step 4.**

**Step 4.** Using the the list of "Vegetation Field Indicators of Wetland" found on pages 5-6, do a quick visual assessment of the apparent dominant species present in the wetland, and pick a location that is most likely to be on or close to the wetland boundary. At this spot, visually estimate percent areal cover of each species and determine the dominant plant species (20 percent of more areal cover in the plant community) from each of the vegetative strata and record them on the data form. For the herb (and if appropriate, bryophyte) stratum visually estimate the percent areal ground coverage of individual species within an approximate 5 foot radius around the selected spot and record on the data form. For woody vines, note those growing (originating) within the 5 foot radius. For the tree and shrub strata, visually estimate canopy cover of species within an approximate 30 foot radius of the same spot as that used for the herb stratum. If there are no leaves on the trees (or at any other time), one can use relative basal area[3] or other scientifically acceptable measure to determine dominance for the tree species.

**Proceed to Step 5.**

**Step 5.** Record the indicator status of dominant species on the data form. Indicator status is obtained from the interagency Federal list of plants occurring in wetlands for New York State.

**Proceed to Step 6.**

**Step 6.** Determine whether the hydrophytic vegetation criterion is met (see the "Vegetation Field Indicators of Wetland" listed on page 5).

**If hydrophytic vegetation is definitely present, proceed to Step 9.**

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[3]To determine basal area for individual trees, one can measure directly using a basal area tape or indirectly using a a diameter tape with a measurement of diameter at breast height (dbh) and converting diamter to basal area using the formula $A = \pi d^2/4$ (where A = basal area, $\pi = 3.1416$, and d = dbh). Calculate the total basal area for each tree species within the 30-foot radius by adding the basal area values of each individual of that species. Calculate the total basal area value of all trees in the 30-foot radius by adding the total basal area for all species. Dominant trees species are those whose total basal area immediately exeeds 20 percent or more of the total basal area in the 30-foot radius. Techniques not described in this manual are also available to determine basal area using a basal area factor prism or an angle gauge.

**If hydrophytic vegetion may be present [*ie.* more than 50 percent of the dominant species of all strata are FAC or some combination of FAC and wetter species (including OBL, FACW+, FACW-, FAC+)], proceed to Step 7 (hydrology indicators) or Step 8 (hydric soils indicators).**

**If hydrophytic vegetation is not present and the area has not been substantially altered and the lack of vegetation is not due to annual or seasonal conditions, then the area is not a New York State regulated wetland.**

**Step 7.** Determine whether any of the "Hydrologic Field Indicators of Wetland" listed on page 7 are present. Record observations and other evidence on a field data form.

**If at least one of the primary indicators or two of the secondary indicators is present, the area is a wetland.**

**If signs of hydrology are not present, proceed to Step 8.**

**Step 8.** Determine whether any of the "Soil Field Indicators of Wetland" listed on page 14 are present.

Using a soil auger, probe, or spade, make a hole at least 18 inches deep at a representative location in the plant community type not yet determined to be regulated wetland. Examine soil characteristics, compare to the indicators listed, and record the data.

**If soils match any hydric soil indicators, then the area is a wetland. Proceed to Step 9.**

If not, the area may be still be a wetland. Become familiar with problematic hydric soils that do not possess good hydric field indicators, such as red parent material soils, some sandy soils, and some floodplain soils, so that these hydric soils are not misidentified as nonhydric soils. See the discussion of Problem Wetland Delineations found on page 28 to determine if this category applies.

**If no hydric soils indicators are present and the area does not fit the description of a problem area wetland, then the area is not a wetland.**

**Step 9.** Delineate the wetland-nonwetland boundary. The wetland boundary is located where there is discernible change in the vegetation from a community predominated by wetland species to one predominated by upland species. Quite commonly, a change in vegetative community is accompanied by changes in hydrology and/or soils. Where the change in community is abrupt or occurs along a discrete interface, the observed difference in vegetation is sufficient for boundary delineation. When the change in vegetation is very gradual and a clear wetland/upland boundary is not present, hydric soils and/or hydrologic indicators may be necessary to delineate the wetland boundary.

Under these circumstances, it is useful to first go to the outer edge of an area that you are confident is wetland and carefully characterize the vegetative community. Follow the same procedure at the inner edge of the area that you are confident is upland. Somewhere between the edges of what is clearly wetland and what is clearly upland plant communities lies the wetland boundary. The wetland boundary must be identified by carefully examining the vegetation within this transition area, and in many cases, the hydrology and/or soils must also be examined.

Within the transition area, choose a spot that you think is probably close to the wetland boundary based upon the relative abundances of wetland and upland indicator species. You may be able to further refine the wetland/upland boundary line by identifying the outer limit of any wetland hydrology field indicators observed.

If this is not possible, or if preferred, soils can also be used to refine the boundary line. Using hydric soils indicators involves digging a pit where you believe the wetland boundary to be located. If characteristics of hydric soils are observed, the area you have clearly identified as wetland on the basis of vegetation is, in fact wetland.

However, the actual wetland boundary may be located somewhat closer to the known upland plant community. Therefore, additional soil pits may be needed closer to the known upland community. If hydric soils are encountered all the way up to what you have identified as the edge of a clearly upland community, and the hydrophytic vegetation criterion is met, this edge will serve as the wetland boundary and flags should be placed along that edge. If non-hydric soils are encountered within the transition zone, the wetland boundary should be located between soil pits with hydric soil characteristics and those with non-hydric soil characteristics.
Flagging the Boundary

Consider how the boundary will be identified; the color of flagging tape or markers to be used and the frequency and permanence of markers. A good rule of thumb is that you should be able to see the last marker when you place the next marker. Also, when placing markers, it is advisable to consider the permanence of the vegetation (woody vs. herbaceous) and the potential for vandalism.

To assist those who may survey your flagged boundary, especially where the boundary is convoluted or otherwise complicated, please consider sequentially numbering and initialling the flags. When flagging, be sure to close loops on themselves or to property boundaries.

**Step 10.** Draw a rough sketch of the wetland boundary on the data form. Note structures, landmarks, benchmarks, etc. and their approximate distances from the wetland boundary. Delineators can learn and use pacing methods to roughly approximate distances.

**Proceed to Step 11.**

**Step 11.** As one moves along the wetland boundary, the plant community in the immediate vicinity of the wetland boundary may change substantially (*ie*. covertype changes from wooded swamp to wet meadow vegetation). If this is the case, then repeat Steps 1 through 10 for each new wetland type.

## Complex or Controversial Wetland Sites

This manual has been written for the wetland delineator who completes normal, routine wetland boundary delineations. There may be times when the method outlined in this Manual is not comprehensive enough to meet the demands of a legal challenge. In these cases a comprehensive method of more rigorous field delineation may be needed.

The 1987 "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" provides the wetland delineator with additional methods for delineating wetland boundaries whenever the need arises. These methods include the "Intermediate-level Onsite Determination Method" and the "Comprehensive Onsite Determination Method."

## Offsite "Delineations" of Wetland Boundaries

There may be times when an onsite inspection of the wetland boundary is not necessary because reliable information on hydrology, hydric soils, hydrophytic vegetation, and other physical characteristics of the wetland is known. Offsite delineations will be rare but might include sites where the wetland boundary is known to be the edge of a pond or lake. Shorelines that have been backfilled or bulkheaded are often distinct boundaries between wetland and upland that can be readily seen on aerial or regular photography.

The accuracy of the offsite delineation depends on the quality of the information used and on one's ability and experience in interpreting data from the area in question. Where reliable, site-specific data are known, the offsite wetland delineation can be reasonably accurate.

The "Pre-inspection Procedures," Steps 1 through 5, found on pages 16-17, may be used to gather appropriate reliable information to conduct an offsite wetland delineation.

## Disturbed and Problematic Area Wetlands

During field investigations, you will undoubtedly encounter significantly disturbed or altered areas, as well as natural areas where conducting delineations is difficult. Disturbed areas include situations where field indicators of wetlands are obliterated or absent due to recent change. Also, certain wetlands, under natural conditions, are difficult to identify. Such wetlands may lack field indicators for one or more of the technical criteria for wetlands, or occur on difficult-to-identify hydric soils. These wetlands are considered problem area wetlands. The following sections discuss these difficult and confounding situations, and present procedures for distinguishing wetlands from non-wetlands and for determining whether certain areas had been regulated wetlands prior to the disturbance.

When you encounter a disturbed wetland, identify which of the three wetland identification criteria has been altered: vegetation, soils and/or hydrology. You can then proceed to the appropriate section below to determine whether hydrophytic vegetation, hydric soil and/or wetland hydrology existed at the site before the disturbance.

The general procedure for evaluating each of the three wetland identification criteria is essentially the same and requires:

**(1)** describing the nature of the disturbance;

**(2)** determining the effect of the disturbance on the vegetation, soils and/or hydrology;

**(3)** describing what likely occurred on the site before the disturbance; and

**(4)** determining if before the disturbance the site met wetland identification criteria.

## Disturbed Areas

Disturbed wetland areas have been modified to varying degrees by human activities or by natural events. Such activities and events change the character of the area, often making it difficult to identify field characteristics of one or more wetland identification criteria. Disturbed wetlands include those subjected to deposition of fill, removal or other alteration of vegetation, conversion to agricultural land and silviculture plantations, dam construction and impoundment, and channeling and drainage systems that significantly modify an area's hydrology.

As you consider the effects of natural events (e.g., wash out of a beaver dam) you must also consider the relative permanence of the change and impacts to wetland function. In cases where recent human activities have caused these changes, it may be necessary, for legal purposes, to determine the date of the alteration or disturbance.

If the activity occurred before the effective date of regulation or as the result of a permit, it may not be necessary to conduct a wetland boundary delineation for regulatory purposes. In this case only the remaining wetland boundary should be delineated. The wetland just outside of the disturbed area can simply be delineated using the routine or other appropriate method.

If the alteration was carried out in violation of Article 24, it may be necessary to determine the nature and extent of the wetland disturbance and perhaps to delineate the former boundary of the wetland for restoration or mitigation purposes.

## Delineations in Disturbed Areas

The following procedures are used to determine whether a disturbed area met the definition of wetland before alteration. Each of the three wetland identification criteria is considered separately. If, for example, only the vegetation appears to have been disturbed (*i.e*., by cutting, clearing or grading), then only those sections pertaining to hydrophytic vegetation need be consulted (Step 2). Once a determination is made concerning hydrophytic vegetation, one can return to the routine wetland delineation method and proceed from there. If alterations have affected soils and/or hydrology, procedures outlined in Steps 3 and 4 should be followed.

Field indicators for one or more of the three technical criteria for wetland identification are usually absent from disturbed wetlands and it may be necessary to determine whether the "missing" indicator(s) existed before alteration. Review existing information for the area (e.g., aerial photos, NYS Freshwater wetlands maps, NWI maps, soil surveys, hydrologic data, permit records, and previous site inspection reports) and contact knowledgeable persons familiar with the area to build supportive evidence.

When a significantly disturbed condition is detected during an onsite inspection, the following steps should be taken to determine if the "missing" indicator(s) was present before alteration.

**Step 1.** Determine whether vegetation, soils, and/or hydrology have been significantly altered at the site.

**If a human activity or natural event altered only the vegetation, proceed to Step 2; the soils, proceed to Step 3; the hydrology, proceed to Step 4.**

**Step 2.** Determine whether hydrophytic vegetation previously occurred:

**(1)** Examine the area and describe the type of alteration that occurred. Look for evidence of selective harvesting, clearcutting, bulldozing, recent conversion to agriculture, or other activities (e.g. burning, discing, the presence of buildings, dams, levees, roads, and parking lots). Estimate the approximate date the alteration occurred, if possible.

(**2)** Generally describe how the recent activities and events have affected the plant communities. Consider the following:

**a.** Has all or a portion of the area been cleared of vegetation?

**b.** Has only one layer of the plant community (e.g., trees) been removed?

**c.** Has selective harvesting resulted in the removal of some species?

**d.** Has the vegetation been burned, mowed, or heavily grazed?

**e.** Has the vegetation been covered by fill, dredged material, or structures?

**f.** Have increased water levels resulted in the death of all or some of the vegetation?

**(3)** If it is obvious that a portion of the wetland has been filled, then the remaining portion of the wetland or a similar undisturbed local or regional wetland may be important as a reference site to ascertain wetland type and boundary location of the filled portion. However, because of the meandering nature of many wetland boundaries, it is more critical to ascertain the actual presence of buried hydrophytic vegetation and hydric soils or wetland hydrology. Develop a list of species that occurred at the disturbed site from onsite and previously compiled information, if possible, and determine the presence and dominance of hydrophytic vegetation. If site specific data do not exist, evaluate a neighboring undisturbed area (reference site) with similar soil, hydrologic and topographic characteristics to the area in question prior to the alteration. If a wetland is not located adjacent to the site, you may need to travel to the next nearest wetland of a similar ecological type to determine probable wetland characteristics of the disturbed site. Be sure to record the location and major characteristics (vegetation, soils, hydrology and topography) of the reference site. Sample the vegetation in the reference site to determine whether hydrophytic vegetation is present and dominant. Aerial photographs may also help to determine what had been the extent of wetland vegetation at the disturbed site. Dig a series of holes through the fill to find the outer limit of what may have been wetland. If the fill is very thick there may be a need for power excavating equipment to determine the location of the buried wetland boundary.

**(4)** Determine whether hydrophytic vegetation was present at the project area before alteration by filling. Examine the available data and determine whether indicators of hydrophytic vegetation were formerly present (see "Vegetation Field Indicators of Wetland" on page 5). Five conditions can potentially exist. These are:

a. Hydrophytic vegetation not dominant on the reference area, no evidence of hydrophytic vegetation in test holes and evidence that the filled area <u>was</u> <u>not</u> cleared or graded prior to filling >>> Area not likely to be a wetland.

b. Hydrophytic vegetation not dominant on the reference area, no evidence of hydrophytic vegetation in test holes and evidence that the filled area <u>was</u> cleared or graded prior to filling >>> Proceed to Steps 3 and/or 4.

c. Hydrophytic vegetation not dominant on reference area <u>and</u> evidence of hydrophytic vegetation present in test holes >>> Proceed to Steps 3 and/or 4.

d. Hydrophytic vegetation dominant on reference area <u>and</u> evidence of hydrophytic vegetation present in test holes >>> Area likely to be a wetland.

e. Hydrophytic vegetation dominant on reference area <u>and</u> no evidence of hydrophytic vegetation in test holes >>> Proceed to Steps 3 and/or 4.

**If indicators of hydrophytic vegetation are lacking or insufficient at the disturbed site, but the reference site are other evidence indicates that a wetland might have existed at the disturbed site, then proceed to Step 3 and/or Step 4 to investigate the presence of hydric soils and/or hydrologic indicators.**

**If indicators and/or evidence of hydrophytic vegetation are found, the hydrophytic vegetation criterion has been met and the area should be considered wetland. Proceed to Steps 3 and 4 to gather further evidence to be used if restoration or remediation of the area is required.**

**Step 3.** Determine whether hydric soils previously existed:

**(1)** Examine the area and describe the type of soil alteration that occurred. Estimate the approximate date the alteration occurred, if possible. Look for evidence of:

- **a.** deposition of dredged or fill material or natural sedimentation.
- **b.** nonwoody debris at the surface. This can only be applied in areas where the original soils do not contain rocks. Non-woody debris includes items such as rocks, bricks, and concrete fragments.
- **c.** plowing of subsurface soil horizons. Has the area recently been plowed below the A-horizon or to depths greater than 10 inches?
- **d.** removal of surface layers. Has the surface soil layer been removed by scraping or natural landslides? Look for bare soil surfaces with exposed plant roots or scrape scars on the surface.
- **e.** human structures. Are buildings, dams, levees, roads, or parking lots, or other structures present?

**(2)** Generally describe how the recent activities and events have affected soils. Consider the following:

- **a.** Has the soil been buried? If so, record the depth of fill material and determine whether the original soil was left intact or disturbed.

(Note: The presence of a typical sequence of soil horizons or layers in the buried soil is an indication that the soil is still intact.)

- **b.** Has the soil been mixed at a depth below the A-horizon or greater than 10 inches? If so, it will be necessary to examine the soil at a depth immediately below the disturbed zone.
- **c.** Has the soil been sufficiently altered to change its permeability, etc.? Describe these changes. If a hydric soil has been drained to some extent, refer to Step 4 below to determine whether soil is effectively drained or is still hydric.

**(3)** Investigate and characterize the soils that existed prior to disturbance at the site. Consider the following:

- **a.** Buried Soils. Look for decomposing vegetation between soil layers and the presence of buried hydric soil layers. It may be impossible to examine the original soil without digging. If possible, dig a hole through the fill material until the original soil is encountered. Fill material will usually be a different color or texture than the original soil (except when fill material has been obtained from similar areas onsite). When fill material has been placed over the original soil without physically disturbing the soil, examine and characterize the buried soils. Dig 18 inches into the original soil and look for indicators of hydric soils. Record pertinent soil characteristics such as color of the soil matrix, presence of an organic layer, presence of mottles or gleying, and/or presence of iron and manganese concretions.

(Note: When the fill material is too thick, it might be necessary to use heavy equipment to expose buried soils.)

**b.** Plowed Soils. Determine the depth to which the soil has been disturbed by plowing. Look for hydric soil characteristics just below this depth.

**c.** Removed Surface Layers. Dig a hole 18 inches deep and determine whether the entire surface layer (A-horizon) has been removed. If so, examine the soil immediately below the top of the subsurface layer (B-horizon) for hydric soil characteristics. As an alternative, examine an undisturbed soil of the same soil series occurring at the same topographic position in an immediately adjacent undisturbed reference area. Look for hydric soil indicators immediately below the A-horizon and within 18 inches of the surface. Record and use these data to determine the presence of hydric soils.

**(4)** Determine whether hydric soils were present at the project area prior to alteration. Examine the available data and determine whether indicators of hydric soils were formerly present (see "Hydric Soil Field Indicators of Wetland" on page 14).

**If no indicators of hydric soils are found at the disturbed site, but the reference site or other evidence indicates that a wetland might have existed at the disturbed site, then proceed to Step 4 to investigate the presence of hydrologic indicators.**

**If indicators and/or evidence of hydric soils are found, the hydric soil criterion has been met. Continue to Step 4 if hydrology was altered, or proceed to Step 5.**

**Step 4.** Determine whether wetlands hydrology existed before alteration or whether wetland hydrology still exists (i.e., is the area effectively drained?). To determine whether wetland hydrology existed before the alteration or still exists:

**(1)** Examine the area and describe the type of alteration that occurred. Estimate the approximate date the alteration occurred, if possible. Look for evidence of:

**a.** Dams. Has recent construction of a dam or some natural event (e.g., beaver activity or landslide) caused the area to become wetter or drier?

(Note: This activity could have occurred at a considerable distance from the site. Be aware of and consider the impacts of major dams in the watershed above the project area.)

**b.** Levees, dikes, and similar structures. Have levees or dikes been recently constructed that prevent the area from periodic overbank flooding?

**c.** Ditches. Have ditches been recently constructed causing the area to drain more rapidly?

**d.** Channelization. Have feeder streams recently been channeled sufficiently to alter the frequency and/or duration of inundation?

**e.** Filling of channels and/or depressions (land-leveling). Have natural channels or depressions been recently filled?

**f.** Diversion of water. Has an upstream drainage pattern been altered so as to divert water from the area?

**g.** Groundwater withdrawal. Has prolonged and intensive pumping of groundwater for irrigation or other purposes significantly lowered the water table and/or altered drainage patterns?

**(2)** Describe the effects of the alteration on the area's hydrology. Consider the following and generally describe how the observed alteration affected the project area:

**a.** Is the area more or less frequently inundated than before alteration? To what degree and why?

**b.** Is the duration of inundation and soil saturation different than before alteration? How much different and why?

**(3)** Investigate and characterize the hydrology that existed before disturbance at the site. Field hydrologic indicators onsite or in a neighboring reference area may be useful. Look for water marks on trees or other structures, drift lines, and debris deposits, etc. If adjacent undisturbed areas are in the same topographic position, have the same soils (check soil survey map), and are similarly influenced by the same sources of inundation, look for wetland hydrology indicators in these areas.

**(4)** Determine whether hydrology was (and still is) present at the project area before alteration. Examine the available data and determine whether indicators of hydrology were formerly present (see "Hydrologic Field Indicators of Wetland" on page 7).

**If no indicators of hydrology are found at the disturbed site, but the reference site or other evidence indicates that a wetland might have existed at the disturbed site, then proceed to Step 5.**

**If indicators and/or evidence of hydric soils are found, the hydrology criterion has been met. Proceed to Step 5.**

**Step 5.** Record final decision about the presence and location of the wetland based on all available information on the site.

Return to the applicable step of the onsite determination method to continue delineating the remainder of the undisturbed wetland if applicable.

## Problematic Wetland Areas

Certain types of wetlands and/or conditions may make wetland identification difficult because field indicators of the three wetland identification criteria may be masked or absent, at least at certain times of the year. For example, wetland delineations during frozen and snow-covered conditions and during significant droughts are extraordinarily difficult and will likely require you to revisit a site during more favorable conditions.

The following wetlands are considered problem area wetlands and not disturbed wetlands because the delineation difficulties are generally due to normal environmental conditions and not the result of human activities or catastrophic natural events. Human-constructed wetlands are also included in this section because their delineation presents problems similar to some of the natural problem area wetlands.

(1) **Wetlands on glacial till -** Sloping wetlands occur in glaciated areas where thin soils cover relatively impermeable glacial till or where layers of till have different hydraulic characteristics that permit groundwater seepage. Such areas are seldom, if ever, flooded, but downslope groundwater movement keeps the soils saturated long enough to produce anaerobic and reducing soil conditions during the growing season. This promotes development of hydric soils and hydrophytic vegetation. Indicators of wetland hydrology may be lacking during the drier portion of the growing season. Hydric soil indicators also may be lacking because certain areas are so rocky that it is difficult to examine soil characteristics within 18 inches of the surface.

(2) **Interdunal swale wetland** - Along the New York coastline, seasonally wet swales supporting hydrophytic vegetation are located within sand dune complexes on barrier islands and beaches. Some of the swales are inundated or saturated to the surface for considerable periods during the growing season, while others are wet for only the early part of the season. In some cases, swales may be flooded irregularly by the tides. These wetlands have sandy soils that generally lack field indicators of hydric soil. In addition, indicators of wetland hydrology may be absent during the drier part of the growing season.

(3) **Vegetated flats -** Vegetated flats are characterized by a marked seasonal periodicity in plant growth. They are dominated by annual *OBL* species, such as wild rice (*Zizania aquatica*), and/or perennial OBL species, such as spatterdock (*Nuphar luteum*), that have leaves and stems that break down rapidly during the winter, providing no visible evidence of the plant on the wetland surface at the beginning of the next growing season. During winter and early spring, these areas lack vegetative cover and resemble mud flats; therefore, they do not appear to qualify as wetlands. But during the growing season the vegetation becomes increasingly evident, qualifying the area as wetland. In evaluating these areas, which occur both in coastal and interior parts of the state, you must consider the time of year and the seasonality of the vegetation. Again, one must become familiar with the ecology of these wetland types (see Appendix B for readings).

(4) **Wetlands created as a result of disturbance -** These wetlands include human-induced wetlands, beaver-created wetlands, and other natural wetlands. Wetlands may be purposely or accidentally created by human activities (e.g., road impoundments, undersized culverts, irrigation, and seepage from earthen dam impoundments). Many of these areas will have indicators of wetland hydrology and hydrophytic vegetation as well as dead or dying vegetation (§24-0107b,c). But the area may lack typical field characteristics of hydric soils, depending on how long the soils were inundated and/or saturated. Since these wetlands may be relatively new, field indicators may not be present. If these wetlands are on the NYS regulatory wetland maps (or, pursuant to 6NYCRR Part 664, are within 50 meters and function as a unit with a mapped wetland) and can reasonably be expected to persist over time without human intervention, then its appropriate to include them in the delineated area. If these areas do not appear on the regulatory maps, delineation of the wetland boundary in this area may be unnecessary. Contact the DEC regional wetland mapping coordinator, or within the Adirondack Park, the Adirondack Park Agency, to determine the status of the wetland area in question.

(5) **Floodplain and sandy soils (Entisols) -** Entisols are usually young or recently formed soils that have little or no evidence of pedogenically developed horizons (U.S.D.A. Soil Survey Staff 1975). These soils are typical of floodplains in New York State, but are also found in glacial outwash plains and other areas. They include sandy soils of riverine islands, bars, and banks and finer-textured soils of floodplain terraces. Wet sandy entisols (with loamy fine sand and coarser textures in horizons within 20 inches of the surface) may lack sufficient organic matter and clay to develop hydric colors. When these soils have a hue between 10YR and

10Y and distinct or prominent mottles present, a matrix chroma of 3 or less is needed to identify the soil as hydric.

(6) **Red parent material soils -** Hydric mineral soils derived from red parent materials (e.g., weathered clays, Triassic sandstones, and Triassic shales) may lack the low chroma colors characteristics of most hydric mineral soils. In these soils, the hue is redder that 10YR because of parent materials that remain red after citrate-dithionite extraction, so the low chroma requirement for hydric soil is waived (U.S.D.A. Soil Conservation Service 1982). Red soils are common in glacial areas where older landscapes of red shales and sandstones have been exposed. These red soils occur in New York in the Catskills, western Lake Ontario plain and east of the Alleghany Hills. Become familiar with these hydric soils and learn how to recognize them in the field (see "Soil Taxonomy," U.S.D.A. Soil Survey Staff 1975 and county soils surveys.)

(7) **Coniferous forested wetlands -** Wetlands dominated by conifer trees occur in many parts of the state. In dense stands, conifers may even preclude the establishment of other species and a vigorous understory. In some cases the trees are *OBL*, *FACW* and *FAC* species, e.g., black spruce (*Picea mariana*), balsam fir (*Abies balsamea*), northern white cedar (*Thuja occidentalis*), Atlantic white cedar (*Chamaecyparis thyoides*), eastern larch (*Larix laricina*). In other cases, however, the dominant conifer trees in the plant community have an indicator status of *FACU*, as listed in the "National List of Plant Species that Occur in Wetlands," e.g., red spruce (*Picea rubens*), white spruce (*P. glauca*), eastern white pine (*Pinus strobus*), red pine (*P. resinosa*), pitch pine (*P. rigida*) and eastern hemlock (*Tsuga canadensis*). These plant communities are regularly found and seem to thrive in areas of inundated and saturated soils in certain locations in New York State. Therefore, we can assume that regional and local physiological differences in these species must account for their obvious tolerance of frequent or permanent wet soil conditions. In these situations, the listed indicator status may be incorrect for the species in question in that local area. To determine if such coniferous forested areas meet the definition of wetland, soils and hydrology may need to be examined. The landscape position of these areas such as depressions, drainageways, bottomlands, flats in sloping terrain, seepage slopes and hummock and hollow topography may provide clues to the liklihood of wetland.

(8) **Spodosols (evergreen forest soils) -** These soils, usually associated with coniferous forests, are common in northern temperate regions of New York State. Spodosols have a gray eluvial E-horizon overlying a diagnostic spodic horizon of accumulated (sometimes weakly cemented) organic matter and aluminum (U.S.D.A. Soil Survey Staff 1975). A process called podzolization is responsible for creating these two soil layers. Organic acids from the leaf litter on the soil surface move down through the soil with rainfall, cleaning the sand grains in the first horizon then coating the sand grains with organic matter and iron oxides in the second layer. Some vegetation produce organic acids that speed podzolization including eastern hemlock (*Tsuga canadensis*), spruces (*Picea* spp.), pines (*Pinus* spp.), larches (*Larix* spp.), and oaks (*Quercus* spp.) (Buol, et al. 1980). To the untrained observer, the gray leached layer may be mistaken as a field indicator of hydric soil, but if one looks below the spodic horizon the brighter matrix colors often distinguish nonhydric spodosols from hydric ones. The wet spodosols (formerly called "groundwater podzolic soils") usually have thick dark surface horizons, dull gray E-horizons with dark organic vertical streaking, and low chroma subsoils. Become familiar with these soils and their diagnostic properties (see "Soil Taxonomy," U.S.D.A. Soil Survey Staff 1975 and county soil surveys).

(9) **Ditches and other narrow linear wetlands -** Ditching can cause a wetland area to become drier. Vegetation in ditches and other linear wetlands is often sparse and may consist of a relatively small number of emergent and submergent species. Ditches and linear wetlands often connect wetland areas.

(10) **Sparsely vegetated floodplains -** These are areas along river banks or bars that may have little vegetation but are inundated often enough to have some wetlands vegetation. The soils often do not exhibit the characteristic field indicators of hydric soils, however, and thereby pose delineation problems.

## Delineations in Problematic Area Wetlands

Application of these steps is necessary only after a site investigation reveals a problematic area wetland where identification of wetland field indicators is difficult because they are lacking, obscured, or otherwise atypical. Specific procedures to be used will vary according to the nature of the area, site conditions, and affected criteria. A delineation must be based on the best available evidence including: (1) information obtained from such sources as aerial photos, wetland maps, soil survey maps, and hydrologic records; (2) field data collected during an onsite inspection; and (3) basic knowledge of the ecology of the particular wetland type and associated environmental conditions. It is imperative that the wetland delineator use an extra degree of best professional judgement when delineating these difficult wetland areas.

**Step 1.** Identify each criterion in question and determine the reason for further consideration. Consider how environmental conditions have affected the criterion in question.

**Proceed to Step 2.**

**Step 2.** Document available information on each criterion in question. Examine the available information and consider personal experience and knowledge of wetland ecology and the range of normal environmental conditions of the area. Document all evidence of wetland indicators found, if any.

**Proceed to Step 3.**

**Step 3.** Determine whether each wetland criterion in question is met or would be met under normal circumstances. If environmental conditions prevent the manifestation of hydrophytic vegetation, for example, an additional site visit may be necessary.

**If sufficient evidence of wetland exists, use the field indicators of wetland found in Part I and the routine method of wetland delineation found in Part II to delineate the wetland boundary. If a reasonable investigation of the area in question reveals no evidence that the area meets the definition of a wetland, then the area is non-wetland.**

# LITERATURE CITED


Buckman, H.O., and N.C. Brady. 1969. **The Nature and Properties of Soils**. Macmillian Publishing Company, Ontario, Canada.

Buol, S.W., F.D. Hole, and R.J. McCracken. 1980. **Soil Genesis and Classification**. The Iowa State University Press, Ames, IA. 406 pp.

Diers, R., and J.L. Anderson. 1984. PART I. **Development of Soil Mottling**. Soil Survey Horizons (Winter):9-12.

Kollmorgen Corporation. 1975. **Munsell Soil Color Charts**. Macbeth Division of Kollmorgen Corp., Baltimore, MD.

New York State. 1975. **Freshwater Wetlands Act**. Article 24 of the Environmental Conservation Law, McKinney's Consolidated Laws of New York, Book 17 1/2.

Parker, W.B., S. Faulkner, B.Gambrell, and W.H. Patrick, Jr. 1984. **Soil Wetness and Aeration in Relation to Plant Adaptation for Selected Hydric Soils in the Mississippi and Pearl River Deltas. Inv: Proceedings of Workshop on Characterization, Classification, and Utilization of Wetland Soils**. (March 26-April 1, 1984). International Rice Research Institute, Los Banos, Laguna, Philippines.

Ponnamperuma, F.N. 1972. **The Chemistry of Submerged Soils**. Advances in Agronomy 24: 29-96.

Reed, P. B., Jr.1988. **National List of Plant Species That Occur in Wetlands: National Summary**. U.S. Fish and Wildlife Service, Washington, DC. Biol.Rpt. 88(24). 244 pp.

Soil Survey Staff. 1975. **Soil Taxonomy. A Basic System of Soil Classification for Making and Interpreting Soil Surveys.** U.S. Department of Agriculture, Soil Conservation Service, Washington, DC. Agriculture Handbook No. 436. 754 pp.

Tiner, R.W. 1993. **The Primary Indicators Method - A Pratical Approach to Wetland Recognition and Delineation in the United States**. Wetlands 13(1): 50-64.

Tiner, R.W. and P.L.M. Veneman. 1989. **Hydric Soils of New England**. University of Massachusetts Cooperative Extension Communications Center. 27 pp.

U.S. Army Corps of Engineers. 1987. **Corps of Engineers Wetlands Delineation Manual**. Department of the Army. Tech. Rept. Y-87-1. 99 pp. plus Appendices.

U.S.D.A. Soil Conservation Service. 1982. **Hydric Soils of the United States**. Washington, DC. National Bulletin No. 430-2-7. (January 4, 1982)

U.S.D.A. Soil Conservation Service. 1987. **Hydric Soils of the United States**. 1987. In cooperation with the National Technical Committee for Hydric Soils. USDA-SCS, Washington, DC.

U.S.F.W.S., U.S.E.P.A., U.S.D.A.S.C.S. and U.S.A.C.E. 1989. **Federal Manual for Delineating Jurisdictional Wetlands. An Interagency Cooperative Publication.** 75 pp. plus Appendices.

## TABLES

### Table 1. Adaptations of Plants that Grow in Permanently or Periodically Flooded or Saturated Soils

| **Adaptations** | **Examples of Plants Possessing Adaptation** |
|---|---|
| Buttressed (swollen) Tree Trunk | black gum (*Nyssa sylvatica*), green ash (*Fraxinus pennsylvanica)*, black ash (F. nigra), northern white cedar (*Thuja occidentalis*), Atlantic white cedar (*Chamaecyparis thyoides*) and red maple (*Acer rubrum*) |
| Multiple Trunks | red maple (*Acer rubrum*), silver maple (*A. saccharinum*), and pussy willow (*Salix discolor*) |
| Pneumataphores | no New York species |
| Adventitious Roots (arising from stem above ground) | box elder (*Acer negundo*), sycamore (*Plantanus occidentalis*), pin oak (*Quercus palustris*), green ash, seedbox (*Ludwigia* spp.), Eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*) and other willows (*Salix* spp.) |
| Shallow Roots (often exposed to ground surface) | red maple |
| Hypertrophied Lenticels | red maple, silver maple, willows, water locust (*Gleditsia aquatica*), black elderberry (*Sambucus canadensis*), and sweet gale (*Myrica gale*) |
| Aerenchyma (air-filled tissue in Roots & Stems | Eastern bur-reed (*Sparganium americanum*), soft rush (*Juncus effusus*), soft-stemmed bulrush (*Scirpus validus*), water shield (*Brasenia schreberi*), umbrella sedges (*Cyperus* spp.), other rushes (*Juncus* spp.) spike-rushes (*Eleocharis* spp.), twig-rush (*Cladium mariscoides*), buckbean (*Menyanthes trifoliata*), giant bur-reed (*Sparganium eurycarpum*), and cattails (*Typha* spp.) |
| Polymorphic Leaves | arrowheads (*Sagittaria* spp.) and water parsnip (*Sium suave*) |
| Floating Leaves | water shield, spatterdock lily (*Nuphar luteum*), and white water lily (*Nymphaea odorata*) |

Sources: Environmental Laboratory (1987) and Tiner (1988).

## Table 2. Wetland Delineation Information Sources

| Data Name | Source |
|---|---|
| Topographic Maps (mostly 1:24,000; 1:63,350 for Alaska) | U.S. Geological Survey (USGS)<br>(Call 1-800-USA-MAPS) |
| County Soil Survey Reports | U.S.D.A. Natural Resources Conservation Service (NRCS) District Offices (Unpublished reports--local district offices) |
| National Hydric Soils List<br>State Hydric Soils List<br>County Hydric Soil Map Unit List | NRCS National Office<br><br>NRCS State Offices<br>NRCS District Offices |
| National Insurance Agency Flood Maps | Federal Emergency Management Agency |
| National Wetlands Inventory Maps<br>(mostly 1:24,000; 1:63,350 for Alaska | U.S. Fish and Wildlife Service (FWS)<br>(Call 1-800-USA-MAPS) |
| Local Wetland Maps | State and local agencies |
| Land Use and Land Cover Maps | USGS (1-800-USA-MAPS) |
| Aerial Photographs | Various sources--USGS, U.S.D.A. Agricultural Stabilization and State agencies, and private sources |
| Satellite Imagery | EOSAT Corporation, SPOT Corporation, and others |
| National List of Plant Species That Occur in Wetlands (Stock No. 024-010-00682-0) | Government Printing Office<br>Superintendent of Documents<br>Washington, D.C. 20402 |
| Regional Lists of Plants that Occur in Wetlands | National Technical Information Service<br>5285 Port Royal Head, Springfield, VA 22161<br>(703) 487-4650 |
| National Wetland Plant Database | FWS |
| Stream Gauge Data | COE District Offices and USGS |
| Soil Drainage Guides | NRCS District Offices |
| Environmental Impact Statements and Assessments | Various Federal and State agencies |
| Published Reports | Federal and State agencies, universities, and others |
| Local Expertise | Universities, consultants, and others |
| Site-specific Plans and Engineering Designs | Private developers |

## Table 3. Recommended equipment and materials for on-site delineations.

| Equipment | Materials |
|---|---|
| Soil auger, probe, or spade | Data sheets and clipboard |
| Sighting compass | Field notebook |
| Pen or pencil | Base (topographic) map |
| Penknife | Aerial photographs |
| Hand lens | National Wetlands Inventory map |
| Vegetation sampling frame* | Soil survey or other soil map |
| Camera/Film | Appropriate Federal interagency wetland plants list |
| Binoculars | County hydric soil map unit list |
| Tape measure | Munsell soil color book |
| Prism or angle gauge | Plant identification field guides/manuals |
| Diameter tape | National List of Scientific Plant Names |
| Vasculum (for plant collection) | Flagging tape/wire flags/wooden stakes |
| Calculator* | Plastic bags (for collecting plants and soil samples as needed |

* Needed only for more comprehensive methods found in the 1987 Federal Delineation Manual

# GLOSSARY

**Adaptation -** The condition of showing fitness for a particular environment, as applied to characteristics of a structure, function, or entire organism; a modification of a species that makes it more fit for reproduction and/or existence under the conditions of its environment.

**Adventitious roots -** Roots found on plant stems in positions where roots normally do not occur.

**Aerenchymous tissue (Aerenchyma) -** A type of plant tissue in which cells are unusually large, resulting in large air spaces in the plant organ; such tissues are often referred to as spongy and usually provide increased buoyancy.

**Aerobic -** A condition in which molecular oxygen is a part of the environment.

**Anerobic -** A condition in which molecular oxygen is absent (or effectively so) from the environment.

**Annual -** Occurring yearly or, as in annual plants, living for only one year.

**Areal cover -** A measure of dominance that defines the degree to which above ground portions of plants cover the ground surface; it is possible for the total areal cover for all strata combined in a community or for single stratum to exceed 100 percent because: 1) most plant communities consist of two or more vegetative strata; 2) areal cover is estimated by vegetative layer; and 3) foliage within a single layer may overlap.

**Basal area -** The cross-sectional area of a tree trunk measured in square inches, square centimeters, etc.; basal area is normally measured at 4.5 feet above ground level and is used as a measure of dominance; the most commonly used tool for measuring basal area is a diameter tape or a D-tape (then convert to basal area).

**Bench mark -** A fixed, more or less permanent reference point or object of known elevation; the U.S. Geological Survey (USGS) installs brass caps in bridge abutments or otherwise permanently sets bench marks at convenient locations nationwide; the elevations on these marks are referenced to the National Geodetic Vertical Datum (NGVD), also commonly known as mean sea level (MSL); locations of these bench marks on USGS topographic maps are shown as small triangles; since the marks are sometimes destroyed by construction or vandalism, the existence of any bench mark should be field verified before planning work which relies on a particular reference point; the USGS or local state surveyors office can provide information on the existence, exact location and exact elevation of bench marks.

**Bog -** A peatland dominated by ericaceous shrubs (Family Ericaceae), sedges, and peat moss (Sphagnum spp.) and usually having a saturated water regime or a forested peatland dominated by evergreen trees (usually spruces and firs) and/or larch (Larix laricina).

**Bryophytes -** A major taxonomic group of nonvascular plants comprised of true liverworts, horned liverworts, and mosses.

**Buried Soil -** Soil covered by an alluvial, loessal, or other deposit (including human-made), usually to a depth greater than the thickness of the solum.

**Buttressed -** The swollen or enlarged bases of trees developed in response to conditions of prolonged inundation.

**Capillary fringe -** A zone immediately above the water table in which water is drawn upward from the water table by capillary action.

**Chemical reduction -** Any process by which one compound or ion acts as an electron donor; in such cases, the valence state of the electron donor is decreased.

**Chroma -** The relative purity or saturation of a color; intensity of distinctive hue as related to grayness; one of the three variables of color.

**Comprehensive Method-** A more rigorous field delineation methodology needed for complex, controversial sites where complete documentation of the delineation procedure is required. The 1987 "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" provides the wetland delineator with these methods which include the "Intermediate-level Onsite Determination Method" and the "Comprehensive Onsite Determination Method."

**Concretion -** A localized concentration of chemical compounds (e.g., calcium carbonate and iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and color; concretions of significance in hydric soils are usually iron oxides and manganese oxides occurring at or near the soil surface, which have developed under conditions of fluctuating water tables.

**Contour -** An imaginary line of constant elevation on the ground surface; the corresponding line on a map is called a "contour line."

**Criteria -** Technical requirements upon which a judgment or decision may be based.

**Deepwater habitat -** Any open water area in which the mean water depth exceeds 6.6 feet at mean low water in freshwater areas, or the maximum depth of emerging vegetation, whichever is greater.

**Density -** The number of individuals per unit area.

**Detritus -** Fragments of plant parts found on the soil surface or in water; when fused together by algae or soil particles, this detritus is an indicator that the soil surface was recently inundated.

**Diameter at breast height (dbh) -** The width of a plant stem (e.g. tree trunk) as measured at 4.5 feet above the ground surface.

**Dike -** An embankment (usually of earth) constructed to keep water in or out of a given area.

**Disturbed area -** An area where vegetation, soil, and/or hydrology have been significantly altered, thereby making a wetland determination difficult.

**Disturbed condition -** As used herein, this term refers to areas in which indicators of one or more characteristics (vegetation, soil, and/or hydrology) have been sufficiently altered by man's activities or natural events so as to make it more difficult to recognize whether or not the wetland identification criteria are met.

**Dominance -** As used in this manual, dominance is based strictly upon the abundance of a species that can be visually estimated or measured in the field. Dominant species are considered to be those with 20 percent or more areal coverage in the plant community.

**Dominance measure -** The means or method by which dominance is established, including areal coverage and basal area; the total dominance measure is the sum total of the dominance measure values for all species comprising a given stratum.

**Drained, effectively -** A condition where ground or surface water has been removed by artificial means to the point that an area no longer meets the wetland hydrology criterion.

**Drift line -** An accumulation of water-carried debris along a contour or at the base of vegetation that provides direct evidence of prior inundation and often indicates the directional flow of flood waters.

**Duff -** The matted, partly decomposed, organic surface layer of forested soils.

**Duration (of inundation/soil saturation) -** The length of time that water stands above the soil surface (inundation) or that water fills most soil pores near the soil surface (saturation); as used herein, "duration" refers to a period during the growing season.

**Entisols -** Soils of slight or recent development; common along rivers and floodplains.

**Evergreen (plant) -** Retaining its leaves at the end of the growing season and usually remaining green through the winter.

**Facultative species -** Species that can occur both in wetlands and uplands; there are three subcategories of facultative species: (1) facultative wetland plants (FACW) that usually occur in wetlands (estimated probability 67-99 percent), but occasionally are found in nonwetlands, (2) facultative plants (FAC) that are equally likely to occur in wetlands or nonwetlands (estimated probability 34-66 percent), and (3) facultative upland plants (FACU) that usually occur in nonwetlands (estimated probability 67-99 percent), but occasionally are found in wetlands (estimated probability 1-33 percent).

**Fern allies -** A group of nonflowering vascular plants comprised of clubmosses (Family Lycopodiaceae), small clubmosses (Family Selaginellaceae), and quillwrorts (Family Isoetaceae).

**Fibrists -** Organic soils (peats) in which plant remains show very little decomposition and retain their original shape; more than two-thirds of the fibers remain after rubbing the materials between the fingers.

**Flooded -** A condition in which the soil surface is temporarily covered with flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources.

**Flooding, frequent -** Flooding is likely to occur often during usual weather conditions (i.e., more than a 50 percent chance of flooding in any year, or more than 50 times in 100 years).

**Flora -** A list or manual of all plant species that may occur in an area.

**Forbs -** Broad-leaved herbs in contrast to bryophytes, ferns, fern allies, and graminoids.

**Frequency (of inundation or soil saturation) -** The periodicity of coverage of an area by surface water or saturation of the soil; it is usually expressed as the number of years the soil is inundated or saturated during part of the growing season of the prevalent vegetation (e.g., 50 years per 100 years) or as a 1-, 2-, 5-year, etc., inundation frequency.

**Gleization -** A process in saturated or nearly saturated soils which involves the reduction of iron, its segregation into mottles and concretions, or its removal by leaching from the gleyed horizon.

**Gleyed -** A soil condition resulting from gleization which is manifested by the presence of neutral grey, bluish or greenish colors through the soil matrix or in mottles (spots or streaks) among other colors.

**Graminoids -** Grasses (Family Gramineae or Poaceae) and grasslike plants such as sedges (Family Cyperaceae) and rushes (Family Juncaceae).

**Groundwater -** That portion of the water below the surface of the ground whose pressure is greater than atmospheric pressure.

**Growing season -** The portion of the year when soil temperatures are above biologic zero (41ºF) as defined by "Soil Taxonomy"; the following growing season months are assumed for each of the soil temperature regimes: (1) thermic (February-October); (2) mesic (March-October); (3) frigid (May-September); (4) cryic (June-August); (5) pergelic (July-August); (6) isohyperthermic (January-December); (7) hyperthermic (February-December), (8) isothermic (January-December) and (9) isomesic (January-December).

**Hardpan -** A very dense soil layer caused by compaction or cementation of soil particles by organic matter, silica, sesquioxides, or calcium carbonate, for example.

**Hemists -** Organic soils (mucky peats and peaty mucks) in which plant remains show a fair amount of decomposition; between one-third and two-thirds of the fibers are still visible upon rubbing the material between the fingers.

**Herb -** Nonwoody (herbaceous) plants including graminoids (grass and grasslike plants), forbs, ferns, fern allies, and nonwoody vines; for the purposes of this manual, seedlings of woody plants that are less than three feet in height are also considered herbs.

**Herb stratum -** Any vegetative layer of a plant community that is composed predominantly of herbs.

**Histic epipedon -** An 8- to 16-inch soil layer at or near the surface that is saturated for 30 consecutive days or more during the growing season in most years and contains a minimum of 20 percent organic matter when no clay is present or a minimum of 30 percent of organic matter when 60 percent or more clay is present; generally a thin horizon of peat or muck if the soil has not been plowed.

**Histosols -** An order in "Soil Taxonomy" (Soil Survey Staff 1975) composed of organic soils (mucks and peats) that have organic soil materials in more than half of the upper 32 inches or that are of any thickness if overlying rock.

**Horizon, soil -** A distinct layer of soil, more or less parallel with the soil surface, having similar properties such as color, texture, and permeability; the soil profile is subdivided into the following major horizons: A-horizon, characterized by an accumulation of organic material; B-horizon, characterized by relative accumulation of clay, iron, organic matter, or aluminum; and the C-horizon, the undisturbed and unaltered parent material. (Note: Some soils have an E-horizon, characterized by leaching of organic and other material.)

**Hue -** A characteristic of color related to one of the main spectral colors (red, yellow, green, blue, or purple), or various combinations of these principle colors; one of the three variables of color; each color chart in the Munsell Soil Color Charts (Kollmorgen Corporation 1975) represents a specific hue.

**Human-induced wetland-** Any wetland area that has been purposely or accidentally created by some activity of humans.

**Hydric soil -** A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part.

**Hydrology -** The science dealing with the properties, distribution, and circulation of water.

**Hydrophyte -** Any macrophyte that grows in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; plants typically found in wetlands and other aquatic habitats.

**Hydrophytic vegetation -** Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

**Hypertrophied lenticels -** An exaggerated (oversized) pore on the stem of woody plants through which gases are exchanged between the plant and the atmosphere; serving to increase oxygen to plant roots during periods of inundation or soil saturation.

**Indicator -** An event, entity, or condition that typically characterizes a prescribed environment or situation; indicators determine or aid in determining whether or not certain stated circumstances exist or criteria are satisfied.

**Inundation -** A condition in which water temporarily or permanently covers a land surface.

**Levee -** A natural or human-made feature of the landscape that restricts movement of water into or through an area.

**Litter -** The undecomposed plant and animal material found above the duff layer on the forest floor.

**Long duration (flooding) -** A duration class in which inundation for a single event ranges from 14 days to 1 month.

**Macrophyte -** Any plant species that can be readily observed without the aid of optical magnification, including all vascular plant species and bryophytes (e.g., *Sphagnum* spp.), as well as large algae (e.g., *Chara* spp., and *Fucus* spp.).

**Map unit -** A portion of a map that depicts an area having some common characteristic.

**Matrix, soil -** The natural soil material composed of both mineral and organic matter; matrix color refers to the predominant color of the soil in a particular horizon. The portion of a given soil having the dominant color, in most cases, the matrix will be the portion of the soil having more than 50 percent of the same color.

**Mineral soil -** Any soil consisting primarily of mineral (sand, silt, and clay) material, rather than organic matter.

**Morphological adaptation -** A structural feature that aids in fitting a species to its particular environment (e.g., buttressed bases, adventitious roots, and hypertrophied lenticels).

**Morphological features -** Properties related to the external structure of soil (such as color and texture) or plants.

**Moss-lichen wetland -** A wetland dominated by mosses (mainly peat mosses) and lichens with little or no taller vegetative species.

**Mottles -** Spots or blotches of different color or shades of color interspersed within the dominant matrix color in a soil layer; distinct mottles are readily seen and easily distinguished from the color of the matrix; prominent mottles are obvious and mottling is one of the outstanding features of the horizon.

**Nonhydric soil -** A soil that has developed under predominantly aerobic soil conditions.

**Nonpersistent vegetation -** Plants that break down readily after the growing season; no evidence of previous year's growth at beginning of next growing season.

**Nonwetland -** Any area that has sufficiently dry conditions that hydrophytic vegetation, hydric soils, and/or wetland hydrology are lacking; it includes upland as well as former wetlands that are effectively drained.

**Normal environmental conditions or circumstances -** Refers to conditions that are normally present, without the influence of human disturbance or intervention, or catastrophic natural events.

**Obligate wetland species -** A plant species that is nearly always found in wetlands; its frequency of occurrence in wetlands is 99 percent or more.

**Offsite determination method -** A technique for delineating a wetland boundary in the office with the help of site-specific information.

**Onsite determination method -** A technique for delineating a wetland boundary using evidence gathered in the field.

**Organic soil -** See Histosols.

**Overbank flooding -** Any situation in which inundation occurs as a result of the water level of a river or stream rising above bank level.

**Oxidation-reduction process -** A complex of biochemical reactions in soil that influences the valence state of elements and their ions found in the soil; long periods of soil saturation during the growing season tend to elicit anaerobic conditions that shift the overall process to a reducing condition.

**Oxidized rhizospheres -** Oxidized zones of iron (rust colored) and manganese (black colored) surrounding living roots and rhizomes of hydrophytic plants.

**Parent material -** The unconsolidated and more or less weathered mineral or organic matter from which the soil profile is developed.

**Pedogenic -** Related to soil-building processes occurring within the soil.

**Perennial (plant) -** Living for many years.

**Periodically -** Used herein, to define detectable regular or irregular saturated soil conditions or inundation, resulting from ponding of groundwater, precipitation, overland flow, or stream flooding that occur(s) with hours, days, weeks, months, or even years between events.

**Permanently flooded -** A water regime condition where standing water covers the land surface throughout the year (but may be absent during extreme droughts).

**Permeability -** The quality of the soil that enables water to move downward through the profile, measured as the number of inches per hour that water moves downward through the saturated soil.

**Physiological adaption -** A peculiarity of the basic physical and chemical activities that occur in cells and tissues of a species, which results in it being better fitted to its environment (e.g. ability to absorb nutrients under low oxygen tensions).

**Plant community -** The plant populations existing in a shared habitat or environment.

**Pneumatophore -** Modified roots (called "knees") rising above ground that may function as a respiratory organ in species subjected to frequent inundation or soil saturation.

**Podzolization -** The process by which sesquioxides (aluminum and iron) are leached from the A-horizon and precipitated in the B-horizon, often resulting in a leached layer, the E-horizon.

**Polymorphic (leaves)-** Two or more different types of leaves formed on plants; in wetland plants, polymorphic leaves may develop due to extended flooding.

**Ponded -** A condition in which free water covers the soil surface, for example, in a closed depression; the water is removed only by percolation, evaporation, or transpiration.

**Poorly drained -** A condition in which water is removed from the soil so slowly that the soil is saturated periodically during the growing season or remains wet for long periods greater than seven days.

**Problem area wetland -** A wetland that is difficult to identify because indicators of wetland plants, hydrology and/or hydric soils are lacking or obscurred as a result of normal environmental conditions.

**Profile -** Vertical section of the soil through all its horizons and extending into the parent material.

**Range -** The set of conditions throughout which an organism (e.g., plant species) naturally occurs.

**Reduction -** The process of changing an element from a higher to a lower oxidation state as in the reduction of ferric ($Fe3+$) iron into ferrous iron ($Fe2+$).

**Relative basal area -** An estimate of basal area for trees, such as produced by the Bitterlich sampling technique.

**Rhizosphere -** The zone of soil in which interactions between living plant roots and microorganisms occur.

**Sapling -** Woody vegetation between 0.4 and 5.0 inches in diameter at breast height and between 3 and 20 feet in height, exclusive of woody vines.

**Saprists -** Organic soils (mucks) in which most of the plant material is decomposed and the original constituents cannot be recognized; less than one-third of the fibers remain visible upon rubbing the material between the fingers.

**Saturated -** A condition in which all easily drained voids (pores) between soil particles are temporarily or permanently filled with water, significant saturation during the growing season is considered to be usually one week or more.

**Seedling -** A young tree that is generally less than three feet high.

**Shrub -** Woody vegetation usually greater than 3 feet but less than 20 feet tall, including multi-stemmed, bushy shrubs and small trees and saplings. (Note: Woody seedlings less than three feet tall are considered part of the herbaceous layer.)

**Soil -** Unconsolidated material on the earth's surface that supports or is capable of supporting plants.

**Soil horizon -** See "Horizon, soil".

**Soil matrix -** See "Matrix, soil".

**Soil permeability -** The ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil.

**Soil pore -** An area within soil occupied by either air or water, resulting from the arrangement of individual soil particles or peds.

**Soil profile -** A vertical section of the soil through all its horizons and extending into the parent material.

**Soil series -** A group of soils having horizons similar in differentiating characteristics and arrangements in the soil profile, except for texture of the surface layer.

**Soil structure -** The combination of arrangement of primary soil particles into secondary particles, units, or peds.

**Soil surface -** The upper limits of the soil profile; for mineral soils, the upper limits of the highest mineral horizon (A-horizon); for organic soils, the upper limit of undecomposed organic matter.

**Soil texture -** The relative proportions of the various sizes of particles (silt, sand and clay) in a soil.

**Somewhat poorly drained -** A condition in which water is removed slowly enough that the soil is wet for significant periods during the growing season.

**Spodic horizon -** A subsurface layer of soil characterized by the accumulation of aluminum oxides (with or without iron oxides) and organic matter; a diagnostic horizon for Spodosols.

**Stratigraphy -** A term referring to the origin, composition, distribution, and succession of geologic strata (layers).

**Strata or stratum, vegetative -** A layer of vegetation used to determine dominant species in a plant community.

**Suborder (soils) -** Second highest taxonomic level of the current U.S. soil classification system.

**Substrate -** nonsoil.

**Surface water -** Water present above the substrate or soil surface.

**Temperate region -** The geographic area having a climate that is neither very hot nor very cold.

**Topography -** The configuration of a surface, including its relief and the position of its natural and man-made features.

**Transpiration -** The process in plants by which water is released into the gaseous environment (atmosphere), primarily through stomata.

**Tree -** A woody plant 5 inches or greater in diameter at breast height and 20 feet or taller.

**Typical -** That which normally, usually, or commonly occurs.

**Unconsolidated parent material -** Material from which a soil develops.

**Upland -** Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils, and/or hydrologic characteristics associated with wetlands. Such areas occurring in floodplains are more appropiately termed nonwetlands.

**Value (soil color) -** The relative lightness or intensity of color, approximately a function of the square root of the total amount of light, one of the three variables of color.

**Vascular (plant) -** Possessing a well-developed system of conducting tissue to transport water, mineral salts, and foods within the plant.

**Vegetation -** The sum total of macrophytes that occupy a given area.

**Very long duration (flooding) -** A duration class in which inundation for a single event is greater than one month.

**Very poorly drained -** A condition in which water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season.

**Water mark -** A line on vegetation or other upright structures that represents the maximum height reached in an inundation event.

**Water table -** The zone of saturation at the highest average depth during the wettest season; it is at least six inches thick and persists in the soil for more than a few weeks.

**Wetlands -** As used herein, areas that under normal circumstances have hydrophytic vegetation, hydric soils, and wetland hydrology.

**Wetland boundary delineation-** The process by which a wetland's uppermost (upland) edge is identified.

**Wetland hydrology -** In general terms, permanent or periodic inundation or prolonged soil saturation sufficient to create anaerobic conditions in the soil.

**Wetland indicator status -** The exclusiveness with which a plant species occurs in wetlands; the different indicator categories (i.e., facultative species, and obligate wetland species) are defined elsewhere in this glossary.

**Wooded swamp -** A wetland dominated by trees; a forested wetland.

# APPENDIX A: FIELD FORMS - FRESHWATER WETLAND PLANT LIST AND FIELD INSPECTION SHEET

## Trees

____Ash, Black **Fraxinus nigra** FACW
____Ash, Green **Fraxinus pennsylvanica** FACW
____Aspen, Trembling **Populus tremuloides** FACU
____Birch, Gray **Betula populifolia** FAC
____Birch, Yellow **Betula allechaniensis** FAC
____Cedar, A. White **Chamaecyparis thyoides** OBL
____Cedar, N. White **Thuja occidentalis** FACW
____Cottonwood, Eastern **Populus deltoides** FAC
____Elm, American **Ulmus americana** FACW
____Fir, Balsam **Abies balsamea** FAC
____Gum, Black **Nyssa sylvatica** FAC
____Hemlock, Eastern **Tsuga canadensis** FACU
____Hornbeam, American **Carpinus caroliniana** FAC
____Larch, Eastern **Larix laricina** FACW
____Maple, Red **Acer rubrum** FAC
____Maple, Silver **Acer saccharinum** FACW
____Oak, Burr **Quercus macrocarpa** FAC
____Oak, Pin **Quercus palustris** FACW
____Oak, Swamp White **Quercus bicolor** FACW
____Pine, Eastern White **Pinus strobus** FACU
____Poplar, Balsam **Populus balsamifera** FACW
____Shadbush, Serviceberry **Amelanchier arborea** FAC
____Spruce, Black **Picea mariana** FACW
____Spruce, Red **P. rubens** FACU
____Sycamore, American **Platanus occidentalis** FACW
____Willow, Black **Salix nigra** FACW

## Shrubs and Vines (see also Bog Mat)

____Alder, Speckled **Alnus incana** ssp. **rugosa** FACW
____Azalea, Swamp **Rhododendron viscosum** OBL
____Birch, Low **Betula pumila** OBL
____Blueberry, Highbush **Vaccinium corymbosum** FACW
____Buttonbush **Cephalanthus occidentalis** OBL
____Chokeberry, Black **Aronia melanocarpa** FAC
____Cranberry-bush **Viburnum trilobum** FACW
____Currant, Black **Ribes americanum** FACW
____Dogwood, Red Osier **Cornus sericea** FACW
____Elder, American **Sambucus canadensis** FACW
____Gale, Sweet **Myrica gale** OBL
____Gooseberries **Ribes lacustre**, **R.glandulosum** FACW
____Honeysuckle, Swamp Fly **Lonicera oblongifolia** OBL
____Inkberry **Ilex glabra** FACW
____Leatherleaf **Chamaedaphne calyculata** OBL
____Maleberry **Lyonia ligustrina** FACW
____Mountainholly **Nemopanthus mucronatus** OBL
____Pepperbush, Sweet **Clethra alnifolia** FAC
____Rose, Swamp **Rosa palustris** OBL
____Spicebush **Lindera benzoin** FACW
____Sweetbells **Leucothoe racemosa** FACW
____Sweetgale **Myrica gale** OBL
____Viburnum, (Arrowwood) **Viburnum recognitum** FACW
____Viburnum, (Wildraisin) **Viburnum cassinoides** FACW
____Water-willow **Decodon verticillatus** OBL
____Willow, Pussy **Salix discolor** FACW
____Willows **Salix** spp. FAC/FACW/OBL
____Winterberry, Holly **Ilex verticillata** FACW
____Witch-hazel, American **Hamamelis virginiana** FAC

## Emergent/Wet Meadow/Understory

____Arrow Arum **Peltandra virginica** OBL
____Arrowhead **Sagittaria** spp. OBL
____Arrow-leaved Tearthumb **Polygonum sagittatum** OBL
____Aster, Purple Stem **Aster puniceus** OBL
____Groundsel-Tree **Baccharis halimifolia** FAC
____Bedstraws **Galium** sp. mostle FACW & OBL
____Beggar Tick **Bidens** spp. OBL/FAC/FACW
____Blackberry, Dwarf **Rubus pubescens** FACW
____Bluegrass, Fowl **Poa palustris** FACW
____Bluejoint **Calamagrostis canadensis** FACW
____Boneset **Eupatorium perfoliatum** FACW
____Bulrush, Common **Scirpus atrovirens** OBL
____Bulrush, Soft Stem **Scirpus validus** OBL
____Bulrush, Hard Stem **Scirpus acutus** OBL
____Burreed, Giant **Sparganium eurycarpum** OBL
____Burreed, Narrow-leaved **Sparganium emersum** OBL
____Burreeds **Sparganium spp.** OBL
____Cardinal Flower **Lobelia cardinalis** FACW
____Cattails **Typha latifolia, T. angustifolia, T.x glauca** OBL
____Cinquefoil, Marsh **Potentilla palustris** OBL
____Dock, Swamp **Rumex verticillatus** OBL
____Forget-me-not **Myosotis scorpioides** OBL
____Goldenrod **Solidago** spp. various
____Hedgey-Hyssop **Gratiola** sp. OBL
____Iris, Wild **Iris versicolor** OBL
____Jewelweed **Impatiens capensis** FACW
____Joe-Pye-Weed, Spotted **Eupatorium maculatum**FACW
____Joe-Pye-Weed, Green-stemmed **E. purpureum** FAC
____Lily, Wild Calla **Calla palustris** FACW
____Lobelia, Ontario **Lobelia kalmii** OBL
____Lobelia, Water **L. dortmanna** OBL
____Loosestrife, Purple **Lythrum salicaria** FACW
____Mannagrass, Slender **Glyceria melicaria** OBL
____Mannagrass, Canada **Glyceria canadensis** OBL
____Mannagrass, Pale **Torreyochloa pallida** OBL
____Mannagrass, Fowl **Glyceria striata** OBL
____Marigold, Marsh **Caltha palustris** OBL
____Meadowrue **Thalictrum** sp. FAC/FACW
____Milkweed, Swamp **Asclepias incarnata** OBL
____Millet, Wild **Echinochloa** spp. FACW
____Mint, Water **Mentha aquatica** OBL
____Monkeyflower **Mimulus** spp. OBL
____Orchid, Purple Fringed **Platanthera psychodes** FACW
____Parsnip, Water **Sium sauve** OBL
____Pickerelweed **Pontederia cordata** OBL
____Pipewort **Eriocaulon septangulare** OBL
____Reed-Meadow Grass **Glyceria grandis** OBL
____Reed Canary Grass **Pharlaris arundinacea** FACW/OBL
____Reedgrass **Phragmites australis** FACW
____Rice Cut-grass **Leersia oryzoides** OBL
____Rice, Wild **Zizania aquatica** spp. OBL
____Rush, River **Scirpus fluviatilis** OBL
____Rush, Slender **Juncus debilis** OBL
____Rush, Soft **Juncus effusus** FACW
____Saxifrage, Swamp **Saxifraga pennsylvanica** OBL
____Sedge, Tussock **Carex stricta** OBL
____Sedge, Three-way **Dulichium arundinaceum** OBL
____Sedges **Carex** spp. mostly FACW & OBL
____Skullcap **Scutellaria** spp. OBL
____Skunk Cabbage **Symplocarpus foetidus** OBL
____Smartweed **Polygonum** spp. OBL/FACW
____Spearmint **Mentha spicata** FACW
____Speedwell, Marsh **Veronica americana** OBL
____Spikerush **Eleocharis** spp. OBL/FACW+
____Spiraea **Spiraea spp.** FAC & FACW
____St. Johnswort, Marsh **Triadenum virginicum** OBL
____Swamp Candles **Lysimachia terrestris** OBL
____Sweet Flag **Acorus calamus** OBL
____Three-square **Scirpus americanus** OBL
____Turtlehead **Chelone glabra** OBL
____Vervain **Verbena** sp. FACW
____Water-horehound (Bugleweed) **Lycopus** spp. OBL
____Water Plantain **Alisma** spp. OBL
____Waterwillow **Decodon verticillatus** OBL
____Willow Herb **Epilobium** spp. OBL/FAC/FACW
____Woolgrass **Scirpus cyperinus** spp. FACW
____Yellow-eyed Grass **Xyris** sp. OBL

## Floating Leaved/Submergent

____Bladderworts **Utricularia spp.** OBL
____Chara **Chara spp.** OBL*
____Coontail **Ceratophyllum demersum** OBL
____Duckweed, Lesser **Lemna minor** OBL
____Frog's-Bit **Hydrocharis morus-ranae** OBL
____Hearts, Floating **Nymphoides cordata** OBL
____Lily, White Water **Nymphaea odorata** OBL
____Lily, Yellow Pond **Nuphar** spp. OBL
____Milfoil, Water **Myriophyllum** spp. OBL
____Naiad **Najas spp.** OBL
____Nitella **Nitella spp.** OBL*
____Pondweeds **Potomogeton** spp. OBL
____Ribbongrass **Vallisneria americana** OBL
____Saxifrage, Golden **Chrysosplenium americanum** OBL
____Smartweed, Water **Polygonum amphibium** OBL
____Starwort, Water **Callitriche** sp. OBL
____Watermeal **Wolffia** spp. OBL
____Watershield **Brasenia schreberi** OBL

## Bog Mat (Use only if mat is present)

____Aster, Bog **Aster nemoralis** FACW
____Bladderwort **Utricularia spp.** OBL
____Bogbean **Menyanthes trifolia** OBL
____Cottongrass **Eriophorum spp.** OBL
____Cranberry, Small **Vaccinium oxycoccos** OBL
____Cranberry, Large **Vaccinium macrocarpon** OBL
____Labrador Tea **Ledum groenlandicum** OBL
____Laurel, Bog **Kalmia polifolia** OBL
____Laurel, Sheep **Kalmia angustifolia** FAC
____Leatherleaf **Chamaedaphne calyculata** OBL
____Orchid, Fringed White **Platanthera blephariglottis** OBL
____Pink, Grass **Calopogon tuberosus** FACW
____Pitcher Plant **Sarracenia purpurea** OBL
____Pogonia, Rose **Pogonia ophioglossoides** OBL
____Rhodora **Rhododendron canadense** FACW
____Rosemary, Bog **Andromeda glaucophylla** OBL
____Few-seeded Sedge **Carex oligosperma** OBL
____Sundews **Drosera** spp. OBL

## Bryophytes

____**Sphagnum spp.**

## Ferns and Allies

____Clubmoss, Bog **Lycopodium inundatum** OBL
____Horsetail, Variegated **Equisetum variegatum** FACW
____Horsetail, Water **E. fluviatile** OBL
____Horsetail, Rough **E. hyemale** FACW
____Horsetail, Marsh **E. palustre** FACW
____Scouring-rush, Dwarf **E. scirpoides** FAC
____Chain Fern, Netted **Lorinseria areolata** FACW
____Chain Fern, Virginia **Anchistea virginica** OBL
____Cinnamon Fern **Osmunda cinnamomea** FACW
____Clinton's Fern **Dryopteris clintoniana** FACW
____Crested Shield Fern **D. cristata** FACW
____Interrupted Fern **Osmunda claytoniana** FAC
____Marsh Fern **Thelypteris palustris** FACW
____Ostrich Fern **Matteuccia struthiopteris** FACW
____Royal Fern **Osmunda regalis** OBL
____Sensitive Fern **Onoclea sensibilis** FACW

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# APPENDIX B

SELECTED WETLAND REFERENCES

## I. WETLAND FIELD GUIDES

Burkhalter, A.P., L.M. Curtis, R.L. Lazor, M.L. Beach, and J.C. Hudson. 1973. **Aquatic Weed Identification and Control Manual**. Bureau of Aquatic Plant Research and Control, Florida Department of Natural Resources, Tallahassee, FL. 100 pp.

Fairbrothers, D.E., E.T. Moul, A.R. Essbach, D.N. Riemer, D.A. Schallock. 1979. **Aquatic Vegetation of New Jersey**. Extension Service, College of Agriculture, Rutgers-The State University, New Brunswick, NJ. Extension Bulletin No. 382. 107 pp.

Hotchkiss, N. 1964. **Pondweeds and Pondweedlike Plants of Eastern North America**. U.S. Fish and Wildlife Service, Washington, DC. Circular 187. 30 pp.

___________. 1965. **Bulrushes and Bulrushlike Plants of Eastern North America**. USDI, Fish and Wildlife Service, Washington, DC. Circular 221. 19 pp.

___________. 1970. **Common Marsh Plants of the United States and Canada**. U.S. Fish and Wildlife Service, Washington, DC. Resources Publication No. 93.

___________. 1972. **Common Marsh, Underwater and Floating-leaved Plants of the United States and Canada**. Dover Publications, New York, NY.

Lyon, J.G. 1993. **Practical Handbook for Wetland Identification and Delineation**. Lewis Publishers, Boca Raton. 157 pp.

Magee, D.W. 1981. **Freshwater Wetlands: A Guide to Common Indicator Plants of the Northeast**. University of Massachusetts Press, Amherst, MA. 245 pp.

Otto, N.E. 1980. **Aquatic Pests on Irrigation Systems, Identification Guide**. (2nd. ed.) Department of the Interior, Water and Power Resources Service, Denver, CO. 90 pp.

Prescott, G.W. 1969. **How to Know the Aquatic Plants**. Brown Co., Dubuque, IA. 171 pp.

Schlosser, D.W. 1986. **A Field Guide to Valuable Underwater Aquatic Plants of the Great Lakes**. Michigan State University, East Lansing, MI. 32pp.

Tiner, R.W. Jr. 1987. **A Field Guide to Coastal Wetland Plants of the Northeastern United States**. University of Massachusetts Press, Amherst, MA. 285 pp.

__________. 1988, **Field Guide to Nontidal Wetland Identification**. Maryland Department of Natural Resources, Water Resources Administration, Annapolis, MD. and U.S. Fish and U.S. Fish and Wildlife Service, Region 5, Newton Corner, MA. 283 pp. plus 198 color plates.

U.S. Army Corps of Engineers. 1977. **Wetland Plants of the Eastern United States**. North Atlantic Corps of Engineers Division, New York, NY. Publ. No. 200-1-1.

______________________________. 1979. **Supplement to Wetland Plants of the Eastern United States**. North Atlantic Division, New York, NY. NADP-200-1-1, Suppl. 1.

## II. WETLAND PLANT TAXONOMIC MANUALS AND CHECKLISTS

Fassett, N.C. 1975. **A Manual of Aquatic Plants**. University of Wisconsin Press, Madison, WI. 405 pp.

Hotchkiss, N. 1950. **Checklist of Marsh and Aquatic Plants of the United States**. USDI, Fish and Wildlife Service, Washington, DC. Wildlife Leaflet No. 210. 34 pp.

Muenscher, W.D. 1972. **Aquatic Plants of the United States**. Cornell University Press, Ithaca, NY.

## III. OTHER FIELD GUIDES FOR PLANT IDENTIFICATION

Brown, L. 1976. **Weeds in Winter**. Houghton Mifflin Co., Boston, MA.

Cobb, B. 1963. **A Field Guide to the Ferns and Their Related Families of Northeastern and Central North America**. Houghton Mifflin Co., Boston, MA. 281 pp.

Courtenay, B. and J.H. Zimmerman. 1972. **Wildflowers and Weeds**. Van Nostrand Reinhold Company, New York, NY. 144 pp.

Grimm, W.C. 1957. **The Book of Shrubs**. Bonanza Books, NY. 522 pp.

Harlow, W.H. 1941. **Fruit Key and Twig Key to Trees and Shrubs**. Dover Publications, New York, NY.

Harrington, H.D. 1977. **How to Identify Grasses and Grasslike Plants**. The Swallow Press, Inc., Chicago. IL. 142 pp.

Knoble, E. 1977. **Field Guide to the Grasses, Sedges, and Rushes of the United States**. (Reprint). Dover Publishing, Inc., NY. 83 pp.

Little, E.L. 1985. **The Audubon Society Field Guide to North American Trees: Eastern Region**. Alfred A. Knopf, Inc., New York, NY.

Newcomb, L. 1977. **Newcomb's Wildflower Guide**. Little, Brown and Co., Boston, MA.

Niering, W.A. and W.C. Olmstead. 1979. **The Audubon Society Field Guide to North American Wildlowers: Eastern Region**. Alfred A. Knopf, Inc., New York, NY.

Petrides, G.A. 1958. **A Field Guide to the Trees and Shrubs**. Houghton Mifflin Co., Boston, MA.

Peterson, R.T. and M. McKenny. 1968. **A Field Guide to Wildflowers of Northeastern and North Central North America**. Houghton Mifflin Co., Boston, MA.

Rickett, H.W. 1979. **Wild Flowers of the United States**. VOLUMES I-VI PLUS INDEX. The New York Botanical Garden, McGraw-Hill Book Company, New York, NY. Vol. I-559 pp., Vol. II-688 pp., Vol. III-553 pp., Vol. IV-801 pp., Vol. V-666 pp., Vol. VI-784 pp., Index-152 pp.

Trelease, W. 1931. **Winter Botany**. Dover Publications, New York, NY.

## IV. OTHER PLANT TAXONOMIC MANUALS, CHECKLISTS, AND ATLASES

Ahmadjian, V. 1979. **Flowering Plants of Massachusetts**. Univerity of Massachusetts Press, Amherst, MA. 582 pp.

Batson, W.T. 1977. **Genera of the Eastern Plants: A Guide to the Genera of Native and Commonly Introduced Ferns and Seed Plants of Eastern North America**. John Wiley and Sons, NY.

Britton, N.L., and H.A. Brown. 1970. **An Illustrated Flora of the Northern United States and Canada, Volumes 1, 2, and 3**. Dover Publications, Inc., New York, NY. Vol. 1-680 pp., Vol. 2-735 pp., Vol. 3-637 pp.

Gleason, H.A. and A. Cronquist. 1963. **Manual of Vascular Plants of Northeastern United States and Adjacent Canada**. D. Van Nostrand Co., New York, NY.

Harlow, W.M. 1957. **Trees of the Eastern and Central United States and Canada**. Dover Publications, Inc. New York, NY. 288 pp.

Hitchcock, A.S. 1971. **Manual of the Grasses of the United States**. Dover Publications, New York, NY. (Two Vols.).

Little, E.L. 1971. **Atlas of United States Trees, Volume, I. Conifers and Important Hardwoods**. USDA, Forest Service, Washington, DC. Miscellaneous Publ. No. 1146. 9 pp. 200 maps.

_________________. 1979. **Checklist of United States Trees (Native and Naturalized)**. USDA, Forest Service, Washington, DC. Agriculture Handbook No. 541. 375 pp.

Preston, J. 1976, **North American Trees**. The Iowa State University Press, Ames, IA. 399 pp.

Sargent, C.S. 1965. **Trees of North America**. Dover Publications, New York, NY. (Two Vols.).

Wiegand, K.M., and A.J. Eames. 1926. **The Flora of the Cayuga Lake Basin, New York**. Cornell University Agricultural Experiment Station, Cornell University Press, Ithaca, NY. Memoir No. 92. 491 pp.

## V. HYDRIC SOILS PUBLICATIONS

Bouma, J. 1983. **Hydrology and Soil Genesis of Soils with Aquic Moisture Regimes**. In: L.P. Wilding, N.E. Smeck, and G.F. Hall (editors), **Pedogenesis and Soil Taxonomy. I. Concepts and Interactions**. Elsevier Science Publishers, B.V. Amsterdam. pp. 253-281.

Diers, R., and J.L. Anderson. 1984. **Part I. Development of Soil Mottling**. Soil Survey Horizons (Winter): 9-12.

International Rice Research Institute. 1985. **Wetland Soils: Characterization, Classification and Utilization**. Manila, Philippines.

Mausbach, M.J. 1994. **Classification of Wetland Soils for Wetland Identification**. Soil Survey Horizons (Spring): 17-25.

Ponnamperuma, F.N. 1972. **The Chemistry of Submerged Soils**. Advances in Agronomy 24:29-96.

Soil Survey Staff. 1988. **Keys to Soil Taxonomy (Fourth Printing)**. Cornell University, Ithaca, NY. SMSS Technical Monograph No. 6.

Tiner, R.W. and P.L.M. Veneman. 1987. **Hydric Soils of New England**. University of Massachusetts Cooperative Extension, Amherst, MA. Bulletin C-183. 27 pp.

## VI. OTHER SOILS MANUALS

Black, C.A. 1968. **Soil-plant Relationships**. John Wiley & Sons, Inc. New York, NY.

Birkehead, P.W. 1984. **Soils and Geomorphology**. Oxford University Press, New York, NY. 372 pp.

Brady, Nyle C. 1974. **The Nature and Properties of Soils**. MacMillan Publishing Co., Inc. 639 pp.

Buol, S.W., F.D. Hole, and R.J. McCracken. 1980. **Soil Genesis and Classification**. The Iowa State University Press, Ames, IA. 406 pp.

Kollmorgen Corporation. 1975. **Munsell Soil Color Charts**. Macbeth Division of Kollmorgen Corporation, Baltimore, MD.

USDA, Soil Conservation Service. 1983. **National Soils Handbook**. Department of Agriculture, Washington, DC.

________________________________. 1984. **Soil Survey Manual**. Department of Agriculture, Washington, DC.

USDA, Soil Survey Staff. 1972. **Soil Series of the United States, Puerto Rico, and the Virgin Islands: Their Taxonomic Classification**. Department of Agriculture, Washington, DC.

## VII. PLANT-SOIL STUDY REPORTS

Allen, S.D., F.C. Golet, A.F. Davis, and T.E. Sokoloski. 1989. **Soil-vegetation Correlations in Transition Zones of Rhode Island Red Maple Swamps**. U.S. Fish and Wildlife Service, Washington, DC.

## VIII. COMMUNITY PROFILE AND ECOLOGICAL CHARACTERIZATION REPORTS

Damman, A.W. H. and T.W. French. 1987. **The Ecology of Peat Bogs in the Glaciatetd Northeastern United States: A Community Profile**. U.S. Fish and Wildlife Service, Washington, DC. Biol. Rpt. 85 (7.16). 100 pp.

Fish and Wildlife Service. 1981. **Fish and Wildlife Resources of the Great Lakes Coastal Wetlands Within the United States**. VOLUMES 1-6 U.S. Fish and Wildlife Service, Washington, DC. Vol. 1-480 pp., Vol. 2-1351 pp., Vol. 3-530 pp., Vol. 4-834 pp., Vol. 5-1676 pp., Vol. 6-901 pp.

Glaser, P.H. 1987. **The Ecology of Patterned Boreal Peatlands of Northern Minnesota: A Community Profile**. U.S. Fish and Wildlife Service, Washington, DC. Biol. Rpt. 85 (7.14). 98 pp.

Herdendorf, C.E. 1987. **The Ecology of Coastal Marshes of Western Lake Erie: A Community Profile**. U.S. Fish and Wildlife Service, Washington, DC. Biol. Rpt. 85 (7.9). 240 pp.

_________________., C.N. Raphael, and E. Jawarski. 1986. **The Ecology of Lake St. Clair Wetlands: A Community Profile**. U.S. Fish and Wildlife Service, Washington, DC. Biol. Rpt. 85 (7.7). 187 pp.

Odum, W.E., T.J. Smith III, J.K. Hoover, and C.C. McIvor. 1984. **The Ecology of Tidal Freshwater Marshes of the United States East Coast: A Community Profile**. U.S. Fish and Wildlife Service, Washington, DC. Publ. No. FWS/OBS-83/17. 176 pp.

Wharton, C.H., W.M. Kitchens, E.C. Pendleton, and T.W. Sipe. 1982. **The Ecology of Bottom-land Hardwood Swamps of the Southeast: A Community Profile**. U.S. Fish and Wildlife Service, Washington, DC. Publ. No. FWS/OBS-81/37.

## IX. OTHER WETLAND BOOKS OF INTEREST

Good, R.E., D.F. Whigham, R.L. Simpson (editors). 1978. **Freshwater Wetlands.** Academic Press, New York, NY.

Hall, L.C. 1968. **Bibliography of Freshwater Wetlands Ecology and Management**. Department of Natural Resources, Madison, WI. Res. Rpt. No. 33.

Hook, D.D. 1978. **Plant Life in Anaerobic Environments.** Ann Arbor Science Publishers, Inc., Ann Arbor, MI. 2564 pp.

Kozlowski, T.T. (editor) 1984. **Flooding and Plant Growth**. Academic Press, Inc., Orlando, FL. 356 pp.

Laderman, A.D. (editor) 1987. **Atlantic White Cedar Wetlands**. Westview Press, Inc., Boulder, CO.

McCormick, J. 1970. **The Pine Barrens: A Preliminary Ecological Inventory**. New Jersey State Museum, Trenton, NJ. Research Report No. 2. 100 pp.

Mitsch, W.J. and J.G. Gosselink. 1986. **Wetlands**. Van Nostrand Reinhold Co., Inc., New York, NY.

Niering, W.A. 1984. **Wetlands**. Alfred A. Knopf, Inc., New York, NY.

Office of Technology Assessment. 1984. **Wetlands: Their Use and Regulation**. U.S. Congress, Washington, DC.

Tiner, R.W., Jr. 1984. **Wetlands of the United States: Current Status and Recent Trends**. U.S. Fish and Wildlife Service, Washington, DC.

_____________________. 1985. **Wetlands of New Jersey**. U.S. Fish and Wildlife Service, Newton Corner, MA. 117 pp.

Wolf, R.B., L.C. Lee, and R.R. Sharitz. 1986. **Wetland Creation and Restoration in the United States from 1970 to 1985: An Annotated Bibliography**. SPECIAL ISSUE. Wetlands 6(1):1-87.

# APPENDIX C

## NATIONAL LIST OF PLANT SPECIES THAT OCCUR IN WETLANDS: 1988 NEW YORK

For a copy of this document, please contact:
US Fish and Wildlife Service
Suite 101, Monroe Building
9720 Executive Center Drive
St. Petersburg, FL 33702

OR

US Government Printing Office
Washington, DC 20402

# APPENDIX D

## NEW YORK HYDRIC SOILS AND SOILS WITH POTENTIAL HYDRIC INCLUSIONS

MARCH 22, 1989 (revised)

For a copy of this document, please contact:
Natural Resouces Conservation Service
James M. Hanley Federal Building
100 S. Clinton Street, Room 771
Syracuse, NY 13260

# APPENDIX E

A soil profile (Figure 1) consists of various soil layers described from the surface downward. Most soils have two or more identifiable horizons. A soil horizon is a layer oriented approximately parallel to the soil surface, and usually is differentiated from contiguous horizons by characteristics that can be seen or measured in the field (e.g., color, structure, texture, etc.). Most mineral soils have A-, B-, and C-horizons, and many have surficial organic layers (O-horizon).

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## APPENDIX F
# FIELD KEY TO NEW YORK STATE WETLAND DELINEATION
(see Manual for more detailed explanation)

### Vegetation Field Indicators of Wetland
(adapted from Tiner 1993)

Having established the dominant species for each stratum, hydrophytic vegetation is considered present if **any** of the following are present:

(1) *FACW* or wetter species comprise more than 50 percent of the dominant species of the plant community and no *FACU* or *UPL* species are dominant, or;

(2) *OBL* perennial species collectively represent at least 10 percent areal cover in the plant community and are evenly distributed throughout the community and not restricted to depressional microsites, or;

(3) One or more dominant plant species in the community has one or more of the following morphological adaptations: hypertrophied lenticels, buttressed stems or trunks, multiple trunks, adventitious roots, shallow root systems, or other locally applicable adaptation, or;

(4) The presence of unbroken expanses of peat mosses (*Sphagnum* spp.) and other regionally applicable species of bryophytes over persistently saturated soil.

The presence of **any** of the above-listed hydrophytic vegetation characteristics typically indicates a wetland. Thus, an area that exhibits any of these indicators can be considered a wetland without detailed examination of hydrology and/or soils, provided significant unusual hydrologic modifications are not evident.

In some areas, particularly in transition zones dominated by *FAC* species, the wetland boundary may be particularly difficult to delineate using vegetation alone.

**If none of the above vegetation indicators of wetland is found, but more than 50 percent of the dominant species of all strata are FAC or some combination of FAC and wetter species (including OBL, FACW+, FACW-, FAC+); then investigation and verification of hydrology and/or hydric soils is required to locate a wetland boundary.**

### Primary Hydrologic Indicators
[taken from "Data Form: Routine Wetland Determination (1987 COE Wetlands Delineation Manual)]

Any one of the following primary hydrologic characteristics (along with hydrophytic vegetation) indicates the presence of a wetland:

1. Visual observation of inundation.
2. Visual observation of soil saturation.
3. Water marks.
4. Drift lines.
5. Water-borne sediment deposits.
6. Wetland drainage patterns.

## Secondary Hydrologic Indicators

Any two or more of the following secondary hydrologic characteristics (along with hydrophytic vegetation) indicates the presence of a wetland.

1. Oxidized zones around living roots and rhizomes (rhizospheres.)
2. Water-stained leaves.
3. Surface-scoured areas.
4. Dead vegetation.

In the absence of any one of the primary hydrologic indicators or any two of the secondary indicators, **AND** if more than 50 percent of the dominant plant species of all strata at the site are any combination of *OBL*, *FACW*, **or** *FAC* species (including *FACW+*, *FACW-*, *FAC+*), **AND** there is no indication of recent significant hydrologic modification, **THEN** investigation and verification of hydric soils is required to locate a wetland boundary. If the area has been significantly disturbed hydrologically, refer to the section on disturbed areas (page 23).

## Soil Field Indicators of Wetland

(adapted from Tiner, 1993)

Several field indicators are available for determining whether a given soil meets the definition of hydric soils. Any one of the following typically indicates that hydric soils are present:

1. Organic soils (all Histosols except Folists) present; or
2. Histic epipedon (e.g., organic surface layer 8-16 inches thick) present; or,
3. Sulfidic material ($H_2S$, odor of "rotten eggs") present within 12 inches of the soil surface; or,
4. Gleyed, low chroma (*ie.* chroma 2 or less with mottles *or* chroma 1 or less with or without mottles) horizon or dominant ped faces present immediately below (within 1 inch) the surface layer *and* within 18 inches of the soil surface; or,
5. Nonsandy soils with a low chroma matrix (chroma of 2 or less) within 18 inches of the soil surface *and* one of the following present within 12 inches of the surface:
   - (a) iron and manganese concretions or nodules.
   - (b) distinct or prominent oxidized rhizospheres along several living roots;
   - (c) low chroma mottles; or,
6. Sandy soils with one of the following present:
   - (a) thin surface layer (1 inch or greater) of peat or muck where a leaf litter surface mat is present;
   - (b) surface layer of peat or muck of any thickness where a leaf litter surface mat is absent;
   - (c) a surface layer (A-horizon) having a low chroma matrix (chroma of 1 or less and value of 3 or less) greater than 4 inches thick;
   - (d) vertical organic streaking or blotchiness within 12 inches of the surface;
   - (e) easily recognized (distinct or prominent) high chroma mottles occupy at least 2 percent of the low chroma subsoil matrix within 12 inches of the surface;
   - (f) organic concretions within 12 inches of the surface;
   - (g) easily recognized (distinct or prominent) oxidized rhizospheres along living roots within 12 inches of the surface;
   - (h) a cemented layer (orstein) within 18 inches of the soil surface; or,
7. Other regionally applicable, field-verifiable soil properties associated with prolonged seasonal high water tables.